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ESSAYS ON EARLY LIFE CIRCUMSTANCES, HEALTH AND LABOR MARKET OUTCOMES IN EUROPE

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O Doutor Melchor Fernández Fernández, profesor titular da Universidade de Santiago de Compostela no departamento de Fundamentos da Análise Económica, o Doutor Adriaan S. Kalwij, associate professor na Utrecht University School of Economics e o Doutor Alberto Meixide Vecino, catedrático no departamento de Fundamentos da Análise Económica da Universidade de Santiago de Compostela,

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Acknowledgments

In Spanish

Hace ya algo más de cuatro años que empecé esta tesis (como cierta persona a la que adoro me recuerda a menudo). Han sido años intensos, de cambios, pero sobre todo han sido años emocionantes y estimulantes. A lo largo de este camino, he tenido la oportunidad de conocer y trabajar con varias personas que me han aportado mucho a nivel académico y personal. Esta tesis se la debo en gran medida a esas personas. También quisiera agradecer la financiación recibida a través del programa predoctoral María Barbeito de la Xunta de Galicia, y a la Asociación de Economía de la Salud (AES) por su apoyo a través de la XXII Beca de Investigación en Economía de la Salud y Servicios Sanitarios para el cuarto capítulo de esta tesis.

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Quien me iba a decir que en Rotterdam encontraría a mi coautora del cuarto capítulo de esta tesis: Pilar García-Gómez. Pilar es una excelente investigadora y el ejemplo más palpable de la valía de los jóvenes investigadores que emigran a un lugar donde se reconozca su trabajo. Su ayuda durante la última etapa ha sido inestimable. Ha sido un placer trabajar y compartir tiempo contigo, ¡que dure mucho!

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Durante estos años he descuidado a las personas que más me quieren y que más quiero (para mí, esta es la otra cara de la moneda). Gracias a mis padres, Enrique y Ana, por invertir tanto tiempo y amor en mí (sobre todo durante mi infancia) y por educarme de esa forma, para que crea en mí y no me rinda nunca. Me siento muy afortunado a la par

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Manuel Flores

Santiago de Compostela, Mayo 2014

In English

More than four years have passed since I started writing this thesis (as the person whom I most appreciate reminds me often). These have been busy years, but mostly they have been exciting and stimulating. Throughout this time, I have had the opportunity to meet and work with people who enriched me both academically and at a personal level. This thesis owes much to those persons. I also gratefully acknowledge the financial support from Xunta de Galicia through its María Barbeito Fellowship Program, as well as from Asociación Española de Economía de la Salud and Química Farmacéutica Bayer through the XXII Beca de Investigación en Economía y Salud for the fourth chapter of this thesis.

Going back to the very beginning of this process, the first person to be acknowledged is Melchor Fernandez. Melchor introduced me to scientific research and guided my first steps in economic analysis. He was also the one who suggested me to do an MA in Economics at Pompeu Fabra (which proved to be a turning point for me), and afterwards to start a PhD in Economics in Santiago. Those were really “great expectations” for someone who just wanted to enjoy economics. I am also thankful to Alberto Meixide who decided to take part in this process. You both gave me very skillful advice, and the freedom to do and undo my own way, making possible whatever was necessary.

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Nowhere is like being at home and at home (at the IDEGA) there is Yolanda Pena-Boquete. “Yoli” is co-author of the second chapter, together with Melchor. I can only thank you for offering your time to me, and especially at the very beginning when this was most needed. I hope this is only the first of many collaborations!

As I said at the beginning, over these years, I have received the esteem and support of many persons. My conversations with Rob Alessie have always been real eye-openers to me. Rob is a brilliant person (in many ways) and together with Adriaan, they form a perfect tandem, which like a magnet to iron attracts the right people. Michele, Viola, Vesile, Peter, and Giacomo: thanks for all the good times and for your contributions. Special thanks go to Peter van Santen for sharing, very generously, his months of work (i.e., his Stata do-files) that were key for constructing the measure of lifetime earnings in the fourth chapter. I also want to remember my colleagues from EvaluAES with whom I have also spent many good times, and especially Patri, for entertaining me with these Monday-morning issues.

Back home, I want to thank our research group GAME for their support and interest over these years: Aishan, Nataly, Nando, Diana, Lola, and especially Manuel Fernández Grela, for sending me all these papers and for those Ducth-type meals (i.e., sandwiches) when I was teaching at the faculty. I am also grateful to Loli and Maribel for making our life easier and for their good mood, as well as to Maria Loureiro, Angela Troitiño, and Nelida Lamelas for their availability and interest during these years. Last, but by no means least, I want to thank my office mate and friend André for the (never-ending) hours of conversation and for his support throughout this stage.

During these years, I have not paid enough attention to the most important persons in my life (for me, this is the other side of the coin). I want to thank my parents, Enrique and Ana, for investing so much time and love in me (especially during my childhood) and for showing me how important it is to believe in oneself and to not give up. I feel very lucky and proud about having a brother like Dani, with whom I could also share

many of these experiences throughout these years. And I also want to remember my friends Marco and Selu, and my other family (Andrés, “Carmiña,” Elena, and Laura), for all the good times that we have spent together. And finally, I want to get back to the key person (the one I mentioned at the beginning) and without whom my life would be much less meaningful (and for sure also much more boring). My *Zahir* is to whom I have taken up the most moments and she is by far the one who has offered me the best times and the most happiness during these years. It is you to whom I am most thankful, for being by my side from the very beginning and for supporting me until today. It is time to start a new period “al otro lado del río”.

Manuel Flores

Santiago de Compostela, May 2014

A mi Zahir

Foreword

This thesis investigates the widely documented positive association between health and socioeconomic status (SES) in adulthood, often referred to as the SES-health gradient in the literature (Marmot and Wilkinson, 1999; Smith, 1999), and it does so in two ways. First, as discussed in Currie and Madrian's (1999) survey in the Handbook of Labor Economics, (adult) health is a major determinant of (adult) labor market outcomes such as wages, hours and labor force participation, which themselves are key components of an individual's (adult) SES. Chapter 1, "**What do wages add to the health-employment nexus? Evidence from older European workers**", adds to this research by quantifying the role of individual wage rates in the health-employment nexus, an issue that, although previously highlighted by Cai (2009, 2010), has received no attention in the empirical literature with the possible exception of Haveman *et al.* (1994). In particular, I measure the direct effect of health and the indirect effect of health through wages on employment. Chapter 2, "**The impact of health on wages: Evidence from Europe before and during the Great Recession**", focuses more closely on the direct effect of health on wages by implementing a recent estimation method proposed by Semykina and Wooldridge (2010) which addresses the problems unobserved heterogeneity, nonrandom sample selection and measurement error (in the self-reported health variable) in one comprehensive framework. Moreover, by using data from before and during the Great Recession—which started in Europe in 2008 (Arpaia and Curci, 2010)—I gain insights into how the current crisis has altered the relationship between health and wages. Still, and more generally, an understanding of the effects of health on labor market outcomes is especially important in regions with aging populations, as is the case across Europe (United Nations, 2009), something that will only become more pressing over time as more individuals reach the age where health has the greatest impact on labor market outcomes (Currie and Madrian, 1999). Chapter 1 uses individual-level panel data on older workers from the Survey of Health, Ageing, and Retirement in Europe (SHARE). Chapter 2 explores the impact of health on wages in the working-age population by using individual-level panel data from the European Union Statistics on Income and Living Conditions (EU-SILC), but also investigates if these effects differ between age groups.

Second, there is a growing literature that demonstrates that the SES-health gradient in adulthood has its origins in an individual's early life (Case *et al.*, 2002; Currie and Stabile, 2003). Two chapters of the most recent volumes of the Handbook of Labor

Economics (Almond and Currie, 2011b; Black and Devereux, 2011), for instance, show that adverse health events in early life and parental SES have long-lasting effects on later life health and SES-related outcomes such as earnings and work effort. The last two chapters of this thesis use individual-level data from SHARE, and in particular from its third wave called SHARELIFE, to explore the relationship between early life circumstances and later life outcomes. Chapter 3, "**The associations between early life circumstances and later life health and employment in Europe**", provides estimates on the associations of early life circumstances—measured by childhood health and socioeconomic SES—with educational attainment, and later life health and employment (at ages 50–64). Apart from presenting new empirical evidence for thirteen European countries on the extent to which an individual's early life circumstances are associated with educational attainment and, once this latter is controlled for, with their later life health (at ages 50–64), this chapter examines the associations between early life circumstances and later life employment (at ages 50–64) once we control for education and later life health, which can be potential mediators of the associations between early life circumstances and later life employment. Finally, Chapter 4, "**Early life circumstances and life-cycle labor market outcomes**", investigates how early life circumstances—as measured by two indices of childhood health and SES—are associated with labor market outcomes over an individual's entire life-cycle. By taking such a life-cycle approach one gains insights not only into which labor market outcomes are associated with adverse childhood events but also into if these associations are already present early or appear only later in adult life and if these are reduced or reinforced with age.

The findings and policy implications from each chapter are as follows. Chapter 1 finds that men (women) who are in relatively better health (measured by a one-unit or a 0.8 standard deviation increase in a health index) have, on average, an 8 percent higher hourly wage rate, which results in a 2 (4) percentage point higher employment probability. I also show a direct impact of health on employment: men (women) in relatively better health have a 16 (12) percentage points higher employment probability. As regards differences between European countries, the findings from this chapter indicate that for all country groups, the mediating role of wages in the health-employment nexus is relatively small while the direct impact of health on employment is relatively large and rather similar. Overall, these findings suggest only a minor role for disability income policies likes wage subsidies to encourage the employment of (older) workers with health limitations, but an instrumental role for policy aimed at helping employers accommodate these workers on the job and keep them employed at older ages.

Chapter 2 shows that in the period prior to the Great Recession, working-age men (20–64 years old) who are in relatively better health (measured by a one-unit increase in a health index) have, on average, a 9 percent higher hourly wage rate. This effect is concentrated (and largest) among older workers (50–64 years old). Instead, during the Great Recession the positive impact of health on wages disappears. One possible explanation for these findings is that *presenteeism* (i.e. attending work even though being sick) has become more common during the current crisis and may at least in the short run reduce the impact of (poor) health on wages. For working-age women (20–59 years old), there is no evidence of an effect of health on wages, both before and during the Great Recession.

These two chapters also provide strong empirical evidence that it is indeed important to control for measurement error in the self-reported health variable when estimating its impact on employment and wages, and to take selectivity bias in wages into account.

Chapter 3 shows that for men and women in thirteen European countries favorable early life circumstances, and in particular a higher childhood SES, are associated with a higher level of education. In most of these countries and in particular for women, favorable early life circumstances are associated with better later life health, also when education is controlled for. Although for some countries, and mainly for men, there is evidence of significant associations between early life circumstances and later life employment when later life health is controlled for, most of the association between early life circumstances and later life employment appears to be transmitted through education and later life health.

Finally, the results in Chapter 4 show that following a life-cycle approach is important because, as some theoretical models stipulate and the results in this chapter confirm, some consequences of adverse (health) events early in life may not become apparent until later in adult life and because some of their impacts, in particular those related to childhood SES, may change and accumulate over the life cycle. For instance, for both men and women in Europe there is strong evidence of a cumulative impact of childhood SES on lifetime earnings over the life cycle which operates through both working years and annual earnings. Moreover, for men this association reverses sign from negative to positive over the working career. There is also evidence of a smaller, rather persistent and positive long-term association between childhood health and lifetime earnings that operates mainly through annual earnings and only to a lesser extent through working years.

The empirical findings from Chapters 3 and 4 may suggest that public policies which invest in children's health and parents' SES can benefit children in terms of better education, (later life) health and employment opportunities over an individual's entire life cycle. Examples of such policies are free health care for children and (means tested) income and in-kind support programs which cover the domains of parent's SES and children's health (e.g., Marmot et al. 2012, pp 1016–7).

Chapter 1:

What do wages add to the health-employment nexus? Evidence from older European workers*

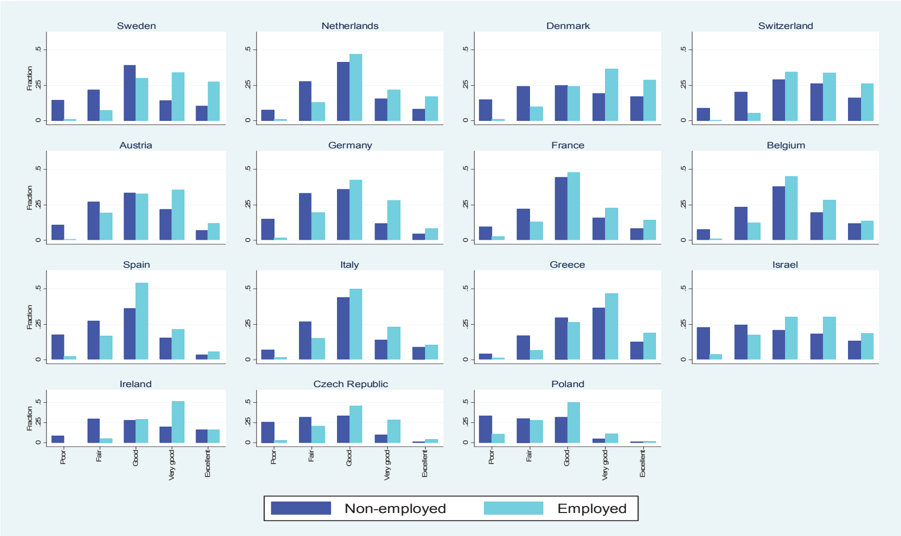
*This chapter is based on Flores and Kalwij (2013).

1.1. Introduction

The fact that employed men and women aged 50 to 64 in 15 European countries report better health than their nonemployed peers (see Figures 1.1 and 1.2) suggests that, as empirically supported in the literature (see, e.g., Currie and Madrian, 1999; Kalwij and Vermeulen, 2008), health plays an important role in explaining employment at older ages.[2] In this paper, we add to this research by quantifying the role of individual wage rates in the health-employment nexus, an issue that, although previously highlighted by Cai (2009, 2010), has received no attention in the empirical literature with the possible exception of Haveman *et al*. (1994). Yet quantifying the mediating role of wages in the health-employment nexus is important for both understanding individuals' labor market behavior and designing policies aimed at keeping older workers with health limitations employed. The direct impact of health on employment is related to the ability to work, which can be affected, for example, by better accommodating workers with health impairments through reduced job demands or a change of tasks (Autor and Duggan, 2010; Burkhauser and Daly, 2011; Currie and Madrian, 1999; Daly and Bound, 1996). Its indirect impact through wages, in contrast, indicates the degree to which it is financially worthwhile to remain employed, a decision that can be influenced by such initiatives as wage subsidies for workers with health impairments (see, e.g., Burkhauser *et al*., 1997).

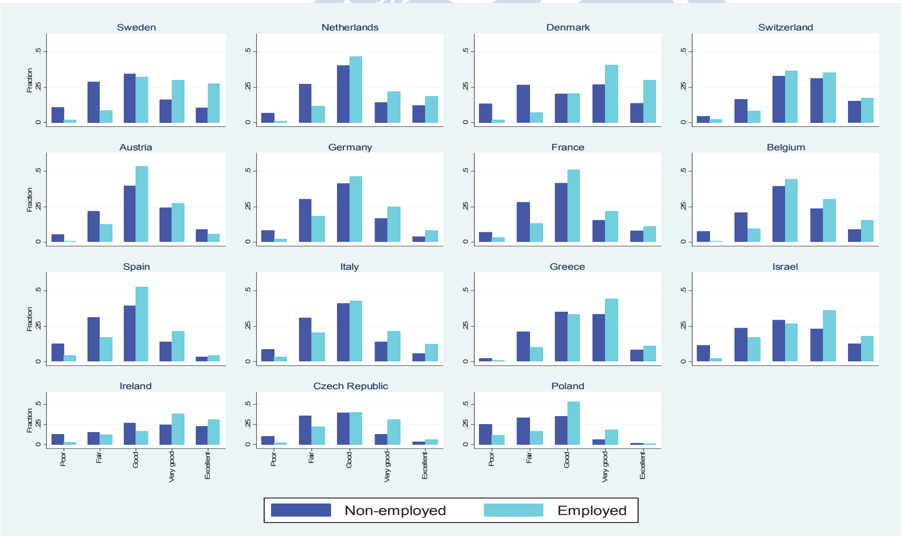
[2] The main theoretical economic argument for this empirical finding is Grossman's 1972 model of health demand, which treats health as an endogenous capital stock that determines the amount of time an individual can spend in the labor market (Grossman, 2001). See also Lazear (1986), for a theoretical model on the retirement-health nexus.

Figure 1.1: Distribution of self-reported health by employment status for men aged 50–64 years in Europe



Source: Author calculations based on SHARE (waves 1, 2, and 4). The figure shows the distribution of self-reported health (SRH) by employment status for men aged 50–64 years in 15 European countries. SRH is measured on a 5-point scale from poor to excellent health.

Figure 1.2: Distribution of self-reported health by employment status for women aged 50–64 years in Europe



Source: Author calculations based on SHARE (waves 1, 2, and 4). The figure shows the distribution of SRH by employment status for women aged 50–64 years in 15 European countries. SRH is measured on a 5-point scale from poor to excellent health.

According to economic theoretical models, health, as a component of human capital, affects employment not only directly but also indirectly through wages. Hence, an individual in bad health is assumed to have not only a lower productivity—and thus a lower wage rate (see, e.g., Becker, 1964)—but also, and perhaps more important, a higher reservation wage. This latter effect may result from such factors as an increase in the value of leisure time in which to attend to health (Brown *et al*., 2010; Cai, 2009), eligibility for disability insurance benefits (Layard *et al*., 1994), or an increase in the disutility of work (Gordon and Blinder, 1980). If the wage rate falls below the reservation wage because worsening health reduces productivity and/or increases the reservation wage, the result is withdrawal from the labor market.[3]

Nevertheless, although health, wages, and employment are interrelated, most previous studies have analyzed health-employment and health-wage relations separately. As regards the first, previous studies have usually identified a positive effect of health on employment (see, e.g., Bound *et al*., 1999, and Disney *et al*., 2006, for the U.S. and Great Britain, respectively). Yet, as Cai (2009, 2010) argues and Bound's (1991) model suggests, labor force equations that do not consider the wage rate should be interpreted as reduced forms. Moreover, because wages may also be affected directly by health, the estimate on the health variable in such equations should be interpreted as the sum of a direct effect of health on labor supply and an indirect effect operating through wages. The evidence on the health-wage relation, on the other hand, is mixed. Brown *et al*. (2010), for example, find no effect of health on men's (reservation) wages in Britain, but Jäckle and Himmler (2010), using data for Germany, find a positive effect of health on wages for men but not for women. The only study we know of that simultaneously analyzes work-time, wages, and health is Haveman *et al.* (1994). Based on data for U.S. men, this study reports that poor health does affect both wages and work-time negatively, but also that wages have no impact on work-time which, in turn, suggests an insignificant indirect effect of health on work-time through wages.

In this study, we analyze the relations between health, wages, and employment using individual-level panel data from the Survey of Health, Ageing and Retirement in Europe (SHARE). Our main contribution to the literature is to estimate for men and women in Europe, both health's direct effect on employment and its indirect effect through wages.

[3] Alternatively, Contoyannis and Rice (2001) argue that the (positive) relation between poor health and low wages may stem from employer beliefs that poor health correlates with unobserved characteristics that are negatively associated with productivity or from discrimination against individuals perceived to be in poor health (see also Currie and Madrian, 1999, pp. 3332–3, and references therein).

At the same time, by categorizing the sample into country groups, we assess whether these relations are affected by institutional differences like degree of labor market flexibility. The adopted empirical framework is a system of equations and is similar to the one of Haveman *et al*. (1994).[4] We extend Haveman *et al*.'s (1994) model by accounting for the potential of measurement error in the health variable, which is measured, as in most of the above-mentioned studies, by self-reported health (SRH).[5] SRH, however, is likely to be an endogenous explanatory variable because it is subject to, e.g., justification bias (i.e., those not employed may report worse than actual health to justify not working) and measurement error (Bound, 1991). Empirical evidence for the justification bias is provided by Lindeboom and Kerkhofs (2009), whose study of older Dutch men shows that failing to account for it leads to overestimation of health's impact for disability recipients. Cai (2010), however, using Australian data, concludes that there may be a justification bias for women but not for men. The likelihood that SRH is also subject to a dominant measurement error is indicated by both Crossley and Kennedy (2002) and Jäckle and Himmler (2010) based on the finding that there is an attenuation bias in health's impact on employment and wages when SRH is treated as an exogenous regressor. In this paper, we follow Bound *et al*. (1999) and correct for measurement error in SRH by using a Health Index (HI) based on both self-assessed objective and doctor diagnosed health indicators. Finally, and also as an extension of Haveman *et al*.'s (1994) model, we take selectivity into account when estimating the wage equation.[6]

Our primary empirical findings for Europe support the theoretical prediction of health's impact on employment through wages; that is, we show that individuals in better health have a higher wage rate, which results in a higher incidence of employment. This finding holds even after health is controlled for in the employment equation. Our results also indicate cross-country differences; for instance, the mediating role of wages for the

[4] A result of Haveman *et al*. (1994) is an insignificant effect of work-time on health. Although in line with this finding, we, however, do not model the impact of employment on health for reasons of identification and we discuss this in section 3.

[5] Haveman *et al*. (1994) use a subjective health variable which is constructed from two questions on whether the individual is work limited by health, and by how much. They treat this measure of health as a continuous variable and not, as we do in this paper, as a categorical variable.

[6] Bound (1991) also considers a labor supply model of older men that includes both health and annual earnings and, using a similar approach to Stern (1989), uses mortality information to instrument two different self-reported health measures. Nevertheless, the earnings variable is taken as exogenous, and no estimation is made of the indirect impact of health on employment mediated through earnings.

health-employment nexus, albeit small, is strongest in Nordic and Continental countries for men and in Continental and Transitional countries for women but is virtually absent in Mediterranean countries, as well as for men from Transitional countries. These latter findings are consistent with the less flexible labor markets in these groups of countries, which results from such factors as stricter employment protection regulations (OECD, 2012; Sapir, 2006). Most interesting is the finding that despite institutional differences, for the most part, health appears to have a rather similar positive impact on employment across all country groups, which suggests that these countries may all have schemes in place that allow unhealthy workers to exit the labor force (Wise, 2012). Finally, we provide strong empirical evidence that it is indeed important to control for measurement error in the SRH variable when estimating its impact on employment and wages.

The remainder of the paper is organized as follows. Section 1.2 describes the data and the main analytical variables. Section 1.3 outlines the empirical model and discusses a number of related econometric issues. Section 1.4 reports the estimation results and analyzes their robustness. Section 1.5 summarizes the main findings and concludes.

1.2. Data and descriptive statistics

Our data set comprises individual-level data from the first, second, and fourth waves of the Survey of Health, Ageing, and Retirement in Europe (SHARE), a multidisciplinary and representative cross-national panel of the European population aged 50 and over. These three waves, conducted in 2004/2005, 2006/2007, and 2010/2012,[7] respectively, include information on socioeconomic status (e.g., employment, income, and education), health (e.g., self-reported subjective health and doctor diagnosed conditions, physical and cognitive functioning, and health behaviors), psychological conditions (e.g., mental health, well-being, and life satisfaction), and social support (e.g., social networks and volunteer activities). Panel attrition in SHARE is high—about 34 percent between the first and second waves, and about 39 percent between the second and fourth waves—and the country samples have been refreshed in the 2006/2007 and 2010/2012 waves to remain representative for the population aged 50 and over. We have tested for possible selectivity bias in our empirical model (see section 3) due to panel attrition using a test proposed by Verbeek and Nijman (1992). The test results

[7] Almost 96 percent of the respondents in the 2010/12 wave were interviewed in 2011.

show no significant sample selection effects due to attrition in the health and wage equations, and only at about a 5 percent significance level for the employment equation for men but not for women (results available upon request).

Our empirical analysis is based on data for respondents aged 50–64 from countries who participated in at least one of the first two waves. We impose this latter restriction because one of our main dependent variables, the (log) hourly net wage rate, is only available in waves 1 and 2. This selection yields 52,081 observations for 37,085 respondents from the following countries: Austria, Germany, Sweden, the Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel, Czech Republic, Poland, and Ireland. Missing values force an 18 percent reduction in sample size. The result is an unbalanced panel comprising 42,883 total observations for 14,058 male and 17,928 female European respondents.

Self-reported health (SRH) status is rated on a five-point scale (from 1 to 5: poor, fair, good, very good, and excellent). Employment, which includes self-employment, is defined as working a positive number of hours per week. The (log) hourly net wage rate—measured in PPP-adjusted 2005 US$—is obtained by dividing the amount of net wages by the number of hours worked and defined for employees only.[8] Detailed information on health limitations for both men and women is reported in Table 1.1 together with the summary statistics for other demographic and socioeconomic characteristics used in the empirical analysis. The definitions of all variables are provided in appendix Table A1.1.

[8] For the self-employed, earnings and working hours are considered a poor proxy for their wage rates (Jäckle and Himmler, 2010). An alternative is to exclude the self-employed from our empirical model (see Section 1.3). This exclusion, however, does not affect the main findings and conclusions of the paper (results available upon request).

Table 1.1: Summary Statistics

	Men		Women	
	Mean	Standard deviation	Mean	Standard deviation
Dependent variables				
Self-reported health (1-5)	3.21	1.08	3.14	1.06
Hourly net wage rate[a]	15.03	16.92	12.5	13.05
Employment	0.62		0.47	
Health limitations				
1+ severe chronic diseases	0.17		0.14	
1+ mild chronic diseases	0.59		0.63	
1+ limitations with ADL	0.06		0.06	
1+ limitations with IADL	0.07		0.11	
1+ limitations with mobility, arm function, and fine motor skills	0.30		0.43	
4+ mental problems	0.16		0.29	
Limited with GALI	0.34		0.38	
Missing/underweight (BMI<18.5)	0.01		0.03	
Normal weight (BMI 18.5–24.9)	0.31		0.44	
Overweight (BMI 25–29.9)	0.49		0.34	
Obese (BMI 30+)	0.19		0.19	
Grip strength (0–100)	45.33	13.65	27.82	9.36
Missing grip strength	0.05		0.05	
Socioeconomic characteristics				
Age (50-64)	57.79	3.94	57.51	4.09
Educational attainment				
ISCED 0–2	0.34		0.4	
ISCED 3-4	0.41		0.38	
ISCED 5-6	0.25		0.22	
Living with spouse/partner	0.86		0.8	
Household size	2.57	1.15	2.39	1.05
Number of grandchildren	1.28	2.10	1.72	2.44
Monthly income from nonemployment (wave 1)[b]	2776	3189	3252	3848
Monthly income from nonemployment (waves 2 and 4)[b]	5748	22590	5081	16909
Homeownership	0.79		0.78	
Country representation				
Austria	0.07		0.08	
Germany	0.06		0.06	
Sweden	0.07		0.07	
Netherlands	0.08		0.09	
Spain	0.06		0.06	
Italy	0.08		0.09	
France	0.11		0.11	
Denmark	0.08		0.07	
Greece	0.05		0.05	
Switzerland	0.05		0.05	
Belgium	0.13		0.12	
Israel	0.03		0.03	
Czech Republic	0.08		0.08	
Poland	0.04		0.04	
Ireland	0.01		0.01	
Observations (N)	18675		24208	

[a] Defined for waves 1 and 2 and for wage-earners only. In PPP-adjusted 2005 US$. N = 5562 for men and N = 5689 for women.
[b] The amounts are in nominal € and in gross terms in wave 1, and in net terms in waves 2 and 4. For the best possible comparability across waves, in the empirical analysis, we use quintile dummies (see table A1.1 for more information).

1.3. The empirical model

We use the following model to estimate the effects of health on wages and employment:

$$E_{it}^{*} = \gamma_0 + \gamma_1 H_{it}^{*} + \gamma_2 w_{it}^{*} + Z_{it}'\gamma_3 + \upsilon_{it}^{E}, \qquad (1.1)$$

$$w_{it}^{*} = \beta_0 + \beta_1 H_{it}^{*} + \beta_2 Educ_i + X_{it}'\beta_3 + \upsilon_{it}^{W}. \qquad (1.2)$$

Equation (1.1) is an employment equation, and Equation (1.2) is a Mincerian type wage equation (Mincer, 1974). All variables superscripted with an asterisk are latent variables. E_{it}^{*} represents an individual *i*'s propensity to be employed at time *t* and we observe whether or not an individual is employed, $E_{it} = 1\left[E_{it}^{*} \succ 0\right]$, w_{it}^{*} is the logarithm of individual *i*'s hourly net market wage at time *t* and we only observe it for wage earners, and H_{it}^{*} is individual *i*'s health at time *t* which is measured by the ordered categorical variable SRH_{it} (Self-Reported Health).

X_{it} is a vector containing socioeconomic characteristics that affect employment and wages (e.g., age), and Z_{it} contains the variables included in X_{it}, as well as variables such as nonlabor income and other household composition variables (e.g., log household size and number of grandchildren) that are assumed to affect employment but not wages.[9] $Educ_i$ is an individual's educational attainment,[10] and υ_{it}^{E} and υ_{it}^{W} are error terms that are allowed to be correlated. As discussed in section 1, we are especially interested in the direct impact of health on employment, determined here by coefficient γ_1, and the indirect impact of health on employment through wages, determined here by coefficients γ_2 and β_1.

[9] The exclusion restriction of nonlabor income in the wage equation would not hold if, for instance, individuals with low nonlabor income have more incentives to find a high wage job than individuals with high nonlabor income. Or likewise for the household variables, if more family-oriented individuals accept a lower wage but with more flexibility in order to better accommodate family life. Empirical support for our assumptions can be found in Mroz (1987), who provides compelling lack of evidence for the rejection of the exogeneity assumption on the nonlabor income and children variables in a (wife's) labor supply equation that includes the wage rate as and additional regressor.

[10] In line with Grossman's 1972 model, we use educational attainment (*Educ*) as a proxy for an individual's stock of knowledge or human capital exclusive of health capital (see also, Currie and Madrian, 1999, p. 3312; Jäckle and Himmler, 2010). Since we examine individual behavior after completion of schooling, *Educ* is taken as a predetermined variable throughout the analysis.

In estimating the model, we must deal with two econometric issues: sample selection and potential measurement error in the SRH variable. To address the first, like Brown *et al*. (2010) and Jäckle and Himmler (2010), we adopt the procedure proposed by Heckman (1979), which is detailed in Appendix A1.1. When identifying the Heckman model, and as mentioned above, we exclude from the wage equation any nonlabor income and other household composition variables (which are included in Z_{it} but not in X_{it}). Potential measurement error in the SRH variable may stem from three sources: *pure* measurement error (see Bound *et al*., 2001; Crossley and Kennedy, 2002), the justification bias (see Bound, 1991; Stern, 1989), or the basing of SRH on subjective judgment, which may hinder comparison across individuals (Kapteyn *et al*., 2007; Meijer *et al*., 2011).[11] It is also worth noting that the *pure* measurement error and the reporting differences are likely to attenuate the impact of SRH on employment and wages, whereas the justification bias will most probably exaggerate its impact (Bound, 1991; Brown *et al*., 2010). Nevertheless, all these issues require that SRH be instrumented during estimation of the employment and wage equations. Our model thus includes not only educational attainment $Educ_i$ and a vector Z_{it} containing other assumed exogenous socioeconomic characteristics, but also a set of objective (self-reported) health limitations (HL_{it}) as predictors of H^*_{it}. We implement this Health Index (HI) approach by estimating the following health equation simultaneously with Equations (1.1) and (1.2):

$$H^*_{it} = \alpha_0 + HL'_{it}\alpha_1 + \alpha_2 Educ_i + Z'_{it}\alpha_3 + \upsilon^H_{it}, \qquad (1.3)$$

where υ^H_{it} is an error term. As mentioned above, the health index is based on SRH. The health limitations are assumed to be contemporaneous exogenous instruments for SRH, meaning that we assume no systematic differences in reporting on these health limitations across countries. Empirical support for this assumption can be found in Kapteyn *et al*. (2007, p. 471, Table 5). The health limitations included are mild or severe chronic diseases, limitations in (instrumental) activities of daily living, mobility limitations, body mass index (BMI), and grip strength (GS) (see appendix Table A1.1

[11] In addition to reporting bias *and* justification bias, Bound (1991) and Bound *et al*. (1999) identify one problem of state-dependence in self-reported subjective health answers to labor market outcomes and a second one of financial incentives for individuals to identify themselves as disabled (see also Stern, 1989).

for details). We do not use the health limitations of depression (or mental health) and the Global Activity Limitation Indicator (GALI) because they are likely to be correlated with the SRH measurement error (Meijer *et al*., 2011).

The assumed contemporaneous exogeneity of health limitations also implies that these limitations are not directly affected by current employment and wages.[12] The empirical evidence on this reverse causality issue is rather mixed, and the models used often require additional assumptions for identification. Stern (1989) and Cai (2010), for instance, find a negative effect of employment on health, but Snyder and Evans (2006), using U.S. data, suggest that post-retirement (part-time) work may have a health-preserving effect, one not found by Coe and Zamarro (2008) for nonemployment in Europe at ages 50–64. Lee (1982) and Cai (2009), for their part, report a positive effect of wages on health for men in the U.S. but no effect for men in Australia.

Recent work by Westerlund *et al.* (2010), on the other hand, provides support for two of our methodological choices. First, it shows that in France, retirement does not change the risk of major chronic diseases, which supports the inclusion of both mild and severe chronic diseases in Equation (1.3). Second, it demonstrates that retirement is associated with a reduction in mental and physical fatigue and depression symptoms, which justifies the omission of depression and GALI from the health equation. The belief that including such health variables in the health equation would violate the exogeneity assumption is also supported by Bonsang *et al*. (2012), Rohwedder and Willis (2010), and Llena-Nozal *et al*. (2004), who all find that nonemployment has an impact on mental health. To find further validation for our choice of health limitations that correlate with SRH, we perform a sensitivity test in Section 1.4.2 by restricting the number of health limitations to only severe chronic conditions, grip strength (GS), and BMI. Nevertheless, as in most previous studies discussed in the introduction, we refrain from drawing strong causal conclusions.[13]

The three error terms in Equations (1.1) to (1.3) are assumed to follow a multivariate normal distribution. Identification of the effects of health on employment and wages is

[12] Currie and Madrian (1999) and Grossman (2001) discuss a theoretical model on the related issue of reverse causality of employment and wages on health.
[13] A further reason to be cautious in this respect is that the health impacts cannot be pinpointed to one specific explanation. For instance, an adverse health shock may cause not only a productivity loss but also a change in time preferences and risk attitudes.

guaranteed by excluding the objective (self-reported) health limitations (HL_{it}) from the wage and employment equations. Hence, the model in Equations (1.1) to (1.3) can be written as a triangular system of equations for health, wages, and employment, which we estimate jointly using full information maximum likelihood (FIML) with freely correlated error terms. We then use a minimum distance estimator (MDE) to obtain the parameter estimates corresponding to the direct and indirect effects of health on employment. The estimation procedure is detailed in Appendix A1.1. Finally, as nonemployed women are often homemakers, while nonemployed men are often retirees, we estimate the model outlined above separately for men and women.

1.4. Estimation results

Table 1.2 reports the coefficient estimates of the objective (self-reported) health limitations with dependent variable SRH, ranging from 1 (poor health) to 5 (excellent health). For both men and women in Europe, we find that all the objective (self-reported) health limitations significantly affect SRH (see Columns (1)). As might be expected, those with health limitations are more likely to be in poor health, and the presence of severe chronic conditions has the largest impact on an individual's health status. Except for the Body Mass Index (BMI) categories, which show a larger impact on health for women, the health limitations have rather similar effects on SRH across genders.

Table 1.2: Estimation results of the health equation from a system of equations for health, wages, and employment[a]

	Men			Women		
	HI (1)	HI (2)	Restricted HI (3)	HI (1)	HI (2)	Restricted HI (3)
1+ severe chronic diseases	-0.787***	-0.787***	-0.964***	-0.678***	-0.677***	-0.830***
	(0.024)	(0.024)	(0.024)	(0.023)	(0.023)	(0.022)
1+ mild chronic diseases	-0.535***	-0.534***		-0.619***	-0.621***	
	(0.018)	(0.018)		(0.016)	(0.016)	
1+ limitations with ADL	-0.482***	-0.482***		-0.593***	-0.594***	
	(0.043)	(0.043)		(0.037)	(0.037)	
1+ limitations with IADL	-0.573***	-0.573***		-0.476***	-0.475***	
	(0.040)	(0.040)		(0.027)	(0.027)	
1+ limitations with mobility, arm function and fine motor limitations	-0.662***	-0.662***		-0.579***	-0.581***	
	(0.021)	(0.021)		(0.017)	(0.017)	
Missing/underweight (<18.5)	-0.129	-0.130	-0.256***	-0.267***	-0.267***	-0.362***
	(0.087)	(0.087)	(0.087)	(0.043)	(0.043)	(0.045)
Overweight (25-29.9)	-0.034*	-0.034*	-0.107***	-0.125***	-0.126***	-0.236***
	(0.020)	(0.020)	(0.020)	(0.017)	(0.017)	(0.017)
Obese (30+)	-0.161***	-0.161***	-0.366***	-0.265***	-0.265***	-0.537***
	(0.025)	(0.025)	(0.025)	(0.022)	(0.022)	(0.021)
Grip strength (GS)	0.012***	0.012***	0.018***	0.019***	0.019***	0.033***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Missing GS	0.266***	0.266***	0.443***	0.171***	0.171***	0.430***
	(0.062)	(0.062)	(0.063)	(0.048)	(0.048)	(0.050)
Log lik.	-39787	-39753	-41750	-48437	-48590	-51400
Observations	18675	18675	18675	24208	24208	24208

[a] Ordered probit coefficient estimates. HI stands for Health Index. The dependent variable is SRH (1 = poor, 5 = excellent). All estimates include the log household size, the number of grandchildren, a linear trend for survey year, and dummy variables for educational levels, age years, nonlabor income quintiles, homeownership, marital status, and country. Cluster-robust standard errors are in parentheses. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

Columns (1) in Table 1.3 contain the estimation results of the wage equation for men and women. Like Cai (2009) for Australian men, Haveman *et al*. (1994) for U.S. men, and Jäckle and Himmler (2010) for Germany, we find that older male workers in Europe who are in better health have a higher wage compared to those in worse health. However, in contrast to Jäckle and Himmler (2010), we also find a significant effect of health on wages for older female workers, one that is, moreover, similar to the effect of health on wages for men. For instance, older male or female workers with a one-unit larger health stock (approximately equivalent to a 0.8 standard deviation of HI) have on average an 8 percent higher hourly wage rate. In addition, in line with human capital theory and previous empirical studies, education contributes positively to an individual's hourly wage rate: compared to an individual with the lowest level of education, an older male and female worker with the highest level has on average, respectively, a 45 ($\exp(0.372) - 1$) and 48 percent higher hourly wage rate.

Table 1.3: Estimation results of the wage equation from a system of equations for health, wages, and employment[a]

	Men				Women			
	HI (1)	HI (2)	SRH (3)	Restricted HI (4)	HI (1)	HI (2)	SRH (3)	Restricted HI (4)
ISCED 3-4	0.161***		0.167***	0.149***	0.154***		0.163***	0.145***
	(0.018)		(0.018)	(0.019)	(0.018)		(0.018)	(0.018)
ISCED 5-6	0.372***		0.383***	0.349***	0.392***		0.410***	0.375***
	(0.020)		(0.019)	(0.021)	(0.019)		(0.019)	(0.021)
Health[b]	0.076***		0.042***	0.129***	0.083***		0.038***	0.110***
	(0.017)		(0.008)	(0.023)	(0.015)		(0.007)	(0.021)
ISCED 3-4 Nordic		0.106***				0.106***		
		(0.025)				(0.026)		
ISCED 3-4 Continental		0.129***				0.094***		
		(0.032)				(0.032)		
ISCED 3-4 Mediterranean		0.293***				0.352***		
		(0.049)				(0.045)		
ISCED 3-4 Transitional		0.182***				0.228***		
		(0.052)				(0.054)		
ISCED 5-6 Nordic		0.287***				0.256***		
		(0.027)				(0.025)		
ISCED 5-6 Continental		0.379***				0.404***		
		(0.032)				(0.035)		
ISCED 5-6 Mediterranean		0.486***				0.725***		
		(0.051)				(0.054)		
ISCED 5-6 Transitional		0.445***				0.593***		
		(0.088)				(0.070)		

Table 1.3 (Continued)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Health Nordic[b]		0.086***				0.060***		
		(0.019)				(0.018)		
Health Continental[b]		0.079***				0.105***		
		(0.020)				(0.020)		
Health Mediterranean[b]		0.060**				0.079***		
		(0.026)				(0.024)		
Health Transitional[b]		0.068**				0.179***		
		(0.034)				(0.028)		
Testing for homogeneity in the effect of health[c]								
Chi2 (3)		1.47				23.65		
p-value		0.6888				0.0000		
Log lik.	-39787	-39753	-17207	-41750	-48437	-48590	-19544	-51400
Observations	18675	18675	18675	18675	24208	24208	24208	24208

[a] Ordinary least squares coefficient estimates. HI stands for Health Index. The dependent variable is the PPP-adjusted hourly net wage rate (in logs). All estimates include a linear trend for survey year and dummy variables for age years and countries. Columns (2) show the interaction terms between the education and health variables and country group dummies. The estimates in Columns (3) correspond to a model that treats SRH as exogenous; the estimates in Columns (4) correspond to a model in which only the more objective HL are included in the HI. Cluster-robust standard errors are in parentheses. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

[b] The coefficient of health corresponds to a one-unit increase that is approximately equivalent to a 0.8 standard deviation of HI.

[c] We test the null hypothesis of the equality of health effects on wages across the different country groups and report the test statistic with corresponding p-values and degrees of freedom (in parentheses).

Columns (1) in Table 1.4 show that for both men and women in Europe, health and wages have positive impacts on employment, a finding that contrasts with Haveman *et al*.'s (1994) result of an insignificant effect of wages on employment for men. The bottom part of Table 1.4 (see Columns (1)) reports the estimates of the correlation coefficients between the error terms in Equations (1.1) to (1.3). The correlation coefficients between the error terms of the health equation and those of the equations for wages and employment are negative and statistically significant for both men and women. Like Cai (2009), we find no evidence of endogenous selection into (wage-earning) jobs for either men or women in Europe: the correlation coefficient between the error terms of the selection and wage equations are not statistically significant. It should be noted, however, that if we exclude the health variable, the correlation coefficient becomes statistically significant for both men and women (results available upon request), implying that health may be the factor determining selection into employment at older ages (once educational attainment and age are controlled for).

Table 1.4: Estimation results of the employment equation and errors correlation matrix from a system of equations for health, wages, and employment[a]

	Men				Women			
	HI	HI	SRH	Restricted HI	HI	HI	SRH	Restricted HI
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Health[b]	0.426***		0.247***	0.399***	0.309***		0.220***	0.264***
	(0.026)		(0.015)	(0.042)	(0.030)		(0.016)	(0.045)
Ln(hourly wage rate)[c]	0.076***		0.103***	0.080***	0.124***		0.151***	0.133***
	(0.013)		(0.013)	(0.015)	(0.014)		(0.015)	(0.016)
Health Nordic[b]		0.409***				0.306***		
		(0.044)				(0.049)		
Health Continental[b]		0.377***				0.234***		
		(0.036)				(0.057)		
Health Mediterranean[b]		0.434***				0.291***		
		(0.032)				(0.028)		
Health Transitional[b]		0.527***				0.282***		
		(0.045)				(0.062)		
Ln(hourly wage rate) Nordic[c]		0.120***				0.202***		
		(0.032)				(0.039)		
Ln(hourly wage rate) Continental[c]		0.104***				0.145***		
		(0.025)				(0.039)		
Ln(hourly wage rate) Mediterranean[c]		0.026*				0.066***		
		(0.013)				(0.010)		
Ln(hourly wage rate) Transitional[c]		0.078***				0.104***		
		(0.026)				(0.022)		
System errors correlation matrix								
SRH/Ln(hourly wage rate)	-0.076**	-0.080**		-0.188***	-0.112***	-0.109***		-0.165***
	(0.033)	(0.033)		(0.043)	(0.029)	(0.031)		(0.041)
SRH/employment	-0.268***	-0.268***		-0.261***	-0.237***	-0.219***		-0.202***
	(0.020)	(0.020)		(0.030)	(0.017)	(0.016)		(0.022)
Ln(hourly wage rate)/employment	-0.036	-0.021	-0.102	0.027	-0.020	-0.036	-0.044	-0.012
	(0.061)	(0.064)	(0.084)	(0.081)	(0.034)	(0.052)	(0.048)	(0.045)
Log lik.	-39787	-39753	-17207	-41750	-48437	-48590	-19544	-51400
Observations	18675	18675	18675	18675	24208	24208	24208	24208

[a] Probit coefficient estimates (top panel). HI stands for Health Index. The dependent variable is employment (1 = employed, 0 = not employed). All estimates include the log household size, the number of grandchildren, a linear trend for survey year, and dummy variables for educational levels, age years, nonlabor income quintiles, homeownership, marital status, and country. Columns (2) show the interaction terms between the education and health variables and country group dummies. The estimates in Columns (3) correspond to a model that treats SRH as exogenous; the estimates in Columns (4) correspond to a model in which only the more objective HL are included in the HI. Cluster-robust standard errors are in parentheses. Significance levels: *** p < 0.01 ** p < 0.05 * p < 0.10.

[b] The coefficient of health corresponds to a one-unit increase that is approximately equivalent to a 0.8 standard deviation of HI.

[c] The coefficient of the hourly wage rate corresponds to a 10% increase.

Finally, and in line with the theoretical predictions, the results in Tables 1.3 and 1.4 support the existence of an indirect impact of health on employment through wages. This indirect effect, together with the direct effects of health and wages on employment, is illustrated by Table 1.5. As the top part of the table shows, employment is about equally sensitive to health across genders but somewhat more sensitive to wages for women. For example, older male (female) workers with a one-unit larger health stock have on average a 16 (12) percentage points higher employment probability, while a 10 percent increase in their hourly wage rate leads to a 3 (5) percentage point higher employment probability. Moreover, the indirect effects of health on employment, although relatively small, are statistically significant and essentially twice as large for women. That is, for an older female (male) worker with a one-unit larger health stock, its 8 percent higher hourly wage rate (see Columns (1), Table 1.3) results in a 4 (2) percentage points higher employment probability.

Table 1.5: The direct effects and indirect effects through wages of health on employment. The reported effects are percentage point increases in employment probability.[a]

Europe	Men	Women
Ln(hourly wage)[b]	0.028***	0.049***
	(0.005)	(0.006)
Health[c]	0.158***	0.123***
	(0.010)	(0.012)
Indirect health[d]	0.022***	0.041***
	(0.006)	(0.009)
Country groups		
Ln(hourly wage rate) Nordic[b]	0.045***	0.080***
	(0.012)	(0.015)
Ln(hourly wage rate) Continental[b]	0.039***	0.058***
	(0.009)	(0.016)
Ln(hourly wage rate) Mediterranean[b]	0.010*	0.026***
	(0.005)	(0.004)
Ln(hourly wage rate) Transitional[b]	0.029***	0.041***
	(0.010)	(0.009)
Testing for homogeneity in the effect of the ln(hourly wage rate)[e]		
Chi2 (3)	14.27	16.47
p-value	0.0026	0.0009
Health Nordic[c]	0.152***	0.122***
	(0.016)	(0.020)
Health Continental[c]	0.140***	0.093***
	(0.014)	(0.023)
Health Mediterranean[c]	0.161***	0.116***
	(0.012)	(0.011)
Health Transitional[c]	0.195***	0.112***
	(0.017)	(0.025)
Testing for homogeneity in the effect of health[e]		
Chi2 (3)	9.84	1.57
p-value	0.0200	0.6662
Indirect health Nordic[d]	0.038***	0.048***
	(0.013)	(0.018)
Indirect health Continental[d]	0.030***	0.060***
	(0.011)	(0.021)
Indirect health Mediterranean[d]	0.006	0.021***
	(0.004)	(0.007)
Indirect health Transitional[d]	0.020	0.074***
	(0.012)	(0.022)
Testing for homogeneity in the indirect effect[e]		
Chi2 (3)	9.27	9.86
p-value	0.0259	0.0198

[a] Cluster-robust standard errors are in parentheses (see Appendix A1.1 for more details). Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.
[b] Measures the increase in employment probability corresponding to a 10% increase in the hourly net wage rate.
[c] Measures the increase in employment probability corresponding to a one-unit increase that is approximately equivalent to a 0.8 standard deviation of HI.
[d] Measures the increase in employment probability corresponding to the indirect effect of a one-unit increase in health on employment through wages.
[e] We test the null hypothesis of equality of the, respectively, direct wage and health effects and of the indirect health effects on employment across the different country groups and report the test statistic with corresponding p-values and degrees of freedom (in parentheses).

1.4.1. Heterogeneous responses

Up to this point in the discussion, labor market responses to health have been assumed to be homogeneous across our sample of European countries. It is plausible, however, to expect that the different institutional settings among countries may imply different relations between health, wages, and employment. Employment, for instance, may be more (less) responsive to wages in more (less) flexible or efficient labor markets. To explore this conjecture, we follow previous studies and classify the countries in our sample into different "social models" (Sapir, 2006); namely, *Nordic*, *Continental*, *Mediterranean*, and *Transitional*. These four models differ in terms of labor market efficiency, income redistribution and health care facilities as measured by the employment rate, Gini coefficient and per capita expenditures on health care, respectively (see Appendix A1.2 for further details). Because the small sample sizes in some country groups preclude us from splitting the sample to estimate separate empirical models, we investigate this conjecture by extending the model in Equations (1.1) to (1.3) with interaction terms between the health and wage variables and country group dummies. The results are reported in Columns (2) of Tables 1.2 to 1.4 and in the bottom part of Table 1.5. We do not discuss the health equation results and system errors correlation matrix in, respectively, Columns (2) of Tables 1.2 and 1.4 because they remain virtually the same as those in Columns (1).

Columns (2) of Table 1.3 reveal possible heterogeneous responses on wages across the different country groups. First, although the educational effects on wages are positive and statistically significant in all country groups, they are larger in the *Mediterranean* and *Transitional* countries for both men and women. The coefficients of educational attainment in *Transitional* countries are, however, less precisely estimated. Health also has a significant effect on wages for all country groups and for both men and women, but we do identify marked differences based on gender. First, we find evidence of heterogeneous health effects on wages for women but not for men. In particular, whereas we reject the null hypothesis of equal effects across country groups at a 1 percent significance level for women, we do not reject the null for men. It is also women from *Transitional* (*Nordic*) countries with a one-unit larger health stock that show the largest (smallest) percentage difference in the hourly wage rate (20 and 6 percent, respectively). Columns (2) of Table 1.4, on the other hand, show possible significant heterogeneous effects of wages and health on employment across the different country groups for both men and women.

Table 1.5 summarizes the main results. The bottom part of the table outlines the direct effects of health and wages on employment, together with the indirect health effects that operate through wages for the different country groups. Our test of equality for all these wage effects across the different country groups shows heterogeneous effects of wages on employment. The null hypothesis of equal effects is rejected at a 1 percent significance level for both women and men. Only for men, however, do we find heterogeneous effects of health on employment (at a 5 percent significance level), due primarily to the relatively large effect of health on employment in the *Transitional* countries.

In general, employment is more sensitive to wages for women than for men, and more in the *Nordic* and *Continental* countries than in the *Mediterranean* and *Transitional* countries. For instance, for an older male (female) worker, a 10 percent increase in the hourly wage rate leads to a 5 (8) percentage points higher employment probability in the *Nordic* countries that reduces to a 1 (3) percentage point increase in the *Mediterranean* countries. The profile for health is slightly different. Employment is about equally sensitive to health for both women and men, except in the *Transitional* countries, where it is greatest for men. Specifically, a male older worker with a one-unit larger health stock has an average 20 percentage points higher employment probability, but this increase reduces to 14 percentage points in *Continental* countries. Finally, we find that the indirect effects of health on employment through wages are positive and heterogeneous across country groups (at a 5 percent significance level), and larger for women than for men.

Overall, the mediating role of wages for the health-employment nexus is weakest for men in the *Mediterranean* and *Transitional* countries—even to the point of being statistically insignificant—and strongest in the *Nordic* and *Continental* countries for men and in the *Continental* and *Transitional* countries for women. Both the absence of an indirect effect of health on employment and the lower responsiveness of wages to employment in the *Mediterranean* and *Transitional* countries for men (and to some extent also for *Mediterranean* women) is consistent with their relatively less flexible labor markets.

1.4.2. Sensitivity analyses

To throw light on the quantitative importance of taking measurement error in SRH into account, we estimate the employment and wage equations (Equations (1.1) and (1.2)) with SRH assumed to be an exogenous regressor having no measurement error. These results are given in Columns (3) of Tables 1.3 and 1.4 and in Table 1.6 for both men and women. As Table 1.3 shows, treating SRH as an exogenous regressor leads, as in Cai (2009) and Jäckle and Himmler (2010), to an attenuation bias in the impact of health on wages (see columns (3)). Similar results emerge for the employment equation: treating SRH as an exogenous regressor attenuates the impact of health and overestimates the impact of wages by about 40 percent for men and to a somewhat lesser extent for women (see Table 1.6). These findings can most probably be attributed to a standard errors-in-variables downward bias in the effect of SRH on employment and wages because of a dominating (*pure* and reporting) measurement error in SRH (see Bound, 1991, p. 111; Bound *et al*., 1999).

We then investigate our model assumption of no reverse impacts of current employment and wages on health limitations (i.e., the assumption of contemporaneous exogeneity of the health limitation variables) by re-estimating the model with health limitations restricted to only severe chronic conditions, grip strength (GS), and BMI. These limitations, as discussed in Section 1.3, are those unlikely to be directly affected by current employment and wages. The estimation results using this restricted HI are given for both men and women in Columns (3) of Table 1.2, in Columns (4) of Tables 1.3 and 1.4, and in Table 1.6. These results show that using the restricted set of health limitations does not change our main empirical findings, lending support to the assumption of no reverse impacts of current employment and wages on health limitations.

Table 1.6: The direct effects and indirect effects through wages of health on employment when treating SRH as an exogenous regressor and when instrumenting SRH with a restricted set of health limitations (i.e. the restricted Health Index). The reported effects are percentage point increases in employment probability.[a]

	SRH		Restricted HI	
Europe	Men	Women	Men	Women
Ln(hourly wage)[b]	0.038***	0.060***	0.030***	0.053***
	(0.005)	(0.006)	(0.006)	(0.006)
Health[c]	0.091***	0.087***	0.148***	0.105***
	(0.006)	(0.007)	(0.016)	(0.018)
Indirect health[d]	0.016***	0.023***	0.038***	0.058***
	(0.004)	(0.005)	(0.010)	(0.014)

[a] Cluster-robust standard errors are in parentheses (see Appendix A1.1 for more details). Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.
[b] Measures the increase in employment probability corresponding to a 10% increase in the hourly net wage rate.
[c] Measures the increase in employment probability corresponding to a one-unit increase that is approximately equivalent to a 0.8 standard deviation of HI.
[d] Measures the increase in employment probability corresponding to the indirect effect of a one-unit increase in health on employment through wages.

Finally, however, as Chung *et al.*'s (2009) study finds that retirement increases the BMI among individuals aged 62 to 71 in the U.S., we further re-estimated the model with health limitations restricted to only severe chronic conditions and GS. The estimation results when using this most restricted HI do again not change our main empirical results. For instance for men, all point estimates are in between the ones obtained when using the previous (extended) HI and the restricted HI. This finding could also be explained by the fact that Chung *et al*. (2009) find no evidence of an effect of retirement on BMI for individuals aged 51 to 61, which represent almost 80 percent of our sample.

In sum, our sensitivity analyses suggest that the endogeneity of health, as a result of various sources of measurement errors, is in our model mainly due to the dominating effect of *pure* and/or reporting measurement error. This assumption is supported by Bound (1991), who argues that the endogeneity of subjective health measures likely to exaggerate the impact of health on employment (i.e., justification bias, state-dependence, and financial incentives) is more of a problem for health questions on work capacity than for more general questions such as SRH status.

1.5. Conclusions

Theoretical economic models, based on productivity and reservation wage arguments, predict that an individual's health affects his or her wage rate and that health and wages affect the employment decision. In fact, the major role of health in determining employment among workers aged 50–64 years is already well documented in the literature on the health-employment nexus (see, e.g., Currie and Madrian, 1999, and references therein). However, with the possible exception of Haveman *et al*. (1994), the extant empirical literature does not disentangle health's direct effect on employment from its indirect effect through wages (Cai, 2009, 2010).

We therefore estimate a system of equations for health, wages, and employment that enables a quantification of both the direct and indirect effect (through wages) of health on employment. Our model also takes into account the potential for measurement error in the self-reported health measure, ignoring which, our results confirm, would attenuate the impact of health on both wages and employment. Our main contribution to the empirical literature relates to the role of individual wage rates in the health-employment nexus. For Europe at least, we find that, as predicted by the theoretical economic models, an older male (female) worker with a one-unit (or 0.8 standard deviation) larger health stock has, on average, an 8 percent higher hourly wage rate, which results in a 2 (4) percentage point higher employment probability. We also identify a direct impact of health on employment: a similar increase in health raises an older male (female) worker's employment probability by 16 (12) percentage points. As regards cross-country differences, our findings suggest that the mediating role of wages for the health-employment nexus is weakest in the *Mediterranean* countries and for men from *Transitional* countries, and strongest in the *Nordic* and *Continental* countries for men and in the *Continental* and *Transitional* countries for women. Labor market flexibility may explain such variation. We also find that despite institutional differences, health appears to have a rather similar positive impact on employment across our social models (except for the somewhat larger effect for men from *Transitional* countries). This similarity may imply the existence of comparable schemes across these country groups that allow unhealthy workers to exit the labor market (Wise, 2012).

Finally, from a policy perspective, the relatively small indirect effects of health on employment through wages suggest a minor role for disability income policies such as wage subsidization aimed at encouraging the employment of workers with health impairments. In fact, our findings support Autor and Duggan's (2007) conclusion that, as exemplified by the U.S. Ticket to Work program, there is limited scope for public policy to increase a return to work among nonelderly disability recipients by reducing the implicit tax on labor income. Rather, the relatively large direct impact of health on employment implies an instrumental role for policy aimed at helping employers accommodate workers with health limitations so as to keep them on the job at older ages. Such an inference is very much in line with recent calls by Autor and Duggan (2010) and Burkhauser and Daly (2011) for supported work over cash benefits for people with disabilities and, in particular, increased employer incentives to accommodate work-limited employees (Burkhauser and Daly, 2012).

Appendices to Chapter 1

A1.1. Estimation procedure

Our empirical model, given by Equations (1.1) to (1.3), is estimated in two stages. In the first stage we estimate a reduced form triangular system using full information maximum likelihood (FIML) and in the second stage we employ a minimum distance estimator to obtain the estimates of all parameters of interest.

In the first stage, the equation for health (SRH) is an ordered probit model. In the health equation (1.3), we do not observe H_{it}^{*} but instead an ordered categorization variable SRH_{it} which takes the values *j*=1, 2, 3, 4, 5, representing *poor*, *fair*, *good*, *very good*, and *excellent* health, respectively. The latent counterpart to SRH_{it}, denoted by SRH_{it}^{*}, is a function of true health H_{it}^{*} and overall measurement error, including *pure* measurement error, justification bias, and reporting differences in our specification (see Section 1.3 for more details)

$$SRH_{it}^{*} = H_{it}^{*} + \varepsilon_{it}^{H} . \tag{A1.1}$$

Substituting Equation (1.3) into Equation (A1.1) yields

$$SRH_{it}^{*} = \alpha_0 + HL_{it}'\alpha_1 + \alpha_2 Educ_i + Z_{it}'\alpha_3 + \upsilon_{it}^{H} + \varepsilon_{it}^{H} . \tag{A1.2}$$

SRH_{it} is related to its unobservable counterpart SRH_{it}^{*} by assuming that $SRH_{it} = j$ if $\mu_{it,j-1} < SRH_{it}^{*} \le \mu_{it,j}$, with the thresholds $\mu_{it,0} = -\infty$, $\mu_{it,j-1} < \mu_{it,j}$, and $\mu_{it,5} = +\infty$. The composite error term $u_{it}^{H} = \upsilon_{it}^{H} + \varepsilon_{it}^{H}$ is assumed to be standard normally distributed.

Next, to obtain a triangular system of equations we substitute the wage equation (1.2) into the employment equation (1.1), which gives

$$E_{it}^{*} = \pi_0 + \pi_1 H_{it}^{*} + \pi_2 Educ_i + X_{it}'\pi_3 + \tilde{Z}_{it}'\tilde{\gamma}_3 + u_{it}^{E} \tag{A1.3}$$

where $\pi_0 = \gamma_0 + \gamma_2\beta_0$, $\pi_1 = \gamma_1 + \gamma_2\beta_1$, $\pi_2 = \gamma_2\beta_2$, $u_{it}^{E} = \upsilon_{it}^{E} + \gamma_2\upsilon_{it}^{W}$, and the parameter vector $\pi_3 = \gamma_2\beta_3 + \breve{\gamma}_3$ with $\breve{\gamma}_3$ being a subset of γ_3 corresponding to the variables in Z_{it}

that are in X_{it}. $\tilde{Z}_{it}$ includes the variables in Z_{it} that are not in X_{it}, and with parameter vector $\tilde{\gamma}_3$ being the corresponding subset of γ_3. The employment equation (A1.3) is a probit model in which $E_{it} = 1\left[E_{it}^{*} \succ 0\right]$, and the error term u_{it}^{E} in Equation (A1.3) is assumed to be standard normally distributed.

The wage rate is only observed for wage-earners (and only in waves 1 and 2, see section 2). In addition, we do not observe the wage rate for self-employed individuals. To avoid estimating a wage equation on a nonrandomly selected sample of individuals for whom we observe a wage rate, we employ the procedure proposed by Heckman (1979), hence use the whole sample to avoid sample selection, and add to our model (Equations (A1.3), (1.2) and (A1.2)) a selection equation for wages, where $w_{it}^{*} = w_{it}$ if $S_{it} = 1$ (unobserved otherwise) and

$$S_{it}^{*} = \pi_4 + \pi_5 H_{it}^{*} + \pi_6 Educ_i + Z_{it}' \pi_7 + \upsilon_{it}^{S}; \qquad S_{it} = 1\left[S_{it}^{*} \succ 0\right]. \tag{A1.4}$$

Here, S_{it} denotes observability of the (net) wages and takes the value 1 if the individual works in a wage-earning job. We assume that υ_{it}^{S} is a standard normally distributed error term, and all assumed exogenous variables enter the selection equation. As explained in section 1.3, the vector Z_{it} contains exclusion restrictions that drive selection but can at the same time be omitted from the wage equation (1.2) (i.e., excluded from X_{it}). Because Equation (A1.4) does not contain parameters of interest but is only needed to account for sample selection, the parameter estimates of this equation are not reported in this paper but are available upon request.

The error terms u_{it}^{H}, υ_{it}^{W}, υ_{it}^{S}, and u_{it}^{E} are freely correlated and are assumed to follow a multivariate normal distribution. We estimate Equations (A1.2), (A1.3), (A1.4) and (1.2) using full information maximum likelihood (FIML). Because estimation of this system requires computation of multidimensional integrals, we implement a maximum simulated likelihood procedure referred to as the Geweke−Hajivassiliou−Keane (GHK) simulator. The practical implementation is carried out using the Stata CMP module (see Roodman, 2009).

In the second stage, we retrieve the coefficients of the employment equation (1.1), γ_1 and γ_2, using nonlinear combinations of coefficients of Equations (1.2) and (A1.3) as defined below Equation (A1.3). Basically, we impose parameter restrictions on the triangular system that are the identifying restrictions. For instance, as in Haveman *et al.*'s (1994) study, education only affects employment through wages (and health). Because $Educ_i$ in Equations (1.2) and (A1.3) contains two dummies, we first use equally weighted minimum distance to estimate γ_2, allowing us to then estimate γ_1 using the nonlinear combination $\gamma_1 = \pi_1 - \gamma_2\beta_1$. The Delta method is used for computing standard errors.

Table A1.1: Variable definitions

Variable	Definition
Dependent variables	
Self-reported health (SRH)	Includes five SRH categories, from 1 to 5: poor, fair, good, very good, and excellent.
Log hourly (net) wage	Hourly net wages are measured in PPP-adjusted 2005 US$. They are defined for paid workers and obtained by dividing the amount of net wage earnings by the number of hours worked. Both variables are available for the primary job in waves 1 and 2. In wave 4 there is no similar information about wages (net or gross). Similarly to Jäckle and Himmler's (2010) study on wages, we do not compute the hourly net wage for the self-employed since their reported earnings and hours are a poor proxy for their wage rate. In addition, for the self-employed, it is only possible to compute an hourly net wage in wave 2. We use unfolding bracket values for net wages to reduce the number of missing values, and treat extreme values in hourly net wages (e.g., those below 1 and above 300 PPP-US$) as missing.
Employment status	Employment status is equal to 1 if a respondent reports working a positive number of hours per week in his/her main job, 0 otherwise.
Respondent's socioeconomic characteristics	
Nonlabor income quintiles	Includes dummies for the quintiles of the rank of monthly nonlabor income, which is defined as (average) monthly total income received by all household members in the previous year minus (average) individual monthly income from employment in the previous year. The dummies are defined by wave and country. Since income from nonemployment is measured in gross terms in wave 1 and in net terms in waves 2 and 4, we assume that workers do not switch rank in the nonemployment income distribution because of the tax system. We use unfolding bracket values to reduce the number of missing values, except for total income received by all household members in wave 1, which is an imputed variable. For this latter, like Meijer *et al*. (2010), we use the mean of the five multiple imputations as our income variable. We treat negative values in income from nonemployment as missing.
Homeowner	Homeowner is equal to 1 if a respondent and/or spouse lives as a homeowner or member of a cooperative, and 0 otherwise (tenants, subtenants, or rent free). A homeowner may have a mortgage, but for the largest fraction in our sample (about 60 percent) this is not the case.

Education	Includes three levels of education defined from the ISCED Code 1997: no education, primary education, or lower secondary education (ISCED 0–2), upper secondary and postsecondary nontertiary education (ISCED 3–4), and tertiary education (ISCED 5–6).
Marital status	Marital status is equal to 1 if married or cohabiting, 0 otherwise (single or widowed).
Log household size	Includes the logarithm of the number of household members.
Number of grandchildren	In addition to the respondent's own grandchildren, includes those of the spouse or partner from previous relationships.
Age	Includes dummy variables for each age year. The reference category is 50–51 years.
Countries	Country dummies.
Time	Survey year.
Respondent's health limitations	
MILD	MILD refers to mild chronic diseases; it is equal to 1 if a respondent has one or more mild conditions, 0 if none. Mild conditions are hypertension, high blood cholesterol, diabetes, asthma, arthritis, osteoporosis, stomach condition, cataracts, and other conditions.
SEVERE	SEVERE refers to severe chronic diseases; it is equal to 1 if a respondent has one or more severe conditions, 0 if none. Severe conditions are cancer, heart condition, stroke, Parkinson's disease, hip problems, and lung disease.
ADL	ADL refers to limitations in the activities of daily living; it is equal to 1 if the respondent suffers one or more limitations, 0 if none. ADL includes six activities: (i) dressing, including putting on shoes and socks; (ii) walking across a room; (iii) bathing or showering; (iv) eating, including cutting up food; (v) getting in and out of bed; and (vi) using the toilet, including getting up and down.
IADL	IADL refers to limitations in the instrumental activities of daily living; it is equal to 1 if the respondent has one or more limitations, 0 if none. IADL includes seven activities: (i) using a map to figure out how to get around in a strange place; (ii) preparing a hot meal; (iii) shopping or buying groceries; (iv) making telephone calls; (v) taking medications; (vi) working around the house or garden; and (vii) managing money, such as paying bills and keeping track of expenses.

GALI	GALI refers to the global activity limitation indicator; it is equal to 1 if the respondent is limited, 0 if not. The question for this index is the following: "For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do." The possible response range is "severely limited," "limited but not severely," and "not limited."
MOBILITY	MOBILITY is equal to 1 if the respondent has any mobility limitations, 0 if none. Assessment of these limitations is based on the following activities: (i) walking 100 meters; (ii) sitting for about 2 hours; (iii) getting up from a chair after sitting for long periods; (iv) climbing one (several) flight(s) of stairs without resting; (v) stooping, kneeling, or crouching; (vi) reaching or extending one's arms above shoulder level; (vii) pulling or pushing large objects like a living room chair; (viii) lifting or carrying weights over 5 kilos, like a heavy bag of groceries; and (ix) picking a small coin up off a table.
DEPRESSION	DEPRESSION is equal to 1 if the respondent suffers from more than three depression symptoms from the so-called EURO-D scale, 0 otherwise. The EURO-D scale was specifically designed for measuring depression and has been validated for use in cross-country analysis (see, e.g., Castro-Costa *et al*., 2008). The following 12 variables make up the EURO-D scale: sadness or depression, pessimism, suicidal thoughts, guilt, sleep trouble, lack of interest, irritability, appetite, fatigue, concentration, enjoyment, and tearfulness.
BMI	BMI refers to Body Mass Index. The variable is reclassified into the standard categories: underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), and obese (>30). Like Meijer *et al*. (2010), we also control for missing BMI.
GS	GS refers to grip strength, and is defined as the maximum grip strength measurement of both hands (if both are measured twice) or one hand (if only one is measured twice). We also control for missing GS.

A1.2. Social models

Sapir (2006) identifies different European social models that perform differently in terms of efficiency and equity as measured, respectively, by the employment rate and Gini coefficient (see, e.g., Kalwij *et al*., 2010). Since our main focus in this paper is the effect of health on wages and employment, we add to these two indicators the per capita expenditures on health care as an overall measure for the health care system in one country. As shown in Table A1.2, based on these indicators, we classify Denmark, Sweden, the Netherlands, and Switzerland as *Nordic*. These countries are characterized by high employment rates and per capita expenditures on health care, and low income inequality.[14] Austria, Germany, France, and Belgium are classified as *Continental* with, typically, low employment rates but also low income inequality and high per capita expenditures on health care. Spain, Italy, Greece, Israel, and Ireland are classified as *Mediterranean*, and the Czech Republic and Poland as *Transitional* countries. The latter two groups have both low employment rates and low per capita expenditures on health care, as well as high income inequality.[15]

[14] For the Netherlands, the preferred measure on health expenditures—the one provided by the government—is unavailable, but as indicated by the other measure on total expenditures in health, these are among the highest in the sample, which justifies its inclusion as a *Nordic* country based on this criterion (see Table A1.2).

[15] The only two exceptions are the Czech Republic and Ireland, which deviate in one out of the three indicators from the classification rule and have, respectively, a low Gini coefficient and high per capita expenditures on health care.

Table A1.2: Social models

	Employment rate (15–64 years)[a] (1994–2009)*		Gini coefficient (after taxes and transfers)[b] (average over 2000 decade)*		Health expenditures in /capita US$ PPP, by the general government and total expenditures[c] (2003–2009)*				Social models
Switzerland	77.9	High	0.286	Low	2669	High	4374	High	Nordic
Denmark	75.7	High	0.235	Low	3027	High	3578	High	Nordic
Sweden	73.4	High	0.245	Low	2645	High	3249	High	Nordic
Netherlands	71.1	High	0.290	Low	-	-	3940	High	Nordic
Austria	69.1	Low	0.259	Low	2842	High	3760	High	Continental
Czech Republic	66.5	Low	0.261	Low	1381	Low	1604	Low	Transitional
Germany	66.0	Low	0.281	Low	2757	High	3586	High	Continental
Ireland	62.7	Low	0.304	High	2443	High	3252	High	Mediterranean
France	61.6	Low	0.289	Low	2702	High	3459	High	Continental
Belgium	59.4	Low	0.273	Low	2538	High	3391	High	Continental
Spain	57.8	Low	0.326	High	1815	Low	2534	Low	Mediterranean
Greece	57.6	Low	0.324	High	1548	Low	2558	Low	Mediterranean
Israel	56.3	Low	0.365	High	1155	Low	1935	Low	Mediterranean
Poland	56.0	Low	0.323	High	705	Low	1002	Low	Transitional
Italy	55.0	Low	0.344	High	2050	Low	2660	Low	Mediterranean

Source: OECD (http://stats.oecd.org/). *Longest period for which comparable data are available for all sample countries. [a]An (overall) employment rate above the Lisbon target of 70% during the 1994–2009 period is considered high. [b]An average Gini coefficient (after taxes and transfers) above the sample average of 0.294 over the 2000 decade is considered high. [c]Average per capita expenditures in health by the general government above the sample average of 2,162 US$ PPP over the 2003–2009 period are considered high. Average total per capita expenditures in health above the sample average of 2,992 US$ PPP over the 2003–2009 period are considered high.

Chapter 2:

The impact of health on wages: Evidence from Europe before and during the Great Recession

2.1. Introduction

According to economic theoretical models, health, as a component of human capital, affects wages through productivity. An individual in bad health is assumed to have a lower productivity, and thus a lower wage rate (Becker, 1962; Mushkin, 1962). Hence, if workers are paid according to their marginal productivity, wages will be determined by firm-level supply and demand factors and by Mincerian-type employee-level human capital (i.e. education and experience) and health effects (cf. Jäckle and Himmler, 2010).[16] However, while there is a wide support in the empirical literature of the positive impact of experience and education on wages (see Card, 1999, for a survey), the relationship between wages and health is less clear-cut.

Still, health, and in particular its possible endogeneity in wage equations, and labor market equations in general, has received a great deal of attention in the literature (see Currie and Madrian, 1999, for a survey). Common reasons for this endogeneity are nonrandom sample selection, because we only observe wages for those who choose to work, and because participation is possibly correlated with idiosyncratic changes in wages, and unobserved heterogeneity, as there may be unobserved characteristics, such as genetic endowment, that affect both health and wages. Another reason is the potential measurement error that arises in many studies which, like ours, use self-reported health (SRH) status as a measure for actual health. This potential measurement error may stem from three sources: *pure* measurement error (see Bound *et al*., 2001; Crossley and Kennedy, 2002), the justification bias (see Bound, 1991; Stern, 1989), or the basing of SRH on subjective judgment, which may hinder comparison across individuals (Kapteyn *et al*., 2007; Meijer *et al*., 2011).[17]

[16] Alternatively, Contoyannis and Rice (2001) argue that the (positive) relation between poor health and low wages may stem from employer beliefs that poor health correlates with unobserved characteristics that are negatively associated with productivity or from discrimination against individuals perceived to be in poor health (see also Currie and Madrian, 1999, pp. 3332–3, and references therein).

[17] There is some consensus in the literature that the pure measurement error and the reporting differences are likely to attenuate the impact of SRH on labor market outcomes (including wages), whereas the justification bias will most probably exaggerate its impact (Bound, 1991; Brown *et al*., 2010). The direction of the other biases due to unobserved heterogeneity and sample selection is, *a priori*, unclear and will depend, respectively, on the correlation between the unobserved characteristics and health, and on whether selection is positive or not, as well as on the correlation between participation (i.e. selection) and health.

Most previous studies that analyze the impact of health on wages have considered the aforementioned problems to different extents. For instance, Haveman *et al.* (1994) estimate a simultaneous equations model for work, wages and health. They use panel data for men with "histories of significant labor force attachment" and report that (lagged) poor health does affect both wages and work-time negatively. However, they do not consider the aforementioned endogeneity problems of unobserved heterogeneity, sample selection and measurement error (in their self-reported health variable). Contoyannis and Rice (2001) use data from employed British men and women and find that the significant effect of (excellent) SRH on wages in ordinary least squares (OLS) models becomes insignificant for men and remains only marginally significant for women when individual fixed effects (FE) are controlled for. However, reduced psychological health is found to reduce hourly wages for men. Using further Hausman-Taylor type instrumental variables estimators leaves these results virtually unchanged. Brown *et al.* (2010) use a Health Index approach in a similar vein to Bound *et al.* (1999) to correct for measurement error in SRH, and additionally control for unobserved heterogeneity and sample selection bias. They do not find an effect of health on men's (reservation) wages in Britain.[18] Jäckle and Himmler (2010), on their side, use German data and compare different estimators that account for selectivity bias, unobserved heterogeneity and measurement error to assess the effect of health on wages. Their results suggest that health has in general a positive effect on wages for men but not for women.

Some studies have also explored the reverse causality of wages on health.[19] The empirical evidence on this issue is rather mixed and the models used often require additional assumptions for identification (see also Currie and Madrian, 1999, pp. 3320, 3331). For instance, Lee (1982) and Cai (2009), report a positive and no effect of wages on health for U.S. and Australian men, respectively. Also Haveman *et al.* (1994) model the reverse impacts of work-time and wages on health, although they do not report the estimation results that include the reverse effect of wages on health. Finally, it is also

[18]However, and as will be made clear in Section 2.3, one possible drawback within their approach is that they plug into the wage equation the fitted values of a health stock variable obtained from a first-stage health equation that is estimated to correct for measurement error *before* correcting for selectivity bias (Semykina and Wooldridge, 2008).

[19] Grossman (2001) discusses a theoretical model on this issue.

worth noting that all previous studies focus on working-age individuals, except Lee (1982) who uses data from older workers.

Our contribution to the literature regarding the relationship between health and wages is twofold. First, we expand the findings of Jäckle and Himmler (2010) for Germany and use individual-level panel data from the European Union Statistics on Income and Living Conditions (EU-SILC) to assess the potential importance of unobserved heterogeneity, selection and measurement error when estimating the impact of health on wages for men and women in Europe, and by age groups. Second, we use data from before and during the Great Recession (GR), which started in Europe in 2008 (Arpaia and Curci, 2010), to gain insights into whether, and how, the current crisis has altered the relationship between health and wages, an issue not yet addressed in the literature. For instance, budget cuts during the GR have restricted (overall) access to health care (Karanikolos *et al.*, 2013), which we would expect to result in an increase in the impact of health on wages, on average. On the other hand, the rise in uncertainty and unemployment (Leduc and Zheng, 2012) combined with decreases in (un) employment protection during the GR (OECD, 2013) may be pushing some workers to go to work when they are sick (CareerBuilder, 2011). This phenomenon is known as *presenteeism*, and may, at least in the short run, reduce the impact of (poor) health on wages. Also, during recent years, there is some evidence of a reduction in the variable component of wages (Vandekerckhove *et al.*, 2012), the one that is likely to be more responsive to productivity-related components such as health, which might further reduce the impact of health on wages.

Our primary empirical findings show that in the period prior to the GR, and similar to Jäckle and Himmler's (2010) study for Germany, European working-age men (20–64 years old) who are in relatively better health (measured by a one-unit increase in a health index) have, on average, a 9 percent higher hourly wage rate. But in addition to their study, we show that this effect is concentrated (and largest) among older workers (50–64 years old). However, during the GR the positive impact of health on wages disappears. Two possible explanations for these findings are the abovementioned increase in *presenteeism* (i.e. attending work even though being sick) and the reduction of the (more) productivity-related component of wages during the current crisis. With regard to working-age women (20–59 years old), we do not find evidence of an effect of health on wages, neither before nor during the GR. Finally, and mainly for men, our results provide further empirical evidence of measurement error in the SRH variable when estimating its impact on wages, and of selectivity bias in wages.

The remainder of the paper is organized as follows. Section 2.2 describes the data and the main analytical variables. Section 2.3 outlines the empirical model and discusses a number of related econometric issues. Section 2.4 reports the estimation results and Section 2.5 analyzes their robustness. Section 2.6 summarizes the main findings and concludes.

2.2. Data and descriptive statistics

We use individual-level panel data from the European Union Statistics on Income and Living Conditions (EU-SILC), a harmonized and representative cross-national panel of the European population aged 16 and over. EU-SILC contains household and individual-level information on various components, e.g., income, work, health, housing and other social indicators about living conditions. It is a four-year rotational panel except for France, where it is an eight-year panel, and Luxemburg, where it is a pure panel. Therefore, we use two different panels for analyzing the period before (2005–2007) and during the GR (2008–2011), which correspond to release 2008 and 2011, respectively.[20]

EU-SILC covers the 27 countries of the European Union (EU) plus Croatia, Iceland, Turkey, Norway and Switzerland. However, it was not implemented in all countries at the same time. On one hand, Bulgaria, Romania, Croatia, Turkey and Switzerland took part in the EU-SILC project after 2005. On the other hand, at the time of writing (April 2014), 2011 data were not available for countries such as Greece, France, Ireland, Sweden and Slovakia. In our analysis, we consider 15 countries that participate in the whole sample period (2005–2011) covering Northern (Denmark, Finland, and Norway), Central (Austria, Belgium, Luxembourg, and the Netherlands), Southern (Cyprus and Spain), and Eastern Europe (the Czech Republic, Estonia, Hungary, Lithuania, Poland, and Slovenia).

[20] The year 2008 is taken as the start of the GR in Europe (Arpaia and Curci, 2010) and, hence, is dropped from the release 2008.

Our empirical analysis is based on data for male (female) respondents aged 20–64 (20–59).[21] This selection yields 125,985 observations for 41,995 respondents for the period 2005–2007, and 131,200 observations for 32,800 respondents during the period 2008–2011. Panel attrition in EU-SILC is relatively low; about 14 (11) percent by wave in the period 2005–2007 (2008-2011). In our analysis, we exclude students, and in general individuals below age 20, as they may not have established work patterns (Haveman *et al.*, 1994). Moreover, we leave out self-employed workers since their motives with respect to labor market participation are specific and their reported earnings and hours are a poor proxy for their hourly wage rate. Additionally, we do not consider individuals in compulsory military service or those in (early) retirement. We also exclude individuals that are permanently disabled (handicapped) because they are not likely to be paid according to their marginal productivity for reasons such as discrimination and due to the fact that most of them work at sheltered workshops with subsidized wages (Jäckle and Himmler, 2010). Missing values forces a 32 (34) percent reduction in sample size for the period 2005–2008 (2008–2011). The result is a balanced panel comprising 61,071 observations for 9,914 male and 10,443 female European respondents for the period 2005–2007, and 60,528 observations for 7,128 male and 8,004 female European respondents for the period 2008–2011.

Details on the definitions of all variables used in the empirical analysis are given in appendix Table A2.1. The (log) hourly gross wage rate—measured in PPP's adjusted 2005 €—is defined for employed individuals and is obtained from dividing the amount of gross wage earnings by the number of hours (usually) worked. Countries such as Greece, Italy, Latvia and Portugal report only net wage earnings in the first waves and were, therefore, excluded from the analysis.[22] Self-reported health (SRH) status is rated on a five-point scale (from 1 to 5: very bad, bad, fair, good, and very good), and the variable determining selection, i.e. participation in the labor market, is defined as 1 if the individual works and 0 otherwise. Among our explanatory variables, experience refers to actual experience, hence avoiding additional measurement error in this variable.[23] In order to capture differences in labor market institutions across the

[21] For women, mandatory retirement age in many of our sample countries (e.g., in the Eastern European countries) is age 60 (www.oecd.org/els/social/pensions/PAG).

[22] The reason for not considering net hourly wages is that they are likely to be affected by family conditions and tax legislation not related to an individual's labor market productivity.

[23] We also had to exclude the UK from our analysis, as they do not report data on experience.

countries within our sample, we also include country- and gender-specific employment and unemployment rates in our empirical model in Section 2.3. This information is taken from the Labour Force Survey available from Eurostat (http://epp.eurostat.ec.europa.eu/). Table 2.1 provides summary statistics on these and other health, demographic and socioeconomic characteristics used in the empirical analysis for both periods, before and during the GR, and for working-age employed and nonemployed men and women. Similar descriptive statistics by age groups are given in appendix Tables A2.2 to A2.4.

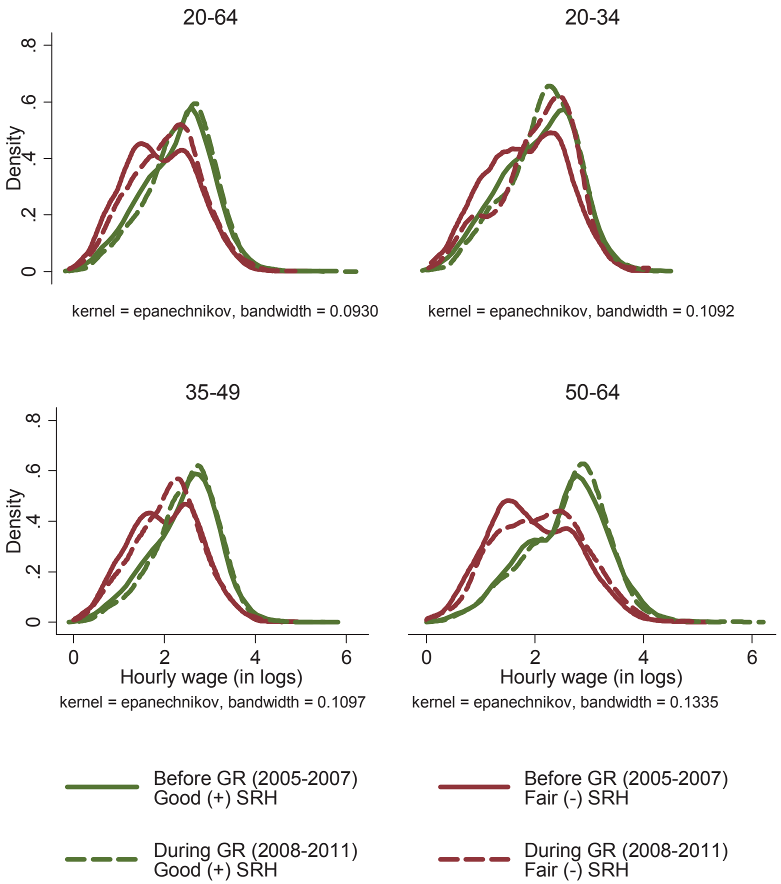
As shown in Table 2.1, both before (2005–2007) and during the GR (2008–2011), men earn higher (real) hourly wages than women, and employed men and women report better health than their nonemployed peers. The most notable change, however, when comparing the two time periods is the increase in the probability of working in women, which increases from 0.73 to 0.79 (the “added-worker effect”). This increase, moreover, is largest among older women (see Tables A2.2–A2.4 in the appendix). Instead for men, the probability of working in our sample remains about the same in both periods (between 0.92–0.93). Furthermore, we do not find large changes in real hourly wages and SRH across time, with the possible exception of employed and nonemployed men for which real hourly wages and SRH increase slightly, respectively.

Figures 2.1 and 2.2 show kernel density estimates for the logarithm of (real) hourly wages before and during the GR for those who report good or very good health (Good (+) SRH) and fair or worse health (Fair (-) SRH), by age groups and for men and women, respectively. As the figures show, across age groups and gender, the main changes in the density of wages occur for those who report worse health, whose wage density shifts slightly to the right, mainly because of a reduction in the lower tail of the density. Thus, the difference in wage densities between those reporting good or very good and fair or worse health becomes smaller during the GR, which suggests a diminishing role of health on wages during this period.

Table 2.1: Descriptive statistics

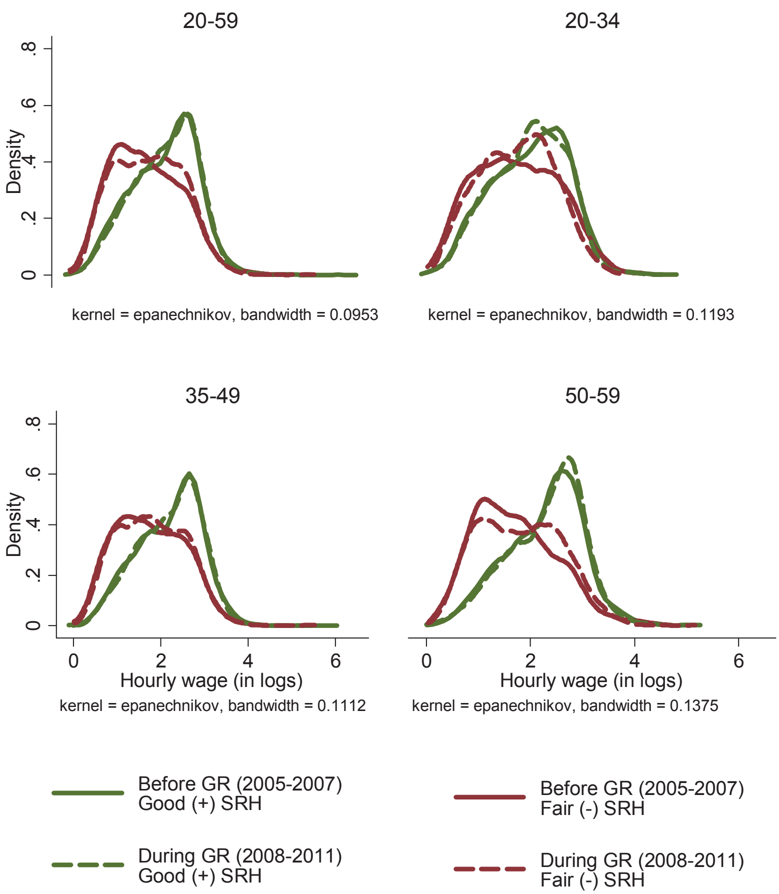
	Employed				Nonemployed			
	2005–2007		2008–2011		2005–2007		2008–2011	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Men (20–64)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	12.66	10.55	13.52	11.73				
Self-reported health (1-5)	4.05	0.76	4.07	0.73	3.54	0.99	3.67	0.9
1+ chronic diseases	0.17	0.38	0.18	0.39	0.28	0.45	0.27	0.45
Limited with GALI (1-3)	1.13	0.4	1.13	0.39	1.33	0.62	1.28	0.55
Experience	20.7	11.35	20.18	11.5	17.13	12.58	17.72	12.6
ISCED 0–2	0.18	0.38	0.2	0.4	0.36	0.48	0.38	0.48
ISCED 3-4	0.56	0.5	0.49	0.5	0.56	0.5	0.52	0.5
ISCED 5-6	0.26	0.44	0.31	0.46	0.08	0.28	0.11	0.31
Annual income from nonemployment	18,530	20,415	19,779	20,604	15,283	16,346	15,649	15,800
Household size	3.3	1.39	3.26	1.41	3.2	1.6	3.28	1.73
Single	0.24	0.43	0.24	0.43	0.44	0.5	0.49	0.5
Age	40.97	10.36	41.98	10.03	42.25	11.88	42.55	11.75
Unemployment rate (%)	5.93	3.01	7.82	5.04	7.91	4.08	10.9	5.73
Employment rate (%)	72.68	6.07	71.07	6.06	68.76	6.6	67.64	5.61
Prob. work (entire sample)	0.92	0.27	0.93	0.26				
Observations (N)	27,462		26,386		2,280		2,126	
Women (20–59)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	10.31	10.03	10.34	8.6				
Self-reported health (1-5)	4.01	0.77	4.01	0.74	3.8	0.89	3.8	0.83
1+ chronic diseases	0.18	0.39	0.2	0.4	0.24	0.43	0.26	0.44
Limited with GALI (1-3)	1.14	0.4	1.15	0.41	1.24	0.54	1.23	0.5
Experience	18.39	10.25	17.32	10.41	9.43	9.04	9.79	9.24
ISCED 0–2	0.15	0.36	0.16	0.37	0.42	0.49	0.39	0.49
ISCED 3-4	0.52	0.5	0.47	0.5	0.46	0.5	0.46	0.5
ISCED 5-6	0.33	0.47	0.37	0.48	0.12	0.32	0.14	0.35
Annual income from nonemployment	25,790	27,946	27,300	29,630	32,700	33,229	27,459	38,773
Household size	3.18	1.29	3.19	1.32	3.76	1.49	3.79	1.54
Single	0.28	0.45	0.27	0.44	0.15	0.35	0.17	0.38
Age	40.72	9.44	41.81	9.14	41.38	10.29	41.54	10.25
Unemployment rate (%)	7.82	3.66	8.39	4.69	8.77	3.87	10.61	5.55
Employment rate (%)	58.66	7.48	59.7	7.3	55.77	5.79	56.6	5.99
Prob. work (entire sample)	0.73	0.44	0.79	0.41				
Observations (N)	22,954		25,153		8,375		6,863	

Figure 2.1: Kernel density estimates for the logarithm of hourly wages before and during the Great Recession by levels of SRH and age groups (Men)



Source: Author calculations based on EU-SILC (2005-2007, 2008-2011). The figures show kernel density estimates for the logarithm of real gross hourly wages before and during the Great Recession for men and by age groups for those who report good or very good (Good (+) SRH) and fair or worse health (Fair (-) SRH).

Figure 2.2: Kernel density estimates for the logarithm of hourly wages before and during the Great Recession by levels of SRH and age groups (Women)



Source: Author calculations based on EU-SILC (2005-2007, 2008-2011). The figures show kernel density estimates for the logarithm of real gross hourly wages before and during the Great Recession for women and by age groups for those who report good or very good (Good (+) SRH) and fair or worse health (Fair (-) SRH)..

2.3. The empirical model

Our aim in this paper is to estimate the impact of health on wages for the entire population (with panel data), but we only observe the wage rates for individuals who work. As previously mentioned in Section 2.1, this creates a selection problem as the decision to participate in the labor market is likely to be nonrandomly determined and this is unlikely to be fully covered by observable factors (Heckman, 1979). Moreover, exploiting the panel nature of our data using, e.g., a fixed effects approach will not solve this problem unless the selection process is time constant (Dustmann and Rochina-Barrachina, 2007). If unobserved time-varying, e.g., lifestyle-related factors such as health determinants or motivation affect selection, this kind of selection will influence wages through the error term and lead to inconsistent estimation (Brown *et al.*, 2010; Jäckle and Himmler, 2010). Therefore, to tackle this selection problem, we estimate the following system of equations that model the relationship between health and wages:

$$w_{it} = \beta_0 + x_{it}\beta_1 + c_{i1} + u_{it1}, \qquad (2.1)$$

$$S_{it}^{*} = \delta_0 + z_{it}\delta_1 + c_{i2} + u_{it2}, \qquad S_{it} = 1\left[S_{it}^{*} \succ 0\right]. \qquad (2.2)$$

Equation (2.1) is a wage equation, and Equation (2.2) is a reduced-form equation that describes an individual's decision to participate in the labor market. The subscripts i and t index individuals and time periods, respectively. w_{it} is the logarithm of the hourly (gross) market wage and we only observe it when S_{it}^{*}, the latent propensity to work, is positive. S_{it} denotes actual labor market participation, and 1[.] is an indicator function which equals one if its argument is true.

The system of equations comprises two sets of explanatory variables, x_{it} and z_{it}. In the wage equation, x_{it} is a 1 x K vector of explanatory variables, with β_1 being the corresponding parameter (column) vector. The variables in x_{it} include SRH (which, as discussed below is not necessarily exogenous due to measurement error problems), as well as variables such as experience and macro-level labor market variables that affect both wages and labor market participation (Montuenga *et al.*, 2003). In the participation equation, z_{it} is a 1 x G vector of explanatory variables including all exogenous variables in x_{it} among others, with δ_1 being the corresponding parameter (column) vector.

Both the wage and participation equations include unobserved heterogeneity in the form of time-constant individual effects denoted by c_{i1} and c_{i2} which are possibly correlated with x_{it} and z_{it}, and two error terms u_{it1} and u_{it2}, with u_{it1} likely to have a non-zero conditional expectation due to selective sampling, i.e., wages being observed for labor market participants only. Hence, the model combines problems of (time-constant) unobserved heterogeneity, sample selectivity and possibly additional endogeneity in one explanatory variable due to measurement error.

To deal with these issues, in this paper we use Semykina and Wooldridge's (2010) framework, which basically extends Wooldridge's (1995) method for correcting for sample selection in fixed effects models by allowing some variable(s) in the main equation (wage equation) to be correlated with the (idiosyncratic) error term. Therefore, z_{it} needs to include at least one variable that is correlated with the possibly endogenous explanatory variable in x_{it} (in our case, SRH) but is at the same time not correlated with the error term in the wage equation u_{it1}. More specifically, z_{it} is assumed to be strictly exogenous in Equation (2.1) conditional on c_{i1}. Here, we include two health limitation variables (chronic conditions and a Global Activity Limitations Indicator, GALI) that are assumed to be exogenous instruments for SRH. Although not strictly necessary, we also add exclusion restrictions to z_{it} such as nonlabor income and other household composition variables (household size and marital status) that drive selection but can be omitted from the wage equation. We also define z_{it1} as a subset of z_{it} including all the exogenous variables in x_{it} (i.e., all variables except SRH) plus the two health limitations variables.

To deal with the issue of unobserved heterogeneity, Semykina and Wooldridge (2010)—in a similar way to Wooldridge (1995)—use Mundlak's (1978) device and write the unobserved individual effects as a linear projection onto the (individual) time averages of z_{it}, denoted $\bar{z}_{i.}$, and an error term. This is particularly important for the participation equation (2.2), as it allows to circumvent the incidental parameters problem in nonlinear models (Wooldridge, 2002). After introducing some self-explanatory notation, we can rewrite Equations (2.1) and (2.2) in the following way:

$$w_{it}^{*} = \beta_0 + x_{it}\beta_1 + \overline{z}_{i.}\xi_1 + v_{it1}, \quad (2.3)$$

$$S_{it} = 1\left[\delta_0 + z_{it}\delta_1 + \overline{z}_{i.}\xi_2 + v_{it2} \succ 0\right], \quad (2.4)$$

where the composite error terms $v_{itj} = \varepsilon_{ij} + u_{itj}, j = 1,2$ are likely to be correlated with each other due to sample selectivity. Semykina and Wooldridge (2010) (and Wooldridge, 1995) basically extend Heckman's (1979) procedure to an unobserved effects framework, where v_{it1} is a linear function of v_{it2} and mean independent of z_i conditional on v_{it2} :[24]

$$E\left(v_{it1} \mid v_{it2}, z_{i1}, \ldots, z_{iT}\right) = \gamma v_{it2}. \quad (2.5)$$

While this is a formal assumption which keeps the model manageable, it still provides flexibility by allowing residual correlation to subsist even after the introduction of the Mundlak terms controlling for persistent individual features in Equations (2.3) and (2.4). If we substitute Equation (2.5) into (2.3), we get:

$$w_{it}^{*} = \beta_0 + x_{it}\beta_1 + \overline{z}_{i.}\xi_1 + \gamma\lambda_{it} + e_{it1}, \quad (2.6)$$

where e_{it1} is an error term.

Finally, the probit selection model requires the composite error term $v_{it2} = \varepsilon_{i2} + u_{it2}$ to be standard normally distributed. The participation equation (2.4) then forms a sequence of T standard probit models that are estimated to calculate the inverse Mills ratios (IMR), $\hat{\lambda}_{it}$. The final estimating equation is obtained by substituting $\hat{\lambda}_{it}$ for λ_{it} in Equation (2.6).

As summarized in Semykina and Wooldridge (2010), a consistent way of estimating Equation (2.6) is to use, for the selected sample ($S_{it} = 1$), pooled 2SLS using z_{it1}, $\overline{z}_i$,

[24] This corresponds to part (iv) of Assumption 4.1.1 in Semykina and Wooldridge (2010).

and $\hat{\lambda}_{it}$ as instruments. $\hat{\lambda}_{it}$ can be interacted with time dummies to allow γ to be different across time periods. Standard errors robust to serial correlation and heteroskedasticity are calculated as suggested in Semykina and Wooldridge (2010), and are adjusted for the additional variation introduced by the estimation of T probit models in the first step.[25]

2.4. Estimation results

As explained in Section 2.1, one of the aims of this study is to gain insights into whether the current crisis has altered the relationship between health and wages. We, therefore, use data from before (2005–2007) and during (2008–2010) the GR and discuss the estimation results in Sections 2.4.1 and 2.4.2, respectively. Moreover, because the effect of health on labor market outcomes is expected to increase with age (Currie and Madrian, 1999), we also explore if the impact of health differs across age groups (in addition to gender). Furthermore, in order to investigate the potential role of unobserved heterogeneity, selection and measurement error when estimating the impact of health on wages, we compare Semykina and Wooldridge's (2010) estimator (SemWool10) to the one of Wooldridge (1995) (Wool95) and computationally undemanding pooled OLS, pooled two-stage least squares (2SLS), fixed effects (FE), and fixed effects two-stage least squares (FE-2SLS) estimators.[26] This also enables us to compare our results with those obtained in some of the studies discussed in Section 2.1. For the sake of completeness, it is worth noting that we include dummies for every age year (OLS and 2SLS models) and survey year (all models), and thereby control for (birth) cohort effects. In addition, in the OLS and 2SLS models we add dummies for medium and high educational attainment, and for country.

The first step in the estimation procedures of Semykina and Wooldridge (2010) and Wooldridge (1995) is to estimate the participation equation as a sequence of T standard cross-sectional probit models to calculate the selectivity correction terms, i.e., the inverse Mills ratios (IMR). These results are reported in appendix tables A2.5 to A2.8

[25] We, therefore, use the Stata do-files that are available in Semykina's webpage (http://mailer.fsu.edu/~asemykina/). Instead of using the analytical formulae for the asymptotic variance one can also apply "panel bootstrap". The bootstrap estimator will be consistent for $N \to \infty$ and T fixed (Semykina and Wooldridge, 2010).

[26] See Semykina and Wooldridge (2008) and Jäckle and Himmler (2010) for a similar analysis using U.S. and German data, respectively.

for men and women. In the wage equations, we tested for (contemporaneous) selection bias as proposed in Semykina and Wooldridge's (2010) Procedure 3.1 which requires estimating for the selected sample ($S_{it} = 1$) by FE-2SLS the equation $w_{it} = \beta_0 + x_{it}\beta_1 + c_{i1} + \gamma_t \hat{\lambda}_{it} + e_{it1}$, using z_{it1} and $\hat{\lambda}_{it}$ as instruments. The resulting p-values from Wald tests to test $H_0 : \gamma_1 = ... = \gamma_T = 0$ are reported in Table 2.2 for both men and women, and by age groups. These indicate the presence of selection bias in the (main) wage equations for men although not for women when using the FE-2SLS estimator, which justifies (in part) the use of the SemWool10 estimator (see Columns 2).[27]

Table 2.2: Tests for selection bias by gender and age groups. P-values from Wald tests on the joint significance of 3 (period 2005–2007) and 4 (period 2008–2011) IMR are provided.[a]

	2005–2007		2008–2011	
	FE[b]	FE-2SLS[c]	FE[b]	FE-2SLS[c]
Men	(1)	(2)	(1)	(2)
20–64	0.00	0.01	0.00	0.01
20–34	0.10	0.18	0.61	0.66
35–49	0.02	0.04	0.03	0.01
50–64	0.09	0.09	0.21	0.16
Women	(1)	(2)	(1)	(2)
20–59	0.75	0.71	0.61	0.75
20–34	0.11	0.19	0.95	0.85
35–49	0.43	0.59	0.76	0.79
50–59	0.31	0.19	0.80	0.48

[a] FE and FE-2SLS estimation. Robust p-values are reported.
[b] Under the null hypothesis the FE estimators are valid.
[c] Under the null hypothesis the FE-2SLS estimators are valid.

Finally, in the 2SLS and FE-2SLS models, we provide two additional tests on the health limitations variables (chronic conditions and GALI) which are shown in the bottom parts of Tables 2.3 to 2.8. The first is an F-test that the coefficients on the health limitations in the first stage (population) health reduced-form regressions are all zero. The test statistics are always high and well over the rule-of-thumb of ten (Bound *et al.*, 1995). The second is an overidentification test where the null hypothesis is that the health limitations variables are orthogonal to the error term in the wage equation. As shown by the p-values, in the FE-2SLS models we do not reject the null hypothesis at any sensible level for men and do so only for older female workers and in the 2005–2007 period, where we reject it at a five percent significance level. This, however, is to

[27] We also tested for selection bias in the FE model using Wooldridge's (1995) Procedure 3.2. As expected, the results from this test also indicate the presence of selection bias in the (main) wage equations for men but not for women (see Columns 1 in Table 2.2). However, it is worth mentioning that another condition required for consistency of, e.g., the FE-2SLS estimator (apart from no contemporaneous selection bias) is that selection in one time period is not correlated with the idiosyncratic errors in other time periods (Semykina and Wooldridge 2008, pp. 20).

be expected as overidentification tests that ignore selection (and/or unobserved heterogeneity) will tend to reject the validity of instruments too often (Semykina, 2012).

2.4.1. Before the Great Recession (2005–2007)
Wage equations

The top and bottom panels in Table 2.3 contain the estimation results of the wage equation for the period prior to the GR for men and women, respectively. As shown in the top part, men in better health earn higher (hourly) wages, although the magnitude differs across models. For instance, in Column 1 the parameter of the health variable using the pooled OLS estimator (0.07) is higher than the coefficient in the FE model (0.012), which suggests a positive correlation between the individual FE and health, with those individuals that are more productive (and, hence, earn higher wages) having unobserved characteristics which lead to better health. Controlling furthermore for selection in the Wooldridge (1995) estimator leaves the coefficient (0.015) and significance level virtually unchanged. Turning to the 2SLS models, a comparison of the parameters shows that the coefficients of the health variable in columns 1, 2 and 3 are smaller than their 2SLS counterparts in columns 4, 5 and 6, respectively, which is to be expected if SRH is error-ridden (see also Cai, 2009; Jäckle and Himmler, 2010).[28] Using the 2SLS estimator yields the highest parameter estimate of 0.106, whereas accounting for unobserved heterogeneity (on top of measurement error) in the FE-2SLS estimator again scales the health coefficient down to 0.055. Controlling furthermore for nonrandom selection into the workforce increases the parameter to 0.085.

The same six econometric models using the female sample are presented in the bottom panel of Table 2.3. The results, however, are much less intuitive than in the male sample. Throughout the specifications, only the pooled OLS and 2SLS estimators yield a significant and rather similar effect of health on wages, which is substantially smaller when using the Wooldridge (1995) estimator, and insignificant in the other specifications.

[28] As explained in Chapter 1 of this dissertation, such an attenuation bias in the impact of health on wages can most likely be attributed to a standard errors-in-variables downward bias in the effect of SRH on wages because of a dominating (pure and reporting) measurement error in SRH (see Bound, 1991, p. 111; Bound *et al.*, 1999).

Table 2.3: Wage equations, 2005–2007[a]

Men (20–64)	OLS (1)	FE (2)	Wool95 (3)	2SLS (4)	FE-2SLS (5)	SemWool10 (6)
Health (+1)	0.070***	0.012***	0.015***	0.106***	0.055***	0.085***
	(0.005)	(0.004)	(0.005)	(0.013)	(0.017)	(0.020)
Experience	0.014***	0.005***	0.010***	0.014***	0.005***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Experience^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.215***			0.211***		
	(0.012)			(0.012)		
ISCED 5-6	0.614***			0.605***		
	(0.014)			(0.014)		
Observations	27462	27462	27462	27462	27462	27462
F-test[b]				1920.97 (2)	435.64 (2)	
Overid. test[c]				11.46 (0.00)	0.21 (0.65)	
Unobserved effects[d]			194.10 (0.00)			119.80 (0.00)
Women (20–59)	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.072***	0.009	0.013**	0.059***	-0.006	0.001
	(0.006)	(0.005)	(0.007)	(0.012)	(0.020)	(0.023)
Experience	0.012***	0.003	0.009***	0.012***	0.003	0.009***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Experience^2	-0.000**	-0.000	-0.000***	-0.000**	-0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.230***			0.231***		
	(0.013)			(0.013)		
ISCED 5-6	0.659***			0.663***		
	(0.014)			(0.014)		
Observations	22954	22954	22954	22954	22954	22954
F-test[b]				1673.08 (2)	387.73 (2)	
Overid. test[c]				8.43 (0.00)	0.82 (0.36)	
Unobserved effects[d]			194.06 (0.00)			119.88 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** p < 0.01 ** p < 0.05 * p < 0.10.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that the health limitations (Chronic and GALI) have no joint impact on SRH.

[c] Overidentification test statistic with corresponding p-value in parentheses. The null hypothesis is that the health limitations variables (Chronic and GALI) are orthogonal to the error term in the wage equation.

[d] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 and 9 variables (vector $\overline{z}_i$) are reported.

Heterogeneous effects across age groups

The impact of health on labor market outcomes is likely to increase with age (Currie and Madrian, 1999). To explore this possibility we re-estimate the six previous econometric models for young (20–34), middle-aged (35–49), and older male (50–64) and female (50–59) workers. Because our main interest is concerning the impact of health on wages, we again discuss only the results from the wage equations, which are shown in Table 2.4 for men and in Table 2.5 for women.

As shown in Columns 1 and 3 in Table 2.4 for men, the parameter estimates obtained when using the pooled OLS and 2SLS estimators increase (slightly) with age, but remain significant when accounting for individual unobserved heterogeneity and sample selection for older workers only. For the latter, the health coefficient ranges from 0.021 (FE model) to 0.164 (SemWool10). Table 2.5 contains the estimation results for women. Only the pooled OLS estimator yields a significant effect of health on wages for all age groups, which, again, slightly increases with age. Moreover, this effect is only robust to individual unobserved heterogeneity and sample selection for middle-aged women. However, the FE-2SLS and SemWool10 estimators yield an insignificant effect of health on wages for all female age groups.

In sum, in accordance with Jäckle and Himmler (2010) we find that once considered the potential problems of unobserved heterogeneity, sample selection and measurement error in SRH, health has a significant impact on wages for men but not for women in Europe. In addition to their study, our results show that the positive impact of health on wages for men is driven by older workers, which is in line with the expectation of health having an increasing impact on labor market outcomes with age (Currie and Madrian, 1999).

Table 2.4: Wage equations by age groups, 2005–2007 (Men)[a]

Age 20–34	OLS (1)	FE (2)	Wool95 (3)	2SLS (4)	FE-2SLS (5)	SemWool10 (6)
Health (+1)	0.051***	0.004	0.006	0.097***	0.036	0.070
	(0.010)	(0.009)	(0.010)	(0.033)	(0.041)	(0.049)
Experience	0.034***	0.014**	0.021***	0.034***	0.014**	0.020***
	(0.006)	(0.007)	(0.008)	(0.006)	(0.007)	(0.008)
Experience^2	-0.002***	-0.001***	-0.001***	-0.002***	-0.001***	-0.001**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
ISCED 3-4	0.200***			0.195***		
	(0.023)			(0.022)		
ISCED 5-6	0.499***			0.492***		
	(0.030)			(0.029)		
Observations	7545	7545	7545	7545	7545	7545
F-test[b]				296.18 (2)	82.36 (2)	
Overid. test[c]				3.52 (0.06)	0.07 (0.80)	
Unobs. effects[d]			61.01 (0.00)			49.12 (0.00)
Age 35–49	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.067***	0.013*	0.010	0.108***	0.045*	0.037
	(0.009)	(0.007)	(0.007)	(0.020)	(0.026)	(0.027)
Experience	0.007*	0.000	0.004	0.006*	-0.000	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Experience^2	-0.000	0.000	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.246***			0.242***		
	(0.019)			(0.019)		
ISCED 5-6	0.664***			0.655***		
	(0.024)			(0.024)		
Observations	10821	10821	10821	10821	10821	10821
F-test[b]				802.99 (2)	206.22 (2)	
Overid. test[c]				3.91 (0.05)	0.06 (0.80)	
Unobs. effects[d]			68.6 (0.00)			41.24 (0.00)
Age 50–64	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.079***	0.021***	0.036***	0.110***	0.101***	0.164***
	(0.011)	(0.008)	(0.009)	(0.021)	(0.033)	(0.039)
Experience	0.006*	0.004	0.007	0.006*	0.003	0.006
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.005)
Experience^2	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.200***			0.197***		
	(0.026)			(0.026)		
ISCED 5-6	0.657***			0.647***		
	(0.031)			(0.032)		
Observations	5896	5896	5896	5896	5896	5896
F-test[b]				606.68 (2)	105.09 (2)	
Overid. test[c]				2.97 (0.08)	0.32 (0.57)	
Unobs. effects[d]			45.27(0.00)			17.84 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that the health limitations (Chronic and GALI) have no joint impact on SRH.

[c] Overidentification test statistic with corresponding p-value in parentheses. The null hypothesis is that the health limitations variables (Chronic and GALI) are orthogonal to the error term in the wage equation.

[d] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 and 9 variables (vector $\overline{z}_i$) are reported.

Table 2.5: Wage equations by age groups, 2005–2007 (Women)[a]

	OLS	FE	Wool95	2SLS	FE-2SLS	SemWool10
Age 20–34	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.054***	-0.004	-0.011	-0.005	-0.018	-0.079*
	(0.012)	(0.013)	(0.014)	(0.030)	(0.040)	(0.046)
Experience	0.020***	0.007	0.020**	0.020***	0.007	0.020**
	(0.007)	(0.008)	(0.009)	(0.007)	(0.008)	(0.009)
Experience^2	-0.001*	-0.001	-0.001**	-0.001*	-0.001	-0.001**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
ISCED 3-4	0.182***			0.188***		
	(0.027)			(0.027)		
ISCED 5-6	0.571***			0.585***		
	(0.030)			(0.031)		
Observations	5809	5809	5809	5809	5809	5809
F-test[b]				249.11(2)	75.33 (2)	
Overid. test[c].				1.16 (0.28)	0.02 (0.88)	
Unobs effects[d]			40.15 (0.00)			27.98 (0.00)
Age 35–49	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.065***	0.016**	0.024***	0.055***	-0.000	0.015
	(0.008)	(0.007)	(0.009)	(0.017)	(0.028)	(0.032)
Experience	0.012***	0.005	0.009**	0.012***	0.005	0.010**
	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)
Experience^2	-0.000	-0.000*	-0.000*	-0.000	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.228***			0.230***		
	(0.020)			(0.020)		
ISCED 5-6	0.686***			0.689***		
	(0.022)			(0.022)		
Observations	10166	10166	10166	10166	10166	10166
F-test df[b]				743.71 (2)	196.31 (2)	
Overid. test[c]				0.75 (0.39)	0.22 (0.64)	
Unobs effects[d]			93.98 (0.00)			51.13 (0.00)
Age 50–59	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.097***	0.021**	0.018	0.120***	0.014	0.039
	(0.014)	(0.011)	(0.012)	(0.024)	(0.035)	(0.037)
Experience	0.011***	0.008**	0.003	0.011***	0.008**	0.003
	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)	(0.004)
Experience^2	-0.000	-0.000**	-0.000	-0.000	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.248***			0.246***		
	(0.026)			(0.026)		
ISCED 5-6	0.713***			0.707***		
	(0.032)			(0.032)		
Observations	4078	4078	4078	4078	4078	4078
F-test df[b]				485.56 (2)	79.65 (2)	
Overid. test[c]				8.64 (0.00)	6.60 (0.01)	
Unobs effects[d]			45.91 (0.00)			19.54 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that the health limitations (Chronic and GALI) have no joint impact on SRH.

[c] Overidentification test statistic with corresponding p-value in parentheses. The null hypothesis is that the health limitations variables (Chronic and GALI) are orthogonal to the error term in the wage equation.

[d] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 and 9 variables are reported.

2.4.2. During the Great Recession (2008–2011)
Wage equations

The top and bottom panels in Table 2.6 contain the estimation results of the wage equation during the GR period for men and women, respectively. As shown in the top panel for men, and similar to the period prior to the GR, the parameter of the health variable using the pooled OLS and 2SLS estimators (0.081 and 0.092, respectively) are larger than the coefficients in the FE and FE-2SLS estimators (0.008 and 0.033, respectively); all these estimated effects are significantly different from zero at the five percent level. However, contrary to the period prior to the GR, accounting for sample selection in the SemWool10 and Wool95 estimators reduces the health effects further, which become insignificant at any sensible level.

The estimation results using the female sample are presented in the bottom panel of the table and are very similar to the ones using the sample period prior to the GR. Only the pooled OLS and 2SLS estimators yield a significant and rather similar effect of health on wages (0.068 and 0.061, respectively), which becomes insignificant once individual unobserved heterogeneity is accounted for (FE and FE-2SLS), and remains insignificant when further controlling for sample selection (Wool95 and SemWool10).

Heterogeneous effects across age groups

As done previously, we re-estimate the six econometric models for young (20–34), middle-aged (35–49), and older male (50–64) and female (50–59) workers and discuss the results obtained from the wage equations, which are given in Tables 2.7 and 2.8 for men and women, respectively.

Table 2.6: Wage equations, 2008–2011[a]

Men (20–64)	OLS (1)	FE (2)	Wool95 (3)	2SLS (4)	FE-2SLS (5)	SemWool10 (6)
Health (+1)	0.081***	0.008**	-0.001	0.092***	0.033**	0.002
	(0.006)	(0.004)	(0.005)	(0.013)	(0.015)	(0.021)
Experience	0.015***	0.104***	0.029	0.015***	0.103***	-0.039
	(0.003)	(0.025)	(0.050)	(0.003)	(0.026)	(0.051)
Experience^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.234***			0.232***		
	(0.013)			(0.013)		
ISCED 5-6	0.618***			0.615***		
	(0.015)			(0.015)		
Observations	26040	26040	26040	26040	26040	26040
F-test[b]				1561.36 (2)	377.05 (2)	
Overid. test[c]				15.3 (0.00)	1.71 (0.19)	
Unobserved effects[d]			283.33 (0.00)			209.2 (0.00)
Women (20–59)	(1)	(2)	(3)	(4)	(5)	(6)
Health (+1)	0.068***	0.007	0.006	0.061***	0.018	-0.002
	(0.006)	(0.005)	(0.005)	(0.013)	(0.017)	(0.020)
Experience	0.014***	0.043***	0.206***	0.014***	0.043***	0.194***
	(0.003)	(0.012)	(0.023)	(0.003)	(0.012)	(0.024)
Experience^2	-0.000***	-0.000***	-0.000	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.230***			0.231***		
	(0.014)			(0.014)		
ISCED 5-6	0.670***			0.672***		
	(0.015)			(0.015)		
Observations	23859	23859	23859	23859	23859	23859
F-test[b]				1488.42 (2)	447.7 (2)	
Overid. test[c]				6.92 (0.01)	2.98 (0.08)	
Unobserved effects[d]			140.34 (0.00)			76.35 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that the health limitations (Chronic and GALI) have no joint impact on SRH.

[c] Overidentification test statistic with corresponding p-value in parentheses. The null hypothesis is that the health limitations variables (Chronic and GALI) are orthogonal to the error term in the wage equation.

[d] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 and 9 variables (vector $\bar{z}_i$) are reported

As Columns 1 and 3 in Table 2.7 show, for men only the pooled OLS and to some extent the 2SLS estimators yield a significant effect of health on wages across age groups. Once individual unobserved heterogeneity is accounted for (FE or FE-2SLS estimators) the parameter estimate of the health variables becomes insignificant (at the five percent level). Notably, the positive effect of health on wages for older workers found in the period prior to the GR disappears when controlling for individual unobserved heterogeneity and sample selection (Wool95 and SemWool10 estimators)[29] and, in general, we no longer find evidence of an increasing effect of health on wages with age. The estimation results by age groups for women are shown in Table 2.8. The pooled OLS and 2SLS estimators in Columns 1 and 3 show a positive association between health and wages. In the youngest age group, the health effect becomes insignificant once individual unobserved heterogeneity is accounted for (FE and FE-2SLS estimators). On the contrary, in middle-aged women, Columns 1 to 5 yield a significant positive impact of health on wages, which becomes insignificant when using only the SemWool10 estimator. Nevertheless, since we do not reject the null hypothesis of no (contemporaneous) selection bias (see Table 2.2), our preferred estimation results for these women are those from the FE-2SLS estimator. In older female workers the significant positive effect of health on wages in Columns 1 and 3 (OLS and 2SLS estimators) reverses its sign from positive to negative when controlling for individual fixed effects and sample selection, and moreover increases in significance in the 2SLS models (FE-2SLS and SemWool10 estimators). Here we cannot reject the null hypothesis of no (contemporaneous) selection bias either and, therefore, we take the FE-2SLS estimator as our preferred specification. This negative effect of health on hourly wages, we find, is due to a dominating effect on hours of work.[30]

To summarize, during the GR the effect of health on wages in the working-age population becomes insignificant for men and remains insignificant for women. However, across age groups we find some evidence of a positive effect of health on wages (FE-2SLS estimator) for middle-aged female workers, which is only marginally significant for older male workers. We also find a significant negative effect of health on wages for older female workers that is due to a dominating effect of health on hours of work.

[29] However, health yields a marginally significant, positive impact on wages in the FE-2SLS estimator, which is the one we should consider, as we find no evidence of (contemporaneous) selection bias for older male workers (see Table 2.2).

[30] More specifically, the effect of health on wage earnings is positive and statistically significant in the OLS and 2SLS models only. Instead, the effect of health on hours of work is always positive and statistically significant (results not shown).

Table 2.7: Wage equations by age groups, 2008–2011 (Men)[a]

20–34	OLS (1)	FE (2)	Wool95 (3)	2SLS (4)	FE-2SLS (5)	SemWool10 (6)
Health	0.066***	0.006	0.003	0.048	0.000	-0.005
	(0.012)	(0.009)	(0.010)	(0.030)	(0.037)	(0.048)
Experience	0.051***	0.093	0.190*	0.051***	0.093	0.175*
	(0.009)	(0.069)	(0.108)	(0.009)	(0.069)	(0.101)
Experience^2	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.159***			0.161***		
	(0.023)			(0.024)		
ISCED 5-6	0.452***			0.456***		
	(0.032)			(0.033)		
Observations	5580	5580	5580	5580	5580	5580
F-test[b]				152.39 (2)	69.94 (2)	
Overid. test[c]				1.76 (0.18)	0.54 (0.46)	
Unobs. effects[d]			75.5(0.00)			63.14 (0.00)
35–49	(1)	(2)	(3)	(4)	(5)	(6)
Health	0.092***	0.007	-0.002	0.100***	0.042	-0.019
	(0.009)	(0.006)	(0.007)	(0.021)	(0.027)	(0.035)
Experience	0.014**	0.112***	0.081	0.014**	0.112***	-0.041
	(0.007)	(0.040)	(0.084)	(0.007)	(0.040)	(0.083)
Experience^2	-0.000*	0.000	-0.000	-0.000*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.275***			0.274***		
	(0.021)			(0.022)		
ISCED 5-6	0.659***			0.657***		
	(0.025)			(0.026)		
Observations	9881	9881	9881	9881	9881	9881
F-test[b]				573.76 (2)	114.44 (2)	
Overid. test[c]				6.56 (0.01)	0.59 (0.44)	
Unobs. effects[d]			118.5 (0.00)			77.32 (0.00)
50–64	(1)	(2)	(3)	(4)	(5)	(6)
Health	0.084***	0.005	-0.004	0.102***	0.051*	0.036
	(0.013)	(0.008)	(0.011)	(0.026)	(0.029)	(0.037)
Experience	0.005	0.111**	0.003	0.005	0.109**	-0.103
	(0.010)	(0.047)	(0.103)	(0.009)	(0.047)	(0.102)
Experience^2	-0.000	0.000	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.205***			0.201***		
	(0.029)			(0.029)		
ISCED 5-6	0.632***			0.626***		
	(0.034)			(0.035)		
Observations	5696	5696	5696	5696	5696	5696
F-test[b]				523.23 (2)	131.97 (2)	
Overid. test[c]				6.28 (0.01)	0.00 (0.97)	
Unobs. effects[d]			58.85 ((0.00)			40.86 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that the health limitations (Chronic and GALI) have no joint impact on SRH.

[c] Overidentification test statistic with corresponding p-value in parentheses. The null hypothesis is that the health limitations variables (Chronic and GALI) are orthogonal to the error term in the wage equation.

[d] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 and 9 variables (vector $\overline{z}_i$) are reported.

Table 2.8: Wage equations by age groups, 2008–2011 (Women)[a]

20–34	OLS (1)	FE (2)	Wool95 (3)	2SLS (4)	FE-2SLS (5)	SemWool10 (6)
Health	0.054***	0.012	-0.001	0.090**	0.055	0.030
	(0.013)	(0.013)	(0.015)	(0.042)	(0.059)	(0.062)
Experience	0.046***	0.091***	0.327***	0.046***	0.091***	0.283***
	(0.009)	(0.034)	(0.070)	(0.009)	(0.034)	(0.069)
Experience^2	-0.003***	-0.002**	-0.002*	-0.003***	-0.002**	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ISCED 3-4	0.195***			0.192***		
	(0.034)			(0.033)		
ISCED 5-6	0.570***			0.563***		
	(0.035)			(0.035)		
Obser	4840	4840	4840	4840	4840	4840
F-test[b]				137.05 (2)	63.66 (2)	
Overid. test[c]				0.49 (0.49)	0.44 (0.51)	
Unobs. effects[d]			28.32 (0.00)			20.37 (0.00)
35–49	(1)	(2)	(3)	(4)	(5)	(6)
Health	0.077***	0.017***	0.023***	0.064***	0.049**	0.025
	(0.009)	(0.006)	(0.007)	(0.020)	(0.022)	(0.026)
Experience	0.017***	0.027	0.183***	0.017***	0.028	0.174***
	(0.005)	(0.017)	(0.033)	(0.005)	(0.017)	(0.034)
Experience^2	-0.000	0.000	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.238***			0.241***		
	(0.022)			(0.023)		
ISCED 5-6	0.680***			0.685***		
	(0.024)			(0.025)		
Obser	9996	9996	9996	9996	9996	9996
F-test[b]				632.84 (2)	209.17 (2)	
Overid. test[c]				8.18 (0.00)	2.7 (0.10)	
Unobs. effects[d]			70.78 (0.00)			41.14 (0.00)
50–64	(1)	(2)	(3)	(4)	(5)	(6)
Health	0.064***	-0.021*	-0.020*	0.045*	-0.069**	-0.101**
	(0.015)	(0.011)	(0.012)	(0.025)	(0.034)	(0.042)
Experience	0.023**	0.011	0.082**	0.022**	0.011	0.052
	(0.010)	(0.028)	(0.040)	(0.010)	(0.028)	(0.044)
Experience^2	-0.000*	0.000	0.000	-0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.214***			0.217***		
	(0.029)			(0.029)		
ISCED 5-6	0.679***			0.685***		
	(0.033)			(0.033)		
Obser	4484	4484	4484	4484	4484	4484
F-test[b]				456.45 (2)	81.66 (2)	
Overid. test[c]				2.42 (0.12)	1.54 (0.21)	
Unobs. effects[d]			32.37 (0.00)			16.01 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that the health limitations (Chronic and GALI) have no joint impact on SRH.

[c] Overidentification test statistic with corresponding p-value in parentheses. The null hypothesis is that the health limitations variables (Chronic and GALI) are orthogonal to the error term in the wage equation.

[d] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 and 9 variables (vector $\overline{z}_i$) are reported.

2.5. Sensitivity analyses

We performed several sensitivity analyses to test the robustness of our results. For instance, one possible concern in our findings is that the significant effect of health on the wages of (older) male workers disappears during the crisis because (unhealthy) workers (early-) retire from the labor market and, hence, are dropped from our sample (see Section 2.2). Therefore, we re-estimated all models keeping the (early-) retirees in our sample, and it does not change our main results for men and women, neither before (2005–2007) nor during (2008–2011) the GR (these results are available upon request).

We also investigated our (implicit) model assumption of no reverse impacts of wages on health limitations (i.e., the assumption of strict exogeneity of the health limitation variables conditional on the individual fixed effect) by re-estimating the two-stage models with health limitations restricted to only chronic conditions. These limitations are those unlikely to be directly affected by current wages (and employment). Recent work by Westerlund *et al.* (2010) provides indirect support for these methodological choices. First, it shows that in France, retirement does not change the risk of major chronic diseases, which supports the inclusion of chronic diseases in the (first-stage) health equation. Secondly, it demonstrates that retirement is associated with a reduction in mental and physical fatigue and depression symptoms, which justifies the omission of GALI from the (first-stage) health equation. The estimation results using only chronic illnesses as an instrument for SRH are given for both men and women in Table 2.9, respectively. These results show that using only chronic conditions to correct for measurement error in SRH does not change our main empirical findings in either period, lending support to the assumption of no reverse impact of current wages on health limitations.[31]

[31]The estimation results by age groups (and in both periods before and during the GR) also remain much unchanged when using only chronic conditions as an instrument for SRH (these results are available upon on request).

Table 2.9: Wage equations. Sensitivity analysis using only Chronic conditions to instrument for SRH.[a]

	2005–2007			**2008–2011**		
	2SLS	FE-2SLS	SemWool10	2SLS	FE-2SLS	SemWool10
Men (20–64)	(4)	(5)	(6)	(4)	(5)	(6)
Health	0.086***	0.049**	0.061**	0.067***	0.020	-0.006
	(0.014)	(0.020)	(0.025)	(0.015)	(0.018)	(0.025)
Experience	0.014***	0.005***	0.011***	0.015***	0.104***	-0.053
	(0.002)	(0.002)	(0.002)	(0.003)	(0.025)	(0.052)
Experience^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.213***			0.237***		
	(0.012)			(0.013)		
ISCED 5-6	0.610***			0.623***		
	(0.014)			(0.016)		
Observations	27462	27462	27462	26040	26040	26040
F-test[b]	2653.65 (1)	530.60 (1)		2088.86 (1)	547.19 (1)	
Unobserved effects[c]			125.83 (0.00)			228.1 (0.00)
Women (20–59)	(4)	(5)	(6)	(4)	(5)	(6)
Health	0.042***	-0.018	0.003	0.045***	-0.001	-0.025
	(0.014)	(0.023)	(0.027)	(0.014)	(0.019)	(0.023)
Experience	0.012***	0.003	0.009***	0.015***	0.043***	0.200***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.012)	(0.024)
Experience^2	-0.000**	-0.000	-0.000***	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ISCED 3-4	0.233***			0.234***		
	(0.013)			(0.014)		
ISCED 5-6	0.667***			0.677***		
	(0.015)			(0.015)		
Observations	22954	22954	22954	23859	23859	23859
F-test[b]	2450.56 (1)	604.93 (1)		2130.59 (1)	636.57 (1)	
Unobserved effects[c]			121.85 (0.00)			85.16 (0.00)

[a] The dependent variable is the PPP-adjusted hourly gross wage rate (in logs). All estimates include country- and gender-specific employment and unemployment rates and dummy variables for survey year. Columns (1) and (4) also include dummy variables for age year and country. Columns (3) and (6) also include interactions of the IMR with the survey year dummy variables. Standard errors robust to serial correlation and heteroskedasticity are in parentheses. The standard errors in Columns (3) and (6) are also corrected for the probit first-stage estimation. Significance levels: *** p < 0.01 ** p < 0.05 * p < 0.10.

[b] F-test statistic with degrees of freedom in parentheses. The null hypothesis is that Chronic conditions has no impact on SRH.

[c] χ^2 test statistics with corresponding p-value in parentheses for the joint significance of 8 variables (vector $\overline{z}_i$) are reported.

2.6. Summary and discussion

Theoretical economic models predict, based on productivity arguments, that an individual's health affects his or her wage rate. However, econometric problems such as unobserved heterogeneity, sample selection and measurement error are likely to bias the estimate of health in a wage equation. In this paper, we add to this empirical literature by expanding on the findings of Jäckle and Himmler (2010) for Germany to Europe and across age groups, based on the idea of health having an increased effect on wages with age. Moreover, by using data from before and during the Great Recession (GR) we gain insights into whether, and how, the current crisis has altered the relationship between health and wages.

Our results provide empirical evidence of measurement error in the SRH variable when estimating its impact on wages and of selectivity bias in wages for men mainly. Our findings for Europe also show that the positive impact of health on wages for (older) male workers in the period prior to the GR largely disappears during the GR. Moreover, although overall for women we do not find evidence of an impact of health on wages both before and during the GR, for middle-aged (35–49) and older female workers (50–59) we find a (significant) positive and negative impact of health on (hourly) wages during the GR, respectively.

These latter results might be related to the "added-worker effect" shown in Table 2.1 and appendix Tables A2.2–A2.4. There is some evidence that suggests that such women (who manage to get a job in a tight labor market) have rather higher levels of education and, hence, also relatively higher wages (see Landivar, 2012, and Tables A2.3–A2.4). The negative effect of health on hourly wages that we find for older female workers is due to a dominating effect on working hours, and might be related to the fact that for these women the increase in employment probability during the GR (i.e. the "added-worker effect") is largest. Still, further research should also consider information on their partners in order to better understand personal circumstances that motivate such women to re-enter into the labor market.

With regard to our findings in the working-age population, although during the GR overall welfare generosity (e.g., access to health care) across countries in Europe has declined, which we would expect to result in an increase in the impact of health on wages, *presenteeism* (i.e. attending work even though being sick) has become more common among workers. For instance, a recent survey by CareerBuilder (2011) in the U.S finds that more than 70 percent of workers typically go to work when they are sick. There is also some evidence during the GR of a reduction in the variable component of wages, which is likely to be more responsive to productivity-related components such as health, for instance, through cuts in bonuses and other rewards (Vandekerckhove *et al.*, 2012). Both the increase in *presenteeism* and the reduction in the variable component of wages could explain why health has become less responsive to wages in the working-age (male) population during the GR.

Appendix to Chapter 2

Table A2.1: Variable definitions

Variable	Definition
Dependent variable	
Log hourly (gross) wage	Hourly gross wages are measured in PPP-adjusted 2005 €. They are defined for paid job workers and obtained from dividing the amount of gross wage-earnings by the number of hours (usually) worked. Both variables are available for the main job. We treat extreme values in hourly gross wages such as those below 1 and above 300 PPP-€ as missing. It does *not* include reimbursements made by an employer for work-related expenses (e.g. business travel), severance and termination pay to compensate employees for employment ending before the employee has reached the normal retirement age for that job and redundancy payments, allowances for purely work-related expenses such as those for travel and subsistence or for protective clothes, lump sum payments at the normal retirement date, and union strike pay.
Participation	Participation (i.e. selection) is equal to 1 if a respondent reports working a positive number of hours per week in his/her main job, 0 otherwise.
Respondent's Health	
Self-reported health (SRH)	Includes five SRH categories, from 1 to 5: very bad, bad, fair, good, and very good.
Chronic	Chronic refers to chronic diseases; it is equal to 1 if a respondent has one or more conditions, 0 if none. Conditions are defined as hypertension, high blood cholesterol, diabetes, asthma, arthritis, osteoporosis, stomach condition, cataracts, and other conditions.
GALI	GALI refers to the global activity limitation indicator. The question for this index is the following: "For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do. It is equal to 1 if the respondent is "not limited", 2 if "limited but not severely," and 3 if "severely limited."
Respondent's Socioeconomic Characteristics	
Experience	Includes the actual number of years worked by the respondent.
Education	Includes three levels of education defined from the ISCED Code 1997: no education, primary education, or lower secondary education (ISCED 0–2), upper secondary and postsecondary nontertiary education (ISCED 3–4), and tertiary education (ISCED 5–6).
Annual nonlabor income	Annual nonlabor income is measured in PPP-adjusted 2005 €. It is defined as total income received by all household members in the previous year minus individual income from employment in the previous year.
Log household size	Includes the logarithm of the number of household members.
Single	Single is equal to 1 if single, 0 otherwise (married or cohabiting).
Age	Includes dummy variables for each age year.
Time	Survey year dummies.

Table A2.2: Descriptive statistics. Men and women aged 20–34.

	Employed				Nonemployed			
	2005–2007		2008–2011		2005–2007		2008–2011	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Men (20–34)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	9.68	6.84	10.13	6.7				
Self-reported health (1-5)	4.3	0.68	4.33	0.64	4.04	0.89	4.08	0.82
1+ chronic diseases	0.11	0.31	0.1	0.3	0.14	0.35	0.19	0.39
Limited with GALI (1-3)	1.09	0.33	1.08	0.3	1.17	0.45	1.17	0.47
Experience	8.09	4.52	7.59	4.48	4.08	4.5	4.81	4.2
ISCED 0–2	0.17	0.37	0.21	0.41	0.35	0.48	0.38	0.49
ISCED 3-4	0.59	0.49	0.5	0.5	0.56	0.5	0.52	0.5
ISCED 5-6	0.24	0.43	0.28	0.45	0.09	0.28	0.09	0.29
Annual income from nonemployment	20,099	21,674	20,925	21,407	15,841	15,503	19,667	16,941
Household size	3.23	1.44	3.21	1.5	3.69	1.57	3.82	1.69
Single	0.47	0.5	0.46	0.5	0.7	0.46	0.73	0.44
Age	28.08	3.59	28.22	3.41	26.71	3.9	26.54	3.74
Unemployment rate (%)	6.05	3.1	7.72	4.77	7.96	4.08	11.06	5.74
Employment rate (%)	72.16	6.07	70.51	5.71	68.29	6.54	67.17	5.29
Prob. work (entire sample)	0.92	0.27	0.91	0.28				
Observations (N)	7,545		5,676		630		528	
Women (20–34)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	9.19	7.19	8.65	6.56				
Self-reported health (1-5)	4.27	0.68	4.26	0.66	4.09	0.76	4.15	0.71
1+ chronic diseases	0.11	0.32	0.11	0.31	0.13	0.34	0.11	0.31
Limited with GALI (1-3)	1.09	0.33	1.09	0.31	1.13	0.39	1.11	0.37
Experience	7.26	4.17	6.89	4.04	4.47	4.18	4.27	4.22
ISCED 0–2	0.11	0.31	0.14	0.35	0.28	0.45	0.28	0.45
ISCED 3-4	0.51	0.5	0.42	0.49	0.58	0.49	0.52	0.5
ISCED 5-6	0.38	0.49	0.43	0.5	0.14	0.35	0.2	0.4
Annual income from nonemployment	24,875	22,622	24,814	21,111	23,561	22,000	22,466	18,036
Household size	3.07	1.33	3.09	1.35	4.07	1.44	4.05	1.43
Single	0.39	0.49	0.37	0.48	0.2	0.4	0.24	0.43
Age	28.16	3.51	28.66	3.15	28.36	3.48	28.06	3.38
Unemployment rate (%)	7.97	3.67	8.57	4.77	9.05	3.98	9.56	4.76
Employment rate (%)	57.86	7.17	58.54	6.89	55.41	5.81	56.8	6.06
Prob. work (entire sample)	0.72	0.45	0.75	0.43				
Observations (N)	5,809		5,145		2,279		1,703	

Table A2.3: Descriptive statistics. Men and women aged 35–49.

	Employed				Nonemployed			
	2005–2007		2008–2011		2005–2007		2008–2011	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Men (35–49)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	13.54	10.73	14	10.91				
Self-reported health (1-5)	4.04	0.73	4.08	0.71	3.38	0.99	3.6	0.86
1+ chronic diseases	0.17	0.37	0.17	0.38	0.31	0.46	0.28	0.45
Limited with GALI (1-3)	1.13	0.39	1.13	0.39	1.4	0.67	1.31	0.59
Experience	21.68	6.34	20.01	7.39	16.14	7.62	16.15	8.5
ISCED 0–2	0.17	0.37	0.18	0.39	0.35	0.48	0.34	0.47
ISCED 3-4	0.56	0.5	0.51	0.5	0.59	0.49	0.54	0.5
ISCED 5-6	0.27	0.44	0.31	0.46	0.06	0.23	0.12	0.32
Annual income from nonemployment	17,167	19,267	18,873	17,857	13,430	15,892	13,579	15,679
Household size	3.58	1.35	3.55	1.39	3.29	1.75	3.47	1.81
Single	0.15	0.36	0.17	0.38	0.43	0.5	0.4	0.49
Age	41.99	3.81	41.92	3.58	42.45	3.86	42.26	3.68
Unemployment rate (%)	5.96	3.06	7.71	5.05	7.77	4.06	11.36	5.8
Employment rate (%)	72.75	6.16	71.27	6.06	69.11	6.69	67.27	5.34
Prob. work (entire sample)	0.94	0.24	0.94	0.24				
Observations (N)	10,821		10,002		738		662	
Women (35–49)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	10.67	9.01	10.67	9.14				
Self-reported health (1-5)	4	0.75	4	0.73	3.8	0.9	3.8	0.8
1+ chronic diseases	0.18	0.39	0.19	0.39	0.24	0.43	0.25	0.43
Limited with GALI (1-3)	1.14	0.4	1.15	0.41	1.24	0.54	1.23	0.5
Experience	19.66	6.82	17.81	7.62	10.18	7.71	10.22	7.95
ISCED 0–2	0.15	0.36	0.14	0.35	0.42	0.49	0.37	0.48
ISCED 3-4	0.53	0.5	0.49	0.5	0.46	0.5	0.48	0.5
ISCED 5-6	0.32	0.47	0.37	0.48	0.12	0.32	0.15	0.35
Annual income from nonemployment	26,389	29,261	28,794	32,964	34,385	35,156	27,723	33,653
Household size	3.48	1.24	3.56	1.28	4.14	1.44	4.15	1.55
Single	0.23	0.42	0.23	0.42	0.12	0.32	0.15	0.35
Age	42.07	3.8	42.16	3.62	41.8	3.78	41.97	3.61
Unemployment rate (%)	7.88	3.78	8.34	4.65	8.89	3.92	11.28	5.84
Employment rate (%)	58.74	7.61	59.88	7.25	55.87	5.95	56.31	5.91
Prob. work (entire sample)	0.77	0.42	0.82	0.38				
Observations (N)	10,166		10,434		2,980		2,246	

Table A2.4: Descriptive statistics. Men aged 50–64 and women aged 50–59.

	Employed				Nonemployed			
	2005–2007		2008–2011		2005–2007		2008–2011	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Men (50–64)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	14.42	12.94	15.55	16.01				
Self-reported health (1-5)	3.77	0.81	3.82	0.74	3.32	0.91	3.39	0.91
1+ chronic diseases	0.26	0.44	0.28	0.45	0.34	0.47	0.36	0.48
Limited with GALI (1-3)	1.19	0.46	1.19	0.45	1.38	0.63	1.36	0.59
Experience	34.6	7.17	32.58	9.83	30.14	9.09	30.17	9.88
ISCED 0–2	0.21	0.41	0.21	0.41	0.38	0.49	0.42	0.49
ISCED 3-4	0.52	0.5	0.46	0.5	0.52	0.5	0.5	0.5
ISCED 5-6	0.27	0.44	0.33	0.47	0.1	0.3	0.08	0.27
Annual income from nonemployment	19,326	21,265	20,722	25,417	17,398	18,151	15,064	14,878
Household size	2.82	1.23	2.77	1.25	2.74	1.27	2.73	1.48
Single	0.12	0.33	0.16	0.37	0.2	0.4	0.38	0.49
Age	55.14	3.21	55.41	3.15	55.88	3.22	56.13	3.39
Unemployment rate (%)	5.76	2.84	8.06	5.22	8.14	4.1	10.35	5.47
Employment rate (%)	73.3	5.91	71.38	6.4	68.63	6.63	68.17	5.86
Prob. work (entire sample)	0.89	0.31	0.90	0.30				
Observations (N)	5,896		5,773		698		635	
Women (50–59)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Hourly gross wage rate	10.73	10.08	11.33	9.66				
Self-reported health (1-5)	3.7	0.8	3.8	0.77	3.51	0.91	3.49	0.84
1+ chronic diseases	0.28	0.45	0.3	0.46	0.36	0.48	0.41	0.49
Limited with GALI (1-3)	1.22	0.48	1.22	0.48	1.38	0.64	1.34	0.58
Experience	29.68	8.76	26.47	11.26	13.46	11.81	14.42	11.67
ISCED 0–2	0.23	0.42	0.21	0.41	0.58	0.49	0.55	0.5
ISCED 3-4	0.51	0.5	0.48	0.5	0.33	0.47	0.38	0.49
ISCED 5-6	0.26	0.44	0.31	0.46	0.09	0.28	0.07	0.25
Annual income from nonemployment	24,746	30,137	27,835	33,567	39,303	38,924	31,988	61,555
Household size	2.51	1.13	2.5	1.13	2.85	1.26	2.9	1.26
Single	0.3	0.46	0.29	0.46	0.14	0.35	0.18	0.38
Age	53.78	2.28	54.08	2.22	54.43	2.42	54.56	2.27
Unemployment rate (%)	7.5	3.31	8.02	4.46	8.32	3.64	10.99	5.9
Employment rate (%)	59.44	7.44	60.78	7.76	56.13	5.62	56.91	5.94
Prob. work (entire sample)	0.66	0.47	0.74	0.44				
Observations (N)	4,078		4,799		2,105		1,665	

Table A2.5: Participation equations, Men aged 20-64 (Wool95)

	2005	2006	2007	2008	2009	2010	2011
Experience	-0.109***	0.120***	0.141***	-2.498***	-4.310***	3.653***	2.055***
	(0.018)	(0.024)	(0.022)	(0.142)	(0.269)	(0.240)	(0.118)
Experience^2	0.001	-0.002***	0.000	-0.006*	-0.015**	-0.007	0.003
	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.005)	(0.003)
SRH	0.059	-0.070	0.143***	0.195**	-0.076	0.116*	0.097
	(0.044)	(0.052)	(0.047)	(0.076)	(0.074)	(0.062)	(0.068)
Single	0.096	-0.135	-0.470**	-0.626**	0.162	-0.098	-0.266
	(0.178)	(0.244)	(0.190)	(0.260)	(0.329)	(0.295)	(0.250)
Household size	-0.219***	0.244***	0.111*	-0.035	-0.015	0.041	0.120*
	(0.056)	(0.092)	(0.065)	(0.080)	(0.104)	(0.083)	(0.072)
ln nonlaborincome	0.006	-0.060**	-0.087***	-0.019	-0.067**	-0.104***	-0.036
	(0.019)	(0.026)	(0.022)	(0.030)	(0.029)	(0.027)	(0.023)
Employment rate	0.161***	-0.056	-0.046	0.054	0.942***	0.399***	-0.141*
	(0.039)	(0.121)	(0.047)	(0.069)	(0.118)	(0.131)	(0.073)
Unemployment rate	0.259***	-0.052	-0.184***	0.029	0.785***	0.322**	-0.352***
	(0.039)	(0.141)	(0.042)	(0.068)	(0.115)	(0.125)	(0.086)
mexperience	0.168***	-0.080***	-0.103***	2.462***	4.309***	-3.645***	-2.048***
	(0.020)	(0.025)	(0.023)	(0.149)	(0.273)	(0.237)	(0.115)
mexperience^2	-0.001***	0.002**	-0.001	0.006*	0.015**	0.007	-0.004
	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.005)	(0.003)
msrh	0.500***	0.665***	0.434***	-0.124	0.276***	0.188**	0.052
	(0.054)	(0.062)	(0.055)	(0.096)	(0.090)	(0.077)	(0.084)
msingle	-0.451**	-0.308	0.040	0.116	-0.550	-0.403	0.028
	(0.183)	(0.253)	(0.199)	(0.272)	(0.342)	(0.306)	(0.259)
mhousehold_size	0.266***	-0.146	-0.045	-0.016	-0.024	-0.070	-0.120
	(0.059)	(0.093)	(0.067)	(0.085)	(0.108)	(0.086)	(0.074)
mln_nonlaborincome	-0.077***	-0.053*	0.015	-0.011	0.053	0.065**	0.044
	(0.023)	(0.029)	(0.022)	(0.036)	(0.035)	(0.029)	(0.028)
memployment_rate	-0.110***	0.071	0.071	-0.015	-0.942***	-0.340***	0.161**
	(0.037)	(0.123)	(0.050)	(0.081)	(0.121)	(0.121)	(0.067)
munemployment_rate	-0.329***	-0.014	0.089**	-0.020	-0.808***	-0.337***	0.358***
	(0.050)	(0.142)	(0.039)	(0.068)	(0.117)	(0.122)	(0.094)
Constant	-4.349***	-1.071*	-2.103***	-3.739***	-0.470	-4.656***	-2.779***
	(0.608)	(0.591)	(0.581)	(1.201)	(0.641)	(0.947)	(0.872)
Observations	9914	9914	9914	7128	7128	7128	7128

[a] Probit coefficient estimates. Robust standard errors are in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

Table A2.6: Participation equations, Men aged 20-64 (SemWool10)

	2005	2006	2007	2008	2009	2010	2011
Experience	-0.099***	0.121***	0.126***	-2.505***	-4.394***	3.770***	2.090***
	(0.018)	(0.024)	(0.023)	(0.141)	(0.268)	(0.237)	(0.118)
Experience^2	0.000	-0.003***	0.000	-0.006*	-0.015**	-0.008	0.003
	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.005)	(0.003)
Chronic	0.117	0.009	-0.119	0.019	0.031	-0.003	-0.026
	(0.089)	(0.101)	(0.094)	(0.153)	(0.138)	(0.121)	(0.130)
GALI	0.039	0.057	0.129*	0.349***	0.154	0.028	0.072
	(0.069)	(0.072)	(0.066)	(0.120)	(0.116)	(0.096)	(0.107)
Single	0.114	-0.106	-0.482***	-0.612**	0.159	-0.088	-0.280
	(0.174)	(0.237)	(0.185)	(0.260)	(0.330)	(0.291)	(0.250)
Household size	-0.215***	0.209**	0.109*	-0.027	-0.029	0.047	0.115
	(0.056)	(0.090)	(0.064)	(0.080)	(0.104)	(0.083)	(0.072)
ln nonlaborincome	0.008	-0.055**	-0.079***	-0.018	-0.066**	-0.100***	-0.035
	(0.019)	(0.025)	(0.021)	(0.030)	(0.029)	(0.027)	(0.023)
Employment rate	0.185***	-0.058	-0.086*	0.053	0.933***	0.400***	-0.150**
	(0.038)	(0.121)	(0.046)	(0.070)	(0.118)	(0.131)	(0.073)
Unemployment rate	0.226***	0.094	-0.183***	0.030	0.767***	0.304**	-0.354***
	(0.038)	(0.143)	(0.042)	(0.068)	(0.114)	(0.125)	(0.085)
mexperience	0.146***	-0.093***	-0.098***	2.470***	4.392***	-3.763***	-2.084***
	(0.019)	(0.026)	(0.023)	(0.147)	(0.272)	(0.235)	(0.114)
mexperience^2	-0.001**	0.002***	-0.001	0.006*	0.015**	0.008	-0.003
	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.005)	(0.003)
mchronic	-0.042	0.027	0.178	0.086	0.014	-0.056	0.137
	(0.115)	(0.131)	(0.121)	(0.208)	(0.194)	(0.166)	(0.169)
mgali	0.645***	0.747***	0.580***	-0.279	0.093	0.389***	0.004
	(0.094)	(0.101)	(0.093)	(0.188)	(0.171)	(0.141)	(0.156)
msingle	-0.476***	-0.334	0.051	0.103	-0.532	-0.391	0.054
	(0.179)	(0.245)	(0.194)	(0.272)	(0.343)	(0.303)	(0.259)
mhousehold_size	0.261***	-0.112	-0.048	-0.020	-0.012	-0.075	-0.116
	(0.059)	(0.092)	(0.065)	(0.085)	(0.109)	(0.086)	(0.075)
mln_nonlaborincome	-0.072***	-0.047*	0.016	-0.012	0.055	0.065**	0.044
	(0.023)	(0.028)	(0.022)	(0.036)	(0.035)	(0.028)	(0.028)
memployment_rate	-0.117***	0.092	0.126***	-0.011	-0.926***	-0.332***	0.174***
	(0.036)	(0.123)	(0.048)	(0.082)	(0.121)	(0.120)	(0.067)
munemployment_rate	-0.279***	-0.159	0.097**	-0.021	-0.785***	-0.311**	0.362***
	(0.049)	(0.144)	(0.038)	(0.068)	(0.117)	(0.121)	(0.093)
Constant	-5.272***	-2.340***	-2.914***	-4.047***	-1.067	-5.268***	-2.930***
	(0.619)	(0.602)	(0.593)	(1.220)	(0.673)	(0.953)	(0.896)
Observations	9914	9914	9914	7128	7128	7128	7128

[a] Probit coefficient estimates. Robust standard errors are in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

Table A2.7: Participation equations, Women aged 20-59 (Wool95)

	2005	2006	2007	2008	2009	2010	2011
Experience	-0.151***	0.151***	0.210***	-3.175***	-5.134***	4.287***	2.003***
	(0.013)	(0.016)	(0.016)	(0.103)	(0.188)	(0.152)	(0.073)
Experience^2	0.002***	-0.003***	-0.003***	0.004	-0.013**	-0.009**	0.005**
	(0.000)	(0.000)	(0.000)	(0.003)	(0.006)	(0.005)	(0.002)
SRH	0.098***	0.004	-0.057	-0.005	-0.047	0.012	0.013
	(0.035)	(0.038)	(0.036)	(0.062)	(0.056)	(0.050)	(0.050)
Single	0.652***	0.286	-0.421***	0.216	-0.158	0.243	0.253
	(0.144)	(0.197)	(0.142)	(0.230)	(0.273)	(0.249)	(0.189)
Household size	-0.039	-0.129*	-0.117**	-0.165**	-0.085	-0.372***	-0.207***
	(0.049)	(0.068)	(0.049)	(0.071)	(0.079)	(0.071)	(0.057)
ln nonlaborincome	0.000	0.054**	-0.120***	-0.063*	-0.038	0.023	-0.064**
	(0.021)	(0.026)	(0.024)	(0.034)	(0.029)	(0.026)	(0.026)
Employment rate	0.110***	-0.065	-0.155***	-0.368***	1.370***	-0.087	0.362***
	(0.030)	(0.068)	(0.031)	(0.067)	(0.083)	(0.091)	(0.079)
Unemployment rate	0.079***	0.211**	-0.105***	0.145***	1.213***	-0.220***	-0.006
	(0.018)	(0.088)	(0.018)	(0.054)	(0.093)	(0.062)	(0.062)
mexperience	0.283***	-0.021	-0.074***	3.198***	5.173***	-4.219***	-1.959***
	(0.014)	(0.017)	(0.017)	(0.106)	(0.190)	(0.151)	(0.073)
mexperience^2	-0.004***	0.001	0.000	-0.004	0.012**	0.008*	-0.006**
	(0.000)	(0.001)	(0.000)	(0.003)	(0.006)	(0.005)	(0.002)
msrh	0.379***	0.478***	0.540***	0.039	0.243***	0.278***	0.158**
	(0.042)	(0.045)	(0.043)	(0.076)	(0.068)	(0.061)	(0.062)
msingle	-0.239	0.188	0.913***	-0.420*	0.248	-0.188	-0.240
	(0.150)	(0.204)	(0.148)	(0.241)	(0.286)	(0.258)	(0.197)
mhousehold_size	-0.034	0.093	0.067	0.112	-0.010	0.311***	0.106*
	(0.051)	(0.070)	(0.051)	(0.075)	(0.082)	(0.074)	(0.061)
mln_nonlaborincome	-0.097***	-0.209***	0.011	0.023	0.080**	-0.004	0.178***
	(0.026)	(0.031)	(0.024)	(0.042)	(0.033)	(0.031)	(0.029)
memployment_rate	-0.065**	0.110	0.210***	0.474***	-1.430***	0.068	-0.370***
	(0.030)	(0.068)	(0.032)	(0.073)	(0.085)	(0.085)	(0.075)
munemployment_rate	-0.051**	-0.188**	0.135***	0.020	-1.265***	0.164**	-0.054
	(0.025)	(0.088)	(0.015)	(0.043)	(0.093)	(0.065)	(0.074)
Constant	-4.384***	-3.792***	-4.882***	-8.891***	2.338***	-0.146	-1.370***
	(0.327)	(0.324)	(0.333)	(0.685)	(0.381)	(0.481)	(0.471)
Observations	10443	10443	10443	8004	8004	8004	8004

[a] Probit coefficient estimates. Robust standard errors are in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

Table A2.8: Participation equations, Women aged 20-59 (SemWool10)

	2005	2006	2007	2008	2009	2010	2011
Experience	-0.147***	0.149***	0.202***	-3.175***	-5.154***	4.334***	2.024***
	(0.013)	(0.016)	(0.016)	(0.103)	(0.188)	(0.151)	(0.073)
Experience^2	0.002***	-0.003***	-0.003***	0.004	-0.014**	-0.009**	0.005**
	(0.000)	(0.000)	(0.000)	(0.003)	(0.006)	(0.005)	(0.002)
Chronic	0.139**	-0.011	0.030	0.058	0.124	0.021	-0.018
	(0.068)	(0.075)	(0.072)	(0.116)	(0.103)	(0.090)	(0.096)
GALI	-0.012	0.067	-0.077	-0.051	0.016	0.096	0.135*
	(0.055)	(0.058)	(0.055)	(0.095)	(0.089)	(0.073)	(0.081)
Single	0.729***	0.222	-0.482***	0.223	-0.151	0.197	0.235
	(0.142)	(0.193)	(0.140)	(0.229)	(0.273)	(0.248)	(0.188)
Household size	-0.054	-0.128*	-0.095*	-0.164**	-0.090	-0.365***	-0.204***
	(0.048)	(0.067)	(0.049)	(0.071)	(0.079)	(0.071)	(0.058)
ln nonlaborincome	0.004	0.049**	-0.112***	-0.064*	-0.034	0.020	-0.063**
	(0.020)	(0.025)	(0.023)	(0.034)	(0.028)	(0.026)	(0.025)
Employment rate	0.088***	-0.097	-0.111***	-0.368***	1.345***	-0.086	0.377***
	(0.030)	(0.068)	(0.031)	(0.067)	(0.083)	(0.090)	(0.080)
Unemployment rate	0.052***	0.285***	-0.074***	0.150***	1.233***	-0.262***	-0.004
	(0.017)	(0.090)	(0.018)	(0.054)	(0.093)	(0.062)	(0.061)
mexperience	0.277***	-0.021	-0.068***	3.197***	5.193***	-4.267***	-1.981***
	(0.014)	(0.017)	(0.017)	(0.106)	(0.190)	(0.151)	(0.073)
mexperience^2	-0.004***	0.001	0.000	-0.004	0.013**	0.008*	-0.006***
	(0.000)	(0.001)	(0.000)	(0.003)	(0.006)	(0.005)	(0.002)
mchronic	0.207**	0.303***	0.257***	-0.130	0.107	0.301**	0.303**
	(0.088)	(0.096)	(0.095)	(0.161)	(0.142)	(0.125)	(0.132)
mgali	0.394***	0.449***	0.559***	0.227	0.042	0.040	-0.269**
	(0.075)	(0.079)	(0.079)	(0.141)	(0.129)	(0.109)	(0.120)
msingle	-0.283*	0.291	1.009***	-0.426*	0.252	-0.139	-0.227
	(0.147)	(0.200)	(0.145)	(0.241)	(0.285)	(0.258)	(0.197)
mhousehold_size	-0.028	0.078	0.036	0.109	-0.007	0.303***	0.101*
	(0.050)	(0.069)	(0.050)	(0.075)	(0.082)	(0.074)	(0.061)
mln_nonlaborincome	-0.076***	-0.167***	0.029	0.025	0.083**	0.002	0.180***
	(0.025)	(0.029)	(0.024)	(0.041)	(0.033)	(0.030)	(0.029)
memployment_rate	-0.037	0.148**	0.171***	0.475***	-1.402***	0.076	-0.381***
	(0.030)	(0.068)	(0.032)	(0.073)	(0.085)	(0.085)	(0.076)
munemployment_rate	-0.027	-0.271***	0.096***	0.016	-1.284***	0.216***	-0.053
	(0.025)	(0.089)	(0.015)	(0.043)	(0.093)	(0.064)	(0.073)
Constant	-4.613***	-4.440***	-5.204***	-9.185***	2.211***	-0.506	-1.132**
	(0.331)	(0.331)	(0.337)	(0.715)	(0.411)	(0.506)	(0.491)
Observations	10443	10443	10443	8004	8004	8004	8004

[a] Probit coefficient estimates. Robust standard errors are in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

Chapter 3:

The associations between early life circumstances and later life health and employment in Europe*

* This chapter is based on Flores and Kalwij (2014).

3.1. Introduction

A positive association between health and socioeconomic status (SES) in adulthood, often referred to as the SES-health gradient, is widely documented in the literature (e.g., Adler *et al.*, 1994; Marmot and Wilkinson, 1999; Pappas *et al.*, 1993; Smith, 1999). To identify the origins of this gradient, earlier studies for the U.S. (e.g. Case *et al.*, 2002) and Canada (e.g. Currie and Stabile, 2003) focus on childhood circumstances. Specifically, they pinpoint SES and health in early life—the latter mainly in terms of chronic conditions during childhood—as contributors to this positive association. This approach is supported by the extant literature that offers several theories for a relationship between early life events and (health) outcomes in later life. For instance, the *fetal-origins hypothesis* (e.g. Barker, 1995; Almond and Currie, 2011a) suggests a direct link from the prenatal period to adult health that may be independent of social class in adult life, *life course models* assume that illness and deprivation during childhood may have long-term consequences for health during adulthood, either directly through the illness itself or indirectly by restricting educational achievement and life opportunities (e.g. Kuh and Wadsworth, 1993) and *pathways models* suggest that the observed SES-health gradient in adulthood is only indirectly attributable to early life events through later life events (e.g. Marmot *et al.*, 2001). More recent studies for the U.K. (Case *et al.*, 2005) and the U.S. (Case and Paxson, 2008a) also present evidence in line with the theoretical predictions and show that having good health during childhood and growing up in a more comfortable environment result in a higher level of education, and good health and higher economic status later in life. Similarly, the literature on intergenerational mobility in class positions provides empirical evidence on the association between parental SES and those of their children (e.g. Erikson and Goldthorpe, 2002). Recent evidence for continental Europe also shows that childhood SES is positively associated with economic status and cognitive abilities in later life (Guven and Lee, 2011) and negatively correlated with cognitive decline (dal Bianco *et al.*, 2013). All these findings are important to policymakers because they may suggest that policies aimed at improving children's health and SES have long-lasting benefits for both the individual and society because of increased human capital accumulation, hence better employment opportunities, and better later life health (see also Marmot *et al.*, 2012).

Although caution is warranted for policy recommendations based on these estimated associations, support for such recommendations is provided by several recent studies that find causal impacts of very specific exogenous early life events on later life outcomes. For instance, using the 1918 influenza pandemic as measure of a health shock around birth is shown to relate to later life outcomes such as education, health and SES (e.g. Almond, 2006; Nelson, 2010; Almond and Mazumder, 2005). Chen and Zhou (2007) show that the 1959–1961 famine in China adversely affected height, earnings and labor supply, and Barreca (2010) shows that malaria exposure adversely affects educational attainment and increases poverty risk. Painter *et al.* (2005) and Roseboom *et al.* (2001, 2006) provide evidence on long-term effects on later life health of prenatal undernutrition during the Dutch famine of 1944/1945. In addition, van den Berg *et al.* (2006) show that economic conditions around birth—measured by the business cycle—affect mortality later in life.

Our contribution to the literature on the relationships between early life circumstances and later life health and employment is twofold. First, we expand the findings of the studies discussed above, and present empirical evidence for thirteen European countries on the extent to which an individual's early life circumstances are associated with educational attainment and, once this latter is controlled for, with their later life health (at ages 50–64). Second, and not done in earlier studies, we examine the associations between early life circumstances and later life employment (at ages 50–64) once we control for education and later life health, which can be potential mediators of the associations between early life circumstances and later life employment. If we find that an association with later life employment is still present once education and health are controlled for then this could be interpreted as empirical evidence in favor of a (direct) transmission of early life circumstances to employment opportunities.

For our empirical analysis we use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) and measure two dimensions of early life circumstances, namely childhood health and childhood socioeconomic status (SES). The countries in our sample cover Northern, Central, Southern and Eastern Europe and we analyze them separately because of the large differences in the levels of development over the period the individuals in our sample were born and raised (1940–1972). To illustrate the differences between, e.g., Northern and Southern Europe over this period, the Netherlands has about one third of the infant mortality rate and about twice the income per capita compared to Spain (United Nations, 2010; Maddison, 2010). These large differences in economic resources and access to medical treatments may affect the associations between early life circumstances and later life outcomes as a more favorable environment in this respect may dampen the consequences of adverse health shocks early in life (Bengtsson and Mineau, 2009).

The remainder of this paper is organized as follows. Section 3.2 describes the data and the main variables for analysis. Section 3.3 presents estimates of the associations of early life circumstances with educational attainment, and later life health and employment. Section 3.4 analyzes joint significance tests of these associations and looks at possible pathways through which early life circumstances may affect later life health and employment. Section 3.5 summarizes the main findings and concludes the paper.

3.2. Data and descriptive statistics

We use individual-level data from the first four waves of the Survey of Health, Ageing, and Retirement in Europe (SHARE), a multidisciplinary and representative cross-national panel of the European population aged 50 and over. The first, second and fourth waves belong to the regular panel of SHARE and were conducted in 2004/2005, 2006/2007, and 2010/2012,[33] respectively. These waves include information on socioeconomic background characteristics as well as current employment and health status. The third wave, carried out in 2008/2009 and referred to as SHARELIFE, contains retrospective information on the early life circumstances of about 75% of the individuals who participated in waves one or two. Additionally, about 78% of the individuals who participated in SHARELIFE did so also in wave four.

Our empirical analysis is based on data for respondents aged 50–64 from the first, second or fourth wave who also participated in SHARELIFE. This selection yields 27,204 observations for 14,767 respondents from the following thirteen countries: Sweden (SE), Denmark (DK), the Netherlands (NL), Switzerland (CH), Austria (AT), Germany (DE), France (FR), Belgium (BE), Spain (ES), Italy (IT), Greece (GR), Czech

[33] Almost 94 percent of the respondents in the 2010/12 wave were interviewed in 2011.

Republic (CZ), and Poland (PL). The sample is reduced by seven percent due to missing values on the variables included in the analysis. The result is an unbalanced panel comprising 25,296 total observations for 5,999 male and 7,614 female respondents. Table 3.1 reports the number of observations and individuals (i.e. respondents) by country and gender. Finally, in all tables we sort the countries in the following order: Northern (Sweden, Denmark), Central (Netherlands, Switzerland, Austria, Germany, France, Belgium), Southern (Spain, Italy, Greece) and Eastern Europe (Czech Republic, Poland).

Details on the definitions of all variables used in the empirical analysis are in Table A3.1 of the appendix. Following most previous literature, we use Self-Reported Health (SRH) status as a measure for health. Because of the low frequencies in the extreme categories for some countries we follow, e.g., Idler and Kasl (1991) and Thong *et al.* (2008) and combine the five SRH categories (from 1 to 5: poor, fair, good, very good, and excellent) into three (from 1 to 3: poor or fair, good, very good or excellent). Employment status is equal to one if the respondent is employed or self-employed, and zero otherwise.

Table 3.1: Number of individuals and observations (for all waves), and health and employment status by gender and country at ages 50-64. [a)]

			Health status (SRH)			Employment status
	Number of individuals	Number of observations	Poor or fair	Good	Very good or excellent	Work
Men			%	%	%	%
Sweden	418	822	13	31	56	85
Denmark	567	1,065	16	24	60	81
Netherlands	555	1,080	20	45	35	72
Switzerland	282	537	10	33	57	87
Austria	171	343	32	31	37	50
Germany	444	841	33	40	27	69
France	528	1,079	21	47	32	61
Belgium	657	1,464	18	44	38	57
Spain	358	644	27	46	27	66
Italy	529	994	24	44	32	54
Greece	703	1,055	13	31	56	77
Czech Rep.	391	555	33	41	26	66
Poland	396	616	48	41	11	48
Women						
Sweden	554	1,082	18	30	52	78
Denmark	655	1,224	18	20	62	76
Netherlands	701	1,393	23	46	31	50
Switzerland	385	728	13	37	50	73
Austria	226	451	26	37	37	29
Germany	556	1,099	29	46	25	62
France	663	1,313	24	48	28	57
Belgium	760	1,679	22	43	35	43
Spain	460	875	39	42	19	34
Italy	757	1,483	36	40	24	29
Greece	797	1,196	16	41	43	34
Czech Rep.	552	819	31	46	23	46
Poland	548	859	50	40	10	29

[a)] More details on the definitions of the variables are in the text and in the appendix. The percentage calculations are based on the number of observations.

As Table 3.1 shows, there is substantial variation in later life health (SRH) and employment rates across countries. For example, the proportion of men aged 50–64 who report being in very good or excellent health ranges from almost 60 percent in Northern Europe and in Switzerland to 11 percent in Poland. Also the employment rates of the same-aged men are highest and above 80 percent in Northern Europe and in Switzerland, and lowest and below 50 percent in Poland. Similar patterns are present for same-aged women, except that their employment rates are lower than those of their male peers at the country level. Concerning educational attainment across countries, Table 3.2 shows that men and women aged 50–64 from Northern and Central Europe are on average more educated than those from Southern and Eastern Europe.

Table 3.2: Educational attainment and household composition by gender and country. [a)]

	Educational attainment			Household composition				
	Low (ISCED 0-2)	Medium (ISCED 3-4)	High (ISCED 5-6)	Married	No children	One child	Two children	Three or more children
Men	%	%	%	%	%	%	%	%
Sweden	39	34	27	85	15	12	45	28
Denmark	11	50	39	85	15	15	46	24
Netherlands	36	31	33	90	18	9	47	26
Switzerland	21	63	16	85	16	11	44	29
Austria	15	53	32	88	17	22	33	28
Germany	4	58	38	87	16	26	40	18
France	31	40	29	86	10	14	39	37
Belgium	38	30	33	85	12	22	39	27
Spain	72	14	15	91	13	12	37	38
Italy	60	30	10	93	12	19	46	23
Greece	40	35	25	88	16	12	55	17
Czech Rep.	58	29	13	88	9	17	49	25
Poland	22	66	12	86	10	13	40	37
Women								
Sweden	35	32	33	82	9	16	46	29
Denmark	15	35	50	81	10	14	51	25
Netherlands	51	24	25	86	14	11	45	30
Switzerland	31	59	10	75	18	13	43	26
Austria	34	52	14	66	10	23	37	30
Germany	14	58	28	86	12	21	42	25
France	40	35	25	77	10	17	39	34
Belgium	40	32	28	81	10	23	40	27
Spain	77	13	10	89	11	10	37	42
Italy	67	26	7	89	11	17	46	26
Greece	50	34	16	77	14	15	53	18
Czech Rep.	49	44	7	77	4	17	55	24
Poland	34	59	7	82	7	11	39	43

[a)] More details on the definitions of the variables are in the text and in the appendix. The percentage calculations for the educational attainment and household composition variables are based on the number of individuals and observations, respectively (see Table 3.1).

Table 3.3 reports statistics on the early life circumstances by country which, to conform to the studies cited in the introduction, are classified into two categories: those related to childhood SES and those that measure childhood health. As in earlier research (e.g. Dutton and Levine, 1989), we treat childhood SES as a composite measure that typically includes parental economic status, social status, and work status, measured by income, education, and occupation, respectively. We thus measure childhood SES based on three variables that refer to the respondent's circumstances at age 10. The first is the number of rooms per person in the household (*rooms*), which proxies for the parents' financial status (see Cavapozzi *et al.*, 2011).[34] The second is an indicator for whether there were enough (26+) books in the parental home to fill one bookcase (*bookcase*) and is meant to capture the parents' cultural background or education (see Cavapozzi *et al.*,

[34] Our variable *rooms* is sometimes also considered a proxy for physical and social environment-related variables like crowding (see Stokols, 1992).

2011), and perhaps also their cognitive and socio-emotional skills (see Brunello *et al.*, 2012). The third indicates whether the primary breadwinner for the household worked as a farmer or in an elementary occupation (*breadwinner*), thereby capturing the household's work status. The variables that measure childhood health refer to health conditions that respondents experienced before the age of 16. These are indicators for whether respondents suffered from chronic conditions during childhood and whether they spent one month or more in bed during childhood because of illness (*bed*).[35] A further indicator for childhood health that we use is height at the time of interview, which arguably also serves as a proxy for childhood SES (Case and Paxson 2008a; Batty *et al.*, 2009).

Concerning the variable *bookcase*, Table 3.3 shows, for instance, that the proportion of men and women who at age 10 lived in households with more than 25 books is substantially higher in Northern Europe and in Switzerland than in Southern Europe. For example, for men (women) this proportion ranges from 67 (66) percent in Sweden to only 12 (14) percent in Italy. This finding suggests a higher parental cultural background for these Northern European and Swiss respondents. Likewise, the proportion of parents who worked as farmers or in elementary occupations is much higher in Southern Europe than in Northern and Central Europe, whereas the opposite is true for the rooms per person (*rooms*). Both the variables *breadwinner* and *rooms* point to a higher work status and income in (the average) households in Northern and Central Europe when the respondents were 10 years old.

[35] We do not use self-reported childhood health as it may suffer from coloring problems (Havari and Mazzonna, 2011).

Table 3.3: Early life circumstances by gender and country. [a)]

	Socioeconomic status (SES) at age 10			Childhood health (0-15 years)		
	Bookcase	Breadwinner	Rooms	Chronic conditions	One month or more in bed	Height (in cm)
Men	%	%	average	%	%	average
Sweden	67	28	0.84	9	8	179
Denmark	61	46	0.95	12	7	179
Netherlands	49	23	0.83	12	15	179
Switzerland	59	23	0.88	10	10	176
Austria	29	39	0.73	12	16	176
Germany	48	21	0.79	12	14	177
France	38	41	0.84	9	12	174
Belgium	38	44	1.00	11	13	175
Spain	21	58	0.62	6	8	170
Italy	12	60	0.61	6	5	172
Greece	16	60	0.54	2	3	174
Czech Rep.	52	20	0.59	7	13	177
Poland	26	47	0.44	8	9	173
Women						
Sweden	66	28	0.80	10	8	166
Denmark	64	46	0.93	12	8	166
Netherlands	51	25	0.81	14	17	167
Switzerland	57	24	0.92	13	11	164
Austria	34	37	0.72	14	15	164
Germany	48	21	0.79	16	15	165
France	40	38	0.82	17	14	161
Belgium	41	44	1.00	16	15	163
Spain	20	56	0.63	12	6	160
Italy	14	65	0.58	6	7	161
Greece	17	55	0.56	2	3	163
Czech Rep.	63	21	0.56	14	20	165
Poland	26	52	0.40	12	10	162

[a)] More details on the definitions of the variables are in the text and in the appendix. The percentage calculations are based on the number of individuals (see Table 3.1).

With regard to the childhood health-related variables, and in line with previous studies such as Cavelaars *et al.* (2000), the height variable unfolds important country differences and shows that men and women are on average tallest in Northern Europe and in the Netherlands and shortest in Southern Europe (in particular in Spain and Italy). Chronic conditions show a larger incidence among women than men in most countries, except, for instance, in Italy and Greece, where their incidence is also lowest. Individuals from Southern Europe report also a lower incidence of spending one month or more in bed during childhood because of a health condition. This incidence is similar to that in Northern Europe, but most probably for very different reasons. One possible explanation for these perhaps counterintuitive findings is that although such negative health shocks might seem more likely for children from poorer households, who are more likely to be located in Southern and Eastern Europe over the time period our respondents were born and raised, a household's SES, and in particular parental cultural background, may in fact contribute not only to the ability to treat and prevent but also to detect a negative health shock (Currie and Stabile, 2003). Also, because high educated parents invest more time in child care than low educated parents (Guryan *et al.*, 2008) and may be more likely to screen their children and take preventive health care (Brunello *et al.*, 2012). In line with this explanation is the relatively high incidence of spending one month or more in bed during childhood because of a health condition for women (and to a lesser extent also men) from the Czech Republic, whose parental cultural background ranges among the highest in our sample.

3.3. Empirical results

This section examines the associations of early life circumstances with educational attainment, later life health (SRH) and employment. For this purpose we estimate (ordered) probit models by Maximum Likelihood (Cameron and Trivedi, 2005) and report the (average) marginal effects of the explanatory variables on the probability of having the highest level of education (ISCED 5 or 6) in Table 3.4, on the probability of being in very good or excellent health in Table 3.5, and on the employment probability in Table 3.6. In all models, we merge for Germany the categories low and medium educational attainment in the estimations as there are very few individuals with low educational attainment (see Table 3.2). We also include dummies for every age and survey year, and, thereby, control for (birth) cohort effects.[36]

Previous studies such as Almond and Currie (2011b) and Doblhammer *et al.* (2011) have shown that the effects of early life circumstances on health differ between men and women and we therefore estimate the models separately for men and women (see also Marmot *et al.*, 2012). In addition, and as discussed in the introduction, we analyze the thirteen countries in our sample separately. Earlier studies in, e.g., Börsch-Supan *et al.* (2011), Brunello *et al.* (2012) and Guven and Lee (2011) often pool the data from the countries included in SHARE. For each model, and by gender, we tested for pooling of

[36] These three variables are linearly dependent (age=year-cohort). In the education equation we control only for a linear time trend because we use the sample of individuals (see footnote to Table 3.4) and there are very few new respondents in the fourth wave for some countries (for instance in Switzerland, there is only one new male respondent in wave four). For completeness, we note that the reference age category is age 50–51, except for men in Austria where it is 50–53 because there were no men of age 53 and only one of age 52 in the category “no work” in our sample.

data and rejected it in each case at a 1% level of significance.[37] This finding indicates, and as will also become clear from the discussion of the results below, that there are important differences across countries in the strength of the associations between the various childhood health and SES variables and later life outcomes.

We refer to the estimated effects of early life circumstances on later life outcomes as associations because of the widely recognized difficulties in identifying causal relationships between the childhood SES and health variables and later life outcomes. The first difficulty is that SES (or factors correlated with it) is likely to affect health during childhood. For instance, Case *et al.* (2002) and Currie and Stabile (2003) show that income buffers children from the negative effects of chronic conditions, which are also more common among low-SES children. In the same vein, and as discussed in Section 3.2, Case and Paxson (2008) and Batty *et al.* (2009) argue that adult height may be an indicator for a healthier but also a financially more comfortable early life environment among others. The second, and most important difficulty, is that, as these authors and others (e.g. Case *et al.*, 2005; Smith, 2009) suggest, unobserved "third or confounding factors" may be driving the correlations between early life variables and later life outcomes. Hence, in our analysis, we consider the childhood SES and health variables to be proxies for early life circumstances.

Sample selection because of (early) mortality of relatively unhealthy individuals, due to for instance high infant mortality rates, is unlikely to invalidate our estimated associations between early life circumstances and later life outcomes. For instance, Bozzoli *et al.* (2009) show that infant mortality rates need to be extremely high for this. Moreover, for Spain, where these rates were highest—with the possible exception of Poland (United Nations, 2010), these authors and others such as Spijker *et al.* (2012) do not find evidence for the typical positive relationship between infant mortality rates and average adult height by birth cohort that shows up when selection dominates scarring,

[37] We test the null-hypothesis that the associations are equal for all countries and country specific intercepts are included in the model when pooling data. The test statistics with the degrees of freedom in parentheses and p-values in the second parentheses are as follows. Educational attainment equation (Table 3.4): For men, $\chi^2(225) = 881.32$ (0.000); for women, $\chi^2(228) = 1148.66$ (0.000). SRH equation (Table 3.5): For men, $\chi^2(307) = 588.28$ (0.000); for women, $\chi^2(309) = 706.12$ (0.000). Employment equation (Table 3.6): For men, $\chi^2(331) = 764.10$ (0.000); for women, $\chi^2(333) = 836.78$ (0.000).

and report instead a negative one for the period our respondents were born.[38] Similarly, and of relevance for the Netherlands, Painter *et al.* (2005) and Roseboom *et al.* (2001, 2006) provide evidence on negative, and not positive, long-term effects on later life health of prenatal undernutrition during the Dutch famine of 1944/45.

Furthermore, it is likely that our childhood health and SES variables are measured with error and this most probably attenuates the estimated associations towards zero (Bound *et al.*, 2001). A validation study of Havari and Mazzonna (2011), however, finds no evidence of recall error in the childhood variables in SHARELIFE, which show a good level of internal and external consistency. In particular, these authors do not find evidence that memory capacity—measured by two cognitive ability tests consisting of a verbal registration and recall of a list of ten items—is significantly associated with the reported number of childhood illnesses.

Finally, as discussed in the introduction, we examine the role of education and later life health as potential mediators of the associations between early life circumstances and later life employment and, once controlled for these two mediators, if there still is a (direct) transmission of early life circumstances to employment opportunities. As we cannot control for all individual characteristics, one has to bear in mind that there might be other variables such as (lifetime) income that can act as mediators, and also possibly mitigate any (in)direct transmissions we find between early life circumstances and later life employment. The same can be argued for any (in)direct transmissions we find between early life circumstances and later life health.

3.3.1. Educational attainment

In Table 3.4, we examine the relationship between early life circumstances and educational attainment and identify the same significant and positive associations found in previous investigations. Like, for instance, Case *et al.* (2005) for the U.K., and Case and Paxson (2008) for the U.S., we find that height is strongly associated with educational attainment for men (except in Austria and Belgium). Unlike Case *et al.*

[38] Still, environmental disease or nutritional burden in early life—as measured by infant mortality rates—could have an effect beyond diminishing adult height, which may become evident later in life as the *fetal-origins hypothesis* and *life course models* suggest. We find, however, only evidence of a negative (or no) relationship between adverse childhood health and later life health (see Table 3.5) which suggests that if there is a selection effect, it does not dominate the scarring effect of childhood disease.

(2005), however, we do not find such an association for women (except in the Netherlands, Spain and Greece). When significant, a 10 cm increase in height is associated with a 3–8 (4–7) percentage point increase in the probability that men (women) have the highest educational level. Childhood SES variables show a remarkably strong association with educational attainment: for both men and women, education levels are significantly higher among individuals whose parents had a bookcase in all countries and are positively associated with rooms per person for most countries in our sample. For individuals whose parents had a bookcase, the associated rise in the probability of having the highest educational level ranges for men from 29 in Italy to 9 percentage points in Poland and for women from 28 in France to 6 percentage points in the Czech Republic. Moreover, for women in all countries and men in most countries, educational attainment is significantly lower among individuals raised in households whose main breadwinner worked as a farmer or in an elementary occupation.

Among the childhood health variables, other than height, and for both men and women, we do not find much evidence of an association with educational attainment. For instance, unlike Case *et al.* (2005), we find no evidence of a negative association between chronic conditions in childhood and education, and only find a (significant) negative association between having spent one month or more in bed during childhood because of illness and education in Denmark and Greece for men and in Germany for women.

In sum, we find that for both men and women in all countries a higher childhood SES, and for men in almost all countries also height, is strongly associated with a higher level of education.

Table 3.4: The marginal effects (m.e.'s) of childhood SES and health variables on the probability of having a highest level of education (ISCED 5 or 6) by country and gender. [a)]

Country	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Men	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)
Bookcase [b)]	0.149*	0.201*	0.164*	0.114*	0.220*	0.204*	0.207*	0.149*	0.193*	0.290*	0.129*	0.135*	0.091*
	(0.045)	(0.037)	(0.038)	(0.035)	(0.089)	(0.051)	(0.042)	(0.038)	(0.055)	(0.066)	(0.042)	(0.034)	(0.036)
Breadwinner [c)]	-0.032	-0.133*	-0.069*	-0.065*	-0.120	-0.042	-0.106*	-0.122*	-0.083*	-0.078*	-0.117*	-0.025	-0.102*
	(0.027)	(0.028)	(0.028)	(0.025)	(0.065)	(0.044)	(0.026)	(0.029)	(0.027)	(0.025)	(0.024)	(0.020)	(0.023)
Rooms [d)]	0.117*	0.070	0.140*	0.119*	-0.026	0.156*	0.115*	0.027	0.193*	0.089*	0.114	0.036	0.129*
	(0.036)	(0.039)	(0.036)	(0.044)	(0.050)	(0.058)	(0.039)	(0.037)	(0.054)	(0.035)	(0.061)	(0.037)	(0.061)
Chronic conditions [e)]	0.067	0.009	0.011	0.078	0.098	0.052	0.035	-0.002	0.054	-0.032	0.119	-0.010	0.061
	(0.051)	(0.047)	(0.043)	(0.054)	(0.102)	(0.062)	(0.047)	(0.055)	(0.068)	(0.055)	(0.099)	(0.039)	(0.057)
Bed [f)]	-0.019	-0.114*	-0.028	-0.037	0.053	0.033	-0.008	0.055	-0.044	0.078	-0.114*	-0.021	0.050
	(0.045)	(0.050)	(0.035)	(0.035)	(0.098)	(0.057)	(0.043)	(0.048)	(0.037)	(0.071)	(0.055)	(0.025)	(0.055)
Height [g)]	0.042*	0.075*	0.058*	0.059*	-0.006	0.054*	0.064*	0.031	0.056*	0.049*	0.073*	0.033*	0.057*
	(0.017)	(0.020)	(0.017)	(0.018)	(0.051)	(0.025)	(0.020)	(0.023)	(0.023)	(0.020)	(0.016)	(0.011)	(0.018)
Joint significance childhood SES & health [h)]	0.000*	0.000*	0.000*	0.000*	0.027*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Joint significance childhood SES [h)]	0.000*	0.000*	0.000*	0.000*	0.004*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Joint significance childhood health [h)]	0.072	0.001*	0.020*	0.016*	0.601	0.162	0.028*	0.326	0.050	0.071	0.000*	0.047*	0.020*
Pseudo R-squared	0.097	0.116	0.077	0.143	0.085	0.096	0.128	0.052	0.203	0.143	0.078	0.120	0.133

Table 3.4 Continued	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Women	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)
Bookcase [b)]	0.200*	0.203*	0.213*	0.075*	0.168*	0.227*	0.279*	0.199*	0.250*	0.166*	0.185*	0.060*	0.126*
	(0.037)	(0.036)	(0.033)	(0.026)	(0.056)	(0.046)	(0.041)	(0.033)	(0.052)	(0.040)	(0.041)	(0.020)	(0.031)
Breadwinner [c)]	-0.141*	-0.170*	-0.068*	-0.061*	-0.163*	-0.084*	-0.085*	-0.143*	-0.156*	-0.121*	-0.114*	-0.059*	-0.077*
	(0.030)	(0.032)	(0.026)	(0.019)	(0.033)	(0.040)	(0.024)	(0.025)	(0.027)	(0.018)	(0.019)	(0.013)	(0.016)
Rooms [d)]	0.160*	0.179*	0.074*	0.051*	0.017	0.033	0.126*	0.066*	0.079	0.149*	0.044	0.072*	0.086*
	(0.044)	(0.044)	(0.038)	(0.021)	(0.048)	(0.043)	(0.037)	(0.032)	(0.051)	(0.033)	(0.042)	(0.031)	(0.044)
Chronic conditions [e)]	0.030	0.030	0.011	0.005	0.024	0.095	0.067	-0.060	-0.001	-0.025	-0.019	-0.020	0.000
	(0.057)	(0.048)	(0.036)	(0.035)	(0.053)	(0.053)	(0.038)	(0.033)	(0.045)	(0.037)	(0.080)	(0.019)	(0.023)
Bed [f)]	0.043	-0.077	0.018	-0.037	0.035	-0.091*	0.003	0.056	-0.041	-0.006	-0.020	0.033	-0.012
	(0.066)	(0.062)	(0.033)	(0.026)	(0.055)	(0.042)	(0.036)	(0.041)	(0.049)	(0.037)	(0.053)	(0.024)	(0.023)
Height [g)]	0.009	0.042	0.057*	0.024	0.047	0.004	0.039	0.011	0.072*	0.009	0.044*	0.022	-0.020
	(0.024)	(0.027)	(0.018)	(0.019)	(0.029)	(0.028)	(0.022)	(0.022)	(0.028)	(0.016)	(0.020)	(0.013)	(0.014)
Joint significance childhood SES & health [h)]	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Joint significance childhood SES [h)]	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Joint significance childhood health [h)]	0.690	0.231	0.014*	0.302	0.310	0.144	0.061	0.235	0.031*	0.842	0.134	0.112	0.540
Pseudo R-squared	0.095	0.096	0.090	0.119	0.170	0.106	0.149	0.086	0.232	0.193	0.120	0.082	0.136

[a)] Standard errors (s.e.'s) are in parentheses. Significance level: * $p<0.05$. Sample sizes are in Table 3.1 (number of individuals). The ordered probit models include age dummies and survey year as explanatory variables. [b)] 1 = more than 25 books, 0 otherwise. [c)] 1 = farmer/elementary occupation, 0 otherwise. [d)] An increase of one room (in the number of rooms per person). [e)] 1 = one or more chronic conditions, 0 otherwise. [f)] 1 = one month or more in bed, 0 otherwise. [g)] A 10 cm increase. [h)] p-values are reported.

3.3.2. Later life health

Table 3.5 shows the associations between early life circumstances and later life health, which, as discussed in Section 3.2, is Self-Reported Health (SRH) and classified into three categories (poor or fair, good, very good or excellent). Here, we condition this association on educational attainment, which only reduces the size of the early life variables' coefficients but leaves the levels of significance virtually unchanged in most countries and for both men and women (we return to this observation in Section 3.4). This outcome stands in contrast to the Case and Paxson (2008) finding that for U.S. elderly the association between childhood SES and SRH at older ages becomes insignificant once education is controlled for.

Overall, the table shows positive and significant associations between educational attainment and later life health for men in all countries and women in most countries. In line with Case and Paxon (2008), we conclude that education appears to be protective of health. Based on the variable *bookcase*, we find mainly for Central Europe a better later life health among men and women whose parents had a higher SES. Moreover, for men in Denmark and Germany growing up in households whose main breadwinner worked as a farmer or in an elementary occupation is significantly associated with worse later life health, and for women in Sweden and Germany growing up in households with more rooms per person is significantly associated with better later life health. Quantitatively, and in particular for women, the differences in later life health associated with a different childhood SES are comparable to the differences in health between those with the lowest and highest levels of education, which underscores the relative importance of childhood SES for later life health.

Also childhood health is strongly associated with later life health. In most countries, and for both men and women, childhood chronic conditions or having spent one month or more in bed during childhood because of illness is significantly and negatively associated with later life health. When significant, having suffered from chronic conditions during childhood is associated with a 7–18 (8–20) percentage point lower probability of reporting very good or excellent health for men (women). This evidence resembles that offered by Case *et al.* (2005) for adults aged 33 and 42. Comparing all the significant effects of the childhood health variables with the effect of having obtained the highest level of education indicates that the magnitude of their association with reporting very good or excellent health is rather similar for men in Northern Europe, Switzerland and Greece, and for women in the Netherlands, Austria and in Southern Europe. This finding underscores the relative importance of childhood health for later life health.

Overall, the results show that a higher level of education and, in particular for women, favorable early life circumstances (i.e. better childhood health and higher childhood SES) are significantly associated with better later life health.

3.3.3. Later life employment

Table 3.6 shows the marginal effects of early life circumstances and educational attainment on later life employment probabilities once also later life health (SRH) is controlled for. In this way, we obtain insights into possible direct associations of early life circumstances with employment opportunities that do not operate through health.[39] The same associations but without controlling for later life health are analyzed by means of joint significance tests. These test results are reported in the bottom part of Table 3.6 and discussed in Section 3.4 (the full set of estimation results are available upon request). As in the previous section, conditioning on educational attainment changes only the size of the early life variables' coefficients and not their levels of significance for men in most countries (except in France, Italy and in the Czech Republic), but this is not true for women; and in particular not for women from Northern Europe, Austria, Germany and Spain. We do not report these results (available upon request) but instead present joint significance tests in the bottom part of the table that are discussed in Section 3.4.

[39] As, e.g., argued in Bound (1991), for reasons such as measurement error and reverse causality, SRH is likely to be an endogenous explanatory variable in an employment equation. We do not take this into account and this may attenuate the estimated associations.

Table 3.5: The marginal effects (m.e.'s) of childhood SES and health variables on the probability of being in very good or excellent health by country and gender. [a)]

Country	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Men	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)
Bookcase [b)]	-0.001	0.007	0.097*	0.014	0.067	0.068*	0.035	0.095*	0.034	0.050	-0.064	-0.030	0.025
	(0.042)	(0.038)	(0.033)	(0.049)	(0.063)	(0.034)	(0.038)	(0.033)	(0.049)	(0.051)	(0.047)	(0.037)	(0.029)
Breadwinner [c)]	-0.060	-0.080*	0.065	-0.055	-0.098	-0.074*	-0.023	-0.020	0.075	-0.011	-0.004	-0.005	0.044
	(0.039)	(0.036)	(0.037)	(0.057)	(0.055)	(0.029)	(0.032)	(0.030)	(0.043)	(0.032)	(0.034)	(0.044)	(0.024)
Rooms [d)]	-0.002	0.033	0.022	-0.016	-0.034	0.075	-0.028	-0.054	-0.008	0.003	0.081	0.068	0.043
	(0.050)	(0.049)	(0.046)	(0.079)	(0.039)	(0.044)	(0.036)	(0.036)	(0.060)	(0.032)	(0.076)	(0.068)	(0.043)
Chronic conditions [e)]	0.006	-0.156*	-0.056	-0.183*	0.051	-0.070*	-0.029	-0.105*	-0.116	0.040	-0.007	0.078	-0.002
	(0.061)	(0.052)	(0.042)	(0.076)	(0.091)	(0.034)	(0.053)	(0.046)	(0.066)	(0.061)	(0.117)	(0.079)	(0.040)
Bed [f)]	-0.164*	0.018	-0.039	0.038	-0.061	0.039	0.047	-0.015	0.018	-0.095	-0.217*	-0.046	-0.061*
	(0.047)	(0.075)	(0.037)	(0.067)	(0.070)	(0.045)	(0.054)	(0.042)	(0.070)	(0.056)	(0.083)	(0.050)	(0.024)
Height [g)]	0.013	0.021	0.025	0.044	0.018	0.002	0.019	-0.001	0.020	0.039	0.040	0.009	0.027
	(0.027)	(0.027)	(0.020)	(0.039)	(0.038)	(0.019)	(0.023)	(0.022)	(0.025)	(0.022)	(0.022)	(0.020)	(0.017)
Medium level of education	0.124*	0.136*	0.120*	0.049	0.153*		0.030	0.123*	0.075	-0.012	0.126*	0.055	0.066*
	(0.042)	(0.056)	(0.038)	(0.058)	(0.076)		(0.039)	(0.036)	(0.052)	(0.032)	(0.037)	(0.041)	(0.031)
High level of education	0.188*	0.185*	0.173*	0.175*	0.331*	0.132*	0.168*	0.163*	0.196*	0.132*	0.215*	0.210*	0.114*
	(0.045)	(0.059)	(0.041)	(0.080)	(0.087)	(0.035)	(0.051)	(0.038)	(0.071)	(0.060)	(0.043)	(0.068)	(0.058)
Joint significance education [h)]	0.000*	0.013*	0.000*	0.115	0.001*	0.000*	0.001*	0.000*	0.007*	0.042*	0.000*	0.003*	0.027*
Joint significance childhood SES & health [h)]	0.023*	0.013*	0.009*	0.123	0.124	0.002*	0.577	0.007*	0.303	0.304	0.042*	0.677	0.031*
Joint significance childhood SES [h)]	0.494	0.126	0.009*	0.737	0.088	0.000*	0.568	0.011*	0.308	0.684	0.477	0.619	0.124
Joint significance childhood health [h)]	0.006*	0.020*	0.217	0.048*	0.737	0.345	0.595	0.098	0.385	0.186	0.025*	0.611	0.052
Pseudo R-squared	0.070	0.039	0.056	0.054	0.097	0.060	0.036	0.039	0.050	0.029	0.058	0.062	0.050
Excluding education attainment													
Joint significance childhood SES & health [h)]	0.004*	0.001*	0.000*	0.076	0.004*	0.000*	0.017*	0.000*	0.202	0.124	0.002*	0.510	0.017*
Joint significance childhood SES [h)]	0.122	0.015*	0.000*	0.370	0.003*	0.000*	0.037*	0.000*	0.247	0.235	0.325	0.689	0.129
Joint significance childhood health [h)]	0.003*	0.016*	0.075	0.058	0.795	0.438	0.461	0.102	0.369	0.228	0.001*	0.447	0.028*

Table 3.5 Continued	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Women	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)
Bookcase [b)]	0.051	0.067	0.034	0.141*	0.191*	0.064*	0.072*	0.035	0.110*	0.049	-0.046	-0.036	0.013
	(0.039)	(0.037)	(0.028)	(0.047)	(0.057)	(0.032)	(0.034)	(0.029)	(0.048)	(0.041)	(0.040)	(0.028)	(0.023)
Breadwinner [c)]	0.046	-0.005	0.035	0.017	0.039	0.022	0.045	-0.034	-0.021	0.004	0.029	-0.062	-0.027
	(0.040)	(0.033)	(0.032)	(0.053)	(0.056)	(0.034)	(0.030)	(0.028)	(0.029)	(0.028)	(0.030)	(0.034)	(0.017)
Rooms [d)]	0.221*	0.026	-0.021	0.019	-0.066	0.094*	0.051	-0.026	0.002	0.035	-0.047	0.097	-0.030
	(0.047)	(0.040)	(0.042)	(0.047)	(0.055)	(0.030)	(0.034)	(0.029)	(0.046)	(0.046)	(0.057)	(0.054)	(0.038)
Chronic conditions [e)]	-0.096*	-0.153*	-0.080*	-0.074	-0.129*	-0.052	-0.019	-0.082*	-0.113*	-0.137*	-0.203*	-0.065	-0.011
	(0.045)	(0.047)	(0.035)	(0.058)	(0.059)	(0.034)	(0.035)	(0.034)	(0.036)	(0.040)	(0.096)	(0.046)	(0.027)
Bed [f)]	-0.057	-0.060	-0.130*	-0.108	0.066	-0.016	-0.032	-0.036	0.010	-0.026	-0.214*	0.072	-0.010
	(0.059)	(0.066)	(0.030)	(0.059)	(0.073)	(0.039)	(0.038)	(0.040)	(0.061)	(0.049)	(0.059)	(0.045)	(0.029)
Height [g)]	0.003	0.044	0.026	0.017	0.054	0.015	-0.019	0.025	0.015	0.038	0.070*	-0.002	0.005
	(0.028)	(0.028)	(0.020)	(0.039)	(0.036)	(0.023)	(0.022)	(0.021)	(0.024)	(0.023)	(0.024)	(0.025)	(0.016)
Medium level of education	0.082*	0.121*	0.030	0.052	0.127*		0.055	0.073*	0.100*	0.094*	0.146*	0.122*	0.012
	(0.040)	(0.050)	(0.034)	(0.048)	(0.061)		(0.032)	(0.032)	(0.050)	(0.033)	(0.034)	(0.033)	(0.021)
High level of education	0.209*	0.238*	0.109*	0.146	0.155*	0.084*	0.146*	0.192*	0.097	0.123*	0.235*	0.337*	0.082
	(0.045)	(0.047)	(0.037)	(0.076)	(0.076)	(0.035)	(0.049)	(0.038)	(0.071)	(0.063)	(0.046)	(0.077)	(0.050)
Joint significance education [h)]	0.000*	0.000*	0.008*	0.172	0.062	0.011*	0.004*	0.000*	0.045*	0.005*	0.000*	0.000*	0.124
Joint significance childhood SES & health [h)]	0.000*	0.005*	0.000*	0.011*	0.001*	0.002*	0.087	0.025*	0.009*	0.014*	0.001*	0.121	0.712
Joint significance childhood SES [h)]	0.000*	0.260	0.443	0.017*	0.004*	0.001*	0.030*	0.260	0.044*	0.422	0.244	0.049*	0.362
Joint significance childhood health [h)]	0.050*	0.005*	0.000*	0.153	0.066	0.350	0.550	0.018*	0.043*	0.005*	0.000*	0.349	0.908
Pseudo R-squared	0.068	0.052	0.033	0.047	0.063	0.034	0.039	0.038	0.050	0.034	0.061	0.050	0.034
Excluding education attainment													
Joint significance childhood SES & health [h)]	0.000*	0.000*	0.000*	0.002*	0.000*	0.000*	0.000*	0.000*	0.000*	0.001*	0.001*	0.013*	0.428
Joint significance childhood SES [h)]	0.000*	0.001*	0.186	0.005*	0.001*	0.000*	0.000*	0.002*	0.001*	0.014*	0.970	0.004*	0.149
Joint significance childhood health [h)]	0.094	0.005*	0.000*	0.111	0.047*	0.411	0.677	0.011*	0.048*	0.008*	0.000*	0.252	0.886

[a)] Cluster-robust standard errors (s.e.'s) are in parentheses. Significance level: * $p<0.05$. Sample sizes are in Table 3.1 (number of observations). The ordered probit models include age dummies, survey year dummies, marital status and dummies for having one, two and three or more children as explanatory variables. [b)] 1 = more than 25 books, 0 otherwise. [c)] 1 = farmer or elementary occupation, 0 otherwise. [d)] An increase of one room (in the number of rooms per person). [e)] 1 = one or more chronic conditions, 0 otherwise. [f)] 1 = one month or more in bed, 0 otherwise. [g)] A 10 cm increase. [h)] p-values are reported.

Table 3.6: The marginal effects (m.e.'s) of childhood SES and health variables on the employment probability by country and gender. [a)]

Country	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Men	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)
Bookcase [b)]	0.019	0.024	0.049	-0.046	0.115	0.067	0.045	-0.025	-0.035	0.047	-0.060	0.054	0.032
	(0.029)	(0.032)	(0.030)	(0.044)	(0.060)	(0.037)	(0.032)	(0.032)	(0.053)	(0.046)	(0.049)	(0.028)	(0.046)
Breadwinner [c)]	-0.016	-0.010	-0.015	-0.036	0.073	-0.041	0.001	-0.063*	-0.007	-0.038	-0.028	0.021	0.047
	(0.033)	(0.031)	(0.034)	(0.051)	(0.048)	(0.047)	(0.029)	(0.030)	(0.039)	(0.031)	(0.034)	(0.034)	(0.041)
Rooms [d)]	0.029	0.074	0.036	0.104	-0.049	0.089	0.006	0.026	0.268*	-0.002	0.108	0.084	-0.015
	(0.038)	(0.044)	(0.037)	(0.075)	(0.049)	(0.066)	(0.031)	(0.036)	(0.060)	(0.036)	(0.077)	(0.053)	(0.068)
Chronic conditions [e)]	-0.121*	-0.095	-0.057	0.095	-0.121*	-0.049	-0.064	-0.052	-0.191*	-0.041	-0.076	-0.069	-0.172*
	(0.053)	(0.053)	(0.051)	(0.058)	(0.061)	(0.063)	(0.047)	(0.047)	(0.094)	(0.069)	(0.119)	(0.053)	(0.076)
Bed [f)]	0.081*	0.072	-0.059	-0.043	-0.072	0.049	0.078*	0.009	-0.091	-0.099	0.045	0.024	-0.010
	(0.037)	(0.061)	(0.044)	(0.066)	(0.062)	(0.058)	(0.036)	(0.043)	(0.073)	(0.067)	(0.083)	(0.040)	(0.078)
Height [g)]	-0.003	0.013	0.030	0.073*	0.073*	0.060*	-0.027	0.042	-0.020	0.030	0.050*	0.025	0.039
	(0.021)	(0.024)	(0.023)	(0.033)	(0.035)	(0.029)	(0.021)	(0.025)	(0.029)	(0.022)	(0.022)	(0.018)	(0.034)
Medium level of education	0.015	0.041	0.013	0.015	0.033		0.085*	0.083*	0.052	0.036	-0.047	0.069*	0.071
	(0.031)	(0.048)	(0.035)	(0.049)	(0.068)		(0.030)	(0.034)	(0.052)	(0.031)	(0.040)	(0.028)	(0.050)
High level of education	0.030	0.056	0.042	0.064	0.200*	0.122*	0.182*	0.104*	0.099	0.263*	-0.035	0.132*	0.202*
	(0.034)	(0.048)	(0.035)	(0.065)	(0.071)	(0.037)	(0.037)	(0.034)	(0.053)	(0.036)	(0.045)	(0.035)	(0.068)
Good health	0.099*	0.179*	0.193*	0.280*	0.121*	0.190*	0.169*	0.116*	0.174*	0.020	0.182*	0.149*	0.132*
	(0.031)	(0.034)	(0.029)	(0.041)	(0.051)	(0.033)	(0.030)	(0.031)	(0.032)	(0.030)	(0.034)	(0.026)	(0.035)
Very good or excellent health	0.190*	0.229*	0.235*	0.318*	0.157*	0.226*	0.189*	0.156*	0.213*	0.093*	0.202*	0.193*	0.094
	(0.031)	(0.030)	(0.030)	(0.040)	(0.052)	(0.035)	(0.033)	(0.035)	(0.033)	(0.032)	(0.034)	(0.026)	(0.058)
Joint significance later life health [h)]	0.000*	0.000*	0.000*	0.000*	0.019*	0.000*	0.000*	0.000*	0.000*	0.009*	0.000*	0.000*	0.001*
Joint significance education [h)]	0.720	0.537	0.510	0.660	0.005*	0.002*	0.000*	0.007*	0.225	0.000*	0.465	0.008*	0.024*
Joint significance childhood SES & health [h)]	0.070	0.190	0.114	0.042*	0.011*	0.031*	0.142	0.126	0.000*	0.216	0.114	0.100	0.228
Joint significance childhood SES [h)]	0.630	0.216	0.230	0.236	0.221	0.065	0.517	0.132	0.000*	0.370	0.355	0.123	0.679
Joint significance childhood health [h)]	0.031*	0.262	0.124	0.047*	0.007*	0.139	0.077	0.255	0.077	0.199	0.099	0.225	0.077
Pseudo R-squared	0.236	0.259	0.251	0.310	0.475	0.218	0.392	0.277	0.203	0.301	0.189	0.342	0.183

Table 3.6 Continued	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Excluding later life health from the model													
Joint significance education [h)]	0.205	0.214	0.118	0.186	0.000*	0.000*	0.000*	0.001*	0.056	0.000*	0.857	0.001*	0.011*
Joint significance childhood SES & health [h)]	0.166	0.040*	0.025*	0.080	0.011*	0.005*	0.088	0.097	0.000*	0.145	0.044*	0.166	0.135
Joint significance childhood SES [h)]	0.625	0.097	0.084	0.231	0.231	0.010*	0.478	0.133	0.001*	0.342	0.287	0.167	0.546
Joint significance childhood health [h)]	0.075	0.128	0.067	0.126	0.009*	0.124	0.050	0.192	0.038*	0.136	0.048*	0.327	0.052
Excluding later life health and education from the model													
Joint significance childhood SES & health [h)]	0.115	0.010*	0.001*	0.060	0.002*	0.000*	0.001*	0.012*	0.000*	0.001*	0.044*	0.002*	0.105
Joint significance childhood SES [h)]	0.279	0.022*	0.007*	0.237	0.031*	0.000*	0.002*	0.023*	0.000*	0.002*	0.283	0.006*	0.622
Joint significance childhood health [h)]	0.117	0.109	0.043*	0.081	0.031*	0.090	0.177	0.119	0.047*	0.198	0.051	0.159	0.039*

Table 3.6 Continued	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Women	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)	m.e. (s.e.)
Bookcase [b)]	0.031	0.034	-0.031	0.037	-0.062	0.058	-0.026	0.116*	0.047	-0.072	-0.037	0.012	-0.014
	(0.028)	(0.032)	(0.034)	(0.047)	(0.044)	(0.035)	(0.038)	(0.032)	(0.062)	(0.047)	(0.039)	(0.028)	(0.038)
Breadwinner [c)]	-0.001	0.036	-0.099*	0.053	-0.074	0.015	-0.013	-0.005	-0.056	0.069*	0.015	-0.032	-0.010
	(0.029)	(0.030)	(0.037)	(0.046)	(0.041)	(0.041)	(0.034)	(0.030)	(0.045)	(0.033)	(0.030)	(0.036)	(0.036)
Rooms [d)]	-0.030	0.006	-0.011	0.109*	0.061	0.007	0.072	-0.029	0.032	-0.017	-0.065	0.103*	-0.025
	(0.039)	(0.040)	(0.054)	(0.047)	(0.039)	(0.040)	(0.051)	(0.034)	(0.073)	(0.050)	(0.061)	(0.050)	(0.064)
Chronic conditions [e)]	0.049	-0.031	0.063	0.024	-0.011	-0.009	0.002	0.048	0.094	-0.050	0.143	0.060	-0.051
	(0.039)	(0.052)	(0.047)	(0.066)	(0.056)	(0.048)	(0.041)	(0.044)	(0.068)	(0.065)	(0.122)	(0.037)	(0.051)
Bed [f)]	0.018	-0.019	-0.035	0.063	0.065	-0.024	-0.033	-0.061	0.043	0.012	-0.080	-0.021	0.086
	(0.047)	(0.059)	(0.043)	(0.057)	(0.060)	(0.051)	(0.042)	(0.043)	(0.080)	(0.056)	(0.066)	(0.035)	(0.063)
Height [g)]	0.043*	0.038	-0.012	0.006	-0.084*	-0.026	-0.024	-0.010	-0.023	0.015	-0.005	0.012	0.025
	(0.022)	(0.022)	(0.025)	(0.037)	(0.031)	(0.029)	(0.026)	(0.023)	(0.033)	(0.025)	(0.026)	(0.022)	(0.030)
Medium level of education	0.061*	0.044	0.069	0.100*	0.085		0.015	0.034	0.111	0.226*	0.039	0.079*	0.039
	(0.030)	(0.042)	(0.040)	(0.043)	(0.050)		(0.037)	(0.035)	(0.067)	(0.037)	(0.034)	(0.026)	(0.040)
High level of education	0.165*	0.196*	0.194*	0.122	0.339*	0.030	0.091*	0.132*	0.216*	0.479*	0.367*	0.230*	0.218*
	(0.025)	(0.037)	(0.038)	(0.075)	(0.077)	(0.039)	(0.045)	(0.040)	(0.084)	(0.047)	(0.055)	(0.041)	(0.071)
Good health	0.207*	0.178*	0.213*	0.133*	0.105	0.103*	0.193*	0.176*	0.094*	0.108*	0.094*	0.181*	0.080*
	(0.024)	(0.032)	(0.033)	(0.049)	(0.055)	(0.032)	(0.031)	(0.032)	(0.039)	(0.029)	(0.039)	(0.029)	(0.032)
Very good or excellent health	0.274*	0.255*	0.231*	0.103*	0.126*	0.162*	0.173*	0.200*	0.151*	0.145*	0.099*	0.202*	0.124*
	(0.023)	(0.028)	(0.037)	(0.051)	(0.059)	(0.038)	(0.036)	(0.036)	(0.055)	(0.037)	(0.041)	(0.033)	(0.047)
Joint significance later life health [h)]	0.000*	0.000*	0.000*	0.049*	0.073	0.000*	0.000*	0.000*	0.010*	0.000*	0.020*	0.000*	0.006*
Joint significance education [h)]	0.000*	0.000*	0.000*	0.078	0.000*	0.452	0.096	0.003*	0.023*	0.000*	0.000*	0.000*	0.007*
Joint significance childhood SES & health [h)]	0.251	0.336	0.120	0.145	0.055	0.740	0.724	0.010*	0.499	0.077	0.450	0.097	0.802
Joint significance childhood SES [h)]	0.651	0.473	0.058	0.051	0.134	0.443	0.523	0.003*	0.395	0.018*	0.374	0.089	0.951
Joint significance childhood health [h)]	0.142	0.337	0.524	0.665	0.050	0.755	0.681	0.479	0.390	0.809	0.422	0.420	0.390
Pseudo R-squared	0.224	0.315	0.186	0.128	0.364	0.185	0.273	0.220	0.135	0.262	0.154	0.339	0.225

Table 3.6 Continued	SE	DK	NL	CH	AT	DE	FR	BE	ES	IT	GR	CZ	PL
Excluding later life health from the model													
Joint significance education [h]	0.000*	0.000*	0.000*	0.068	0.000*	0.288	0.047*	0.000*	0.012*	0.000*	0.000*	0.000*	0.003*
Joint significance childhood SES & health [h]	0.332	0.057	0.134	0.124	0.109	0.562	0.671	0.012*	0.470	0.094	0.421	0.090	0.820
Joint significance childhood SES [h]	0.460	0.267	0.116	0.033*	0.211	0.251	0.497	0.003*	0.271	0.038*	0.307	0.026*	0.908
Joint significance childhood health [h]	0.299	0.102	0.314	0.736	0.079	0.739	0.595	0.483	0.560	0.588	0.451	0.865	0.426
Excluding later life health and education from the model													
Joint significance childhood SES & health [h]	0.003*	0.000*	0.060	0.058	0.003*	0.359	0.309	0.000*	0.017*	0.099	0.631	0.003*	0.756
Joint significance childhood SES [h]	0.007*	0.004*	0.031*	0.014*	0.005*	0.113	0.117	0.000*	0.004*	0.073	0.649	0.001*	0.725
Joint significance childhood health [h]	0.172	0.039*	0.409	0.767	0.087	0.741	0.632	0.677	0.616	0.266	0.425	0.766	0.510

[a] Cluster-robust standard errors (s.e.'s) are in parentheses. Significance level: * $p<0.05$. Sample sizes are in Table 3.1 (number of observations). The probit models include age dummies, survey year dummies, marital status and dummies for having one, two and three or more children as explanatory variables. [b] 1 = more than 25 books, 0 otherwise. [c] 1 = farmer or elementary occupation, 0 otherwise. [d] An increase of one room (in the number of rooms per person). [e] 1 = one or more chronic conditions, 0 otherwise. [f] 1 = one month or more in bed, 0 otherwise. [g] A 10 cm increase. [h] p-values are reported.

As the table shows, there are positive and significant associations between later life health (SRH) and employment for men and women in all countries. For instance, the associated increase in the employment probability for reporting very good or excellent health at older ages ranges for men from 32 in Switzerland to 9 percentage points in Italy and for women from 27 in Sweden to 10 percentage points in Greece. Conditional on later life health, there are significant associations between educational attainment and later life employment for women in all countries (except in Germany) but for men in only half of the countries. The associated increase in the employment probability for having the highest level of education (relative to the lowest level) is mostly larger among women than men, and is largest among Italian women.

As the table shows, most associations between early life circumstances and later life employment are insignificant when later life health is controlled for. There are, however, a few notable exceptions. For women, the variables *bookcase* in Belgium, *breadwinner* in the Netherlands and *rooms* in Switzerland and in the Czech Republic are significantly associated with later life employment (and with the correct sign). For men, we find mainly associations with childhood health and only in a few countries. For instance, having suffered from chronic conditions during childhood is associated with a 12 percentage point lower employment probability in Sweden and Austria which increases to 19 and 17 percentage point in Spain and Poland, respectively. These estimates are somewhat larger than the ones reported in Case *et al.* (2005) for U.K. men at ages 33 and 42. But, as suggested by these authors, this may in part be due to our older sample as they find that childhood chronic conditions have an increasing impact on employment with age. In addition, we find a positive and significant association between height and later life employment for men in Switzerland, Austria, Germany and Greece. Relative to the employment differences between those with poor or fair and very good or excellent later life health (SRH), the associations with childhood health and SES are substantial for men from Spain (the variables *rooms* and chronic conditions), Poland (the variable chronic conditions) and Austria (the variables chronic conditions and height).[40] For Swedish and French men the variable *bed* is positively and for Austrian women height is negatively associated with employment. We have no

[40] For Polish men the comparison is done with poor or fair versus good health (and not very good or excellent health).

explanation for these two findings and also do not wish to speculate as the childhood variables are jointly insignificant for these cases. Finally, for Italian women the positive association between the variable *breadwinner* and employment appears not to be a robust finding as it becomes negative and insignificant when SRH and education are excluded from the employment equation (these results are not shown but available upon request).

In sum, for both men and women we find a strong association between later life health and employment. For women and to a lesser extent for men, we find that educational attainment is positively associated with later life employment. Most associations between early life circumstances and later life employment are insignificant, although there are notable exceptions such as the association with *chronic conditions* for men in a few countries. All in all, we find only weak empirical evidence in favor of associations between early life circumstances and later life employment once later life health and education are controlled for.

3.4. Pathways

To facilitate an overall interpretation of our empirical results, we discuss the results of joint significance tests on all the associations of early life circumstances and education variables with later life health and employment in the models on which we have reported in Tables 3.5 and 3.6. More importantly, these test results provide insights into the role of education as a pathway through which early life circumstances may affect later life health, and education and later life health as pathways through which early life circumstances may affect later life employment. These test results are presented in Tables 3.5 and 3.6.[41]

Section 3.3.1 already discussed the associations of educational attainment with early life circumstances. Taking into account that childhood SES is likely to influence childhood health but not vice versa, these associations occur mainly with the SES-related variables, and for men also with height (see Table 3.4, also for the joint significance tests).

[41] To perform the tests, we exclude education and/or later life health from the models in Section 3.3 and re-estimate them. Excluding, furthermore, the demographic variables marital status and children leaves the tests results virtually unchanged. All estimation results are available upon request.

As shown at the bottom part of Table 3.5, after controlling for education, we find significant associations between early life circumstances and later life health for men in about half of the countries and for women in all countries except in Eastern Europe. Overall, for women from Northern and Southern Europe childhood health links early life circumstances to later life health; but for women from Central Europe, it is childhood SES that does so. For men, we do not find such a pattern. When educational attainment is excluded, childhood health and/or SES become jointly significant in Denmark, Austria and France for men and women, and for men in Poland and women in Belgium, Italy and in the Czech Republic. This finding provides some support for education being a pathway through which early life circumstances are associated with later life health.

After controlling for education but not later life health, we find significant associations between early life circumstances and later life employment in most countries for men and to a lesser extent for women. For women from Northern Europe, the Netherlands, Austria and Spain, and for men from Denmark, the Netherlands, Austria, France, Belgium, Italy, and Eastern Europe the associations between early life circumstances—and in particular childhood SES—and later life employment become jointly significant once the education variables are excluded from the employment equation. These results are in line with Case and Paxson (2008) who report a positive association between SES and health during childhood and white collar occupations for U.S. individuals above age 50 that becomes insignificant once education is controlled for, and underscores the important role of education as a mediator between early life circumstances and later life employment. For women in Belgium only and men in Switzerland, Austria, Germany and in particular in Spain, also when later life health is controlled for, early life circumstances remain jointly significantly associated with later life employment. As discussed in Section 3.3, these latter results for men may suggest a long-lasting positive impact of early life circumstances on employment opportunities that do not only operate through health. One explanation for this difference in findings between men and women could be the gender differences in labor market behavior attributed to the persistence of the male-breadwinner model in Southern European countries such as Spain (e.g. Adam, 1996; de la Rica and Iza, 2005) and to some extent also in other European countries where the male-breadwinner model was gradually being replaced by the dual-breadwinner model as the most common form of household labor supply (e.g. Gustafsson and Stafford, 1994; Lewis, 2001).

As also discussed in Section 3.3, with regard to educational effects, and with the exception of Switzerland, we find that education is health protective for men in all and for women in virtually all countries (see bottom part of Table 3.5). After controlling for later life health, we find significant associations between education and later life employment in almost all countries for women and in half of the countries for men. For example, we find a strong association between educational attainment and later life employment among Northern European and Dutch women that is inexistent among their male peers (see bottom part of Table 3.6).[42]

3.5. Summary and discussion

We use data from the Survey of Health, Ageing, and Retirement in Europe and (ordered) probit models to examine the associations between individuals' early life circumstances (specifically, childhood SES and childhood health) and later life health and employment in thirteen European countries. Childhood SES is approximated by three variables pertaining to the parental home when the respondent was 10 years old: enough books to fill one bookcase, a main breadwinner working as a farmer or in an elementary occupation, and the number of rooms per person. Childhood health is measured based on chronic conditions during childhood (at ages 0–15) and lengthy confinement to bed because of illness. We also control for the individual's height at the time of interview as a proxy for both childhood SES and childhood health.

Although the empirical results show that there are differences across the thirteen European countries in the strength of the associations between the various childhood health and SES variables and later life outcomes, they also show similarities that enable us to draw general conclusions. In all countries and for both men and women, favorable early life circumstances, and in particular a higher childhood SES, are associated with a higher level of education, which in turn is protective of later life health. Once educational attainment is controlled for, we find for most countries and in particular for women, strong empirical support that favorable early life circumstances are associated

[42] This may be due to a series of educational reforms in these countries, which eliminated almost the educational gender gap (see, e.g., Dronkers, 1993, for the Netherlands).

with better later life health. Although, and mainly for men, we find evidence for some countries of significant associations between early life circumstances and later life employment when later life health is controlled for, most of the association between early life circumstances and later life employment appears to be transmitted through education and later life health.

Our empirical findings may suggest that public policies which invest in children's health and parents' SES can benefit children in terms of better education, (later life) health and employment opportunities. Examples of such policies are free health care for children and (means tested) income and in-kind support programs which cover the domains of parent's SES and children's health (e.g., Marmot *et al.*, 2012, pp 1016–7). However, it is still an open question what the most effective and cost efficient ways are to implement such policies, as well as the optimal timing when to intervene (e.g. Almond and Currie, 2011b), even if with regard to the latter point there is an increasing consensus on the advantages for intervening as early as possible (e.g. Doyle *et al.*, 2009).

As discussed in the introduction, caution is warranted for policy recommendations based on these estimated associations. And though the literature provides evidence in support of causal relationships between early life circumstances and later life outcomes, more research is needed to identify the mechanisms that drive these relationships. Nonetheless, concerning this latter issue important advances have been made in this area. For instance, van den Berg and Gupta (2011) find a causal effect of economic circumstances at birth—measured by the business cycle—on mortality later in life and that operates for Dutch women (but not for men) through marriage, and Maccini and Yang (2009) provide suggestive evidence that the causal effect of weather conditions early in life—measured by birth year rainfall—on the adult SES of Indonesian women is mediated more strongly by improved schooling attainment, and not as importantly by adult health.

Appendix to Chapter 3

Table A3.1: Variable definitions

Variable	Definition
Respondent's Socioeconomic Characteristics	
Health status	Self-Reported Health (SRH). The five SRH categories (from 1 to 5: poor, fair, good, very good, and excellent) are combined into three (from 1 to 3: poor or fair, good, very good or excellent).
Employment status	The categories no work and work. As suggested by Maestas (2010), we combine more objective information on hours of work and subjective employment status (both self-reported) to construct our measure of employment. No work includes those who are retired; permanently sick, or disabled; homemakers; the unemployed; and other individuals who make a living from owning properties, doing voluntary work, and so forth. Work refers to employed or self-employed individuals who report a positive number of hours of work per week in their primary job.
Education	Includes three levels of education defined from the 1997 International Standard Classification of Education (ISCED, http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm): no education, primary education and lower secondary education (ISCED 0–2), upper secondary and postsecondary nontertiary education (ISCED 3–4), and tertiary education (ISCED 5–6).
Marital status	Is equal to 1 if living with spouse/partner, 0 if living as a single. Six individuals who live alone but report a marital status "other" are included as singles.
Number of children	Includes biological children. Four intervals are considered: no children, 1 child, 2 children, and 3 or more children.
Age	Includes dummy variables for each age year.
Time	Includes dummy variables for each survey year.
Respondent's Early Life Circumstances	
More than 25 books at home when 10 years old (*bookcase*)	Is equal to 1 if there were more than 25 books (at least enough to fill one bookcase) in the household when the person was 10 years old, 0 if less. Magazines, newspapers, and school books are not considered.
Breadwinner farmer or elementary occupation when respondent was 10 years old (*breadwinner*)	Is equal to 1 if the main household breadwinner worked as an agricultural-fishery worker or in an elementary occupation when the respondent was 10 years old, 0 otherwise.
Rooms per person when 10 years old (*rooms*)	The number of rooms per person in the household when the respondent was 10 years old. Includes bedrooms, but excludes kitchen, bathrooms, and hallways.
Chronic conditions during childhood (0–15 years)	Is equal to 1 if a respondent suffered from one or more chronic conditions during his childhood (0–15 years), 0 otherwise. Includes the following chronic conditions: severe headaches or migraines; epilepsy, fits, or seizures; emotional, nervous, or psychiatric problem; childhood diabetes or high blood sugar; heart trouble; and other serious health conditions.
One month or more in bed during childhood (0–15 years)	Is equal to 1 if during childhood (0–15 years) and because of a health condition, the respondent was confined to bed or home for one month or more, 0 otherwise.
Height (in centimeters)	Adult self-reported height (in centimeters).

Chapter 4:

Early life circumstances and life-cycle labor market outcomes

4.1. Introduction

There is a growing literature that demonstrates that the widely documented socioeconomic status (SES)-health gradient in adulthood (Marmot and Wilkinson, 1999; Smith, 1999) has its origins in an individual's early life (Case *et al.*, 2002; Currie and Stabile, 2003). Two chapters of the most recent volumes of the Handbook of Labor Economics (Almond and Currie, 2011b; Black and Devereux, 2011), for instance, show that adverse health events in early life and parental SES have long-lasting effects on later life health and SES-related outcomes such as earnings and work effort. But with the possible exception of Smith (2009), and to the best of our knowledge, there is no empirical study to date that has attempted to quantify how such early life circumstances relate to an individual's earnings and other labor market outcomes over the entire life cycle. To investigate this is in particular important as some consequences of adverse (health) events early in life may not become apparent until later in adult life as, for instance, discussed in Almond and Currie's (2011a) survey on the economic consequences of Barker's (1995) *fetal-origins hypothesis*, or if their impacts accumulate over the life-cycle as some *life course models* propose (e.g., Kuh and Wadsworth, 1993). Likewise, children from parents with a higher SES may face better economic opportunities over their life cycle as a result of nepotistic family connections (Bowles, 1972)[43] or because of (inherited) factors that are correlated with family background (Bowles and Gintis, 2002) and which are rewarded in the labor market such as cognitive skills (Case and Paxson, 2008b), social skills (Persico *et al.*, 2004) and other noncognitive skills related to personality (Lundborg *et al.*, 2014; Mueller and Plug, 2006), and beauty and other aspects of physical appearance (Scholz and Sicinski, 2014).

A study closest to ours is that of Smith (2009). He uses a subsample of U.S. siblings from the Panel Survey of Income Dynamics (PSID) aged 25–47 in 1999 to estimate the associations of childhood self-reported health (SRH) status and parental income during childhood on an individual's initial level of (annual) earnings at age 25 and its subsequent growth. He finds that about 50 percent of their overall impact is already present at age 25, while the remaining 50 percent is the consequence of faster individual income growth after age 25. Moreover, when unobserved family effects are controlled

[43] This is also consistent with the importance of (social) networks as the literature on intergenerational mobility (in occupation) suggests. See Black and Deveraux (2011) for a survey.

for (using within-siblings estimates), the estimate of childhood SRH on post-age 25 individual income growth is substantially larger. When looking at (annual) weeks worked, he reports no evidence of an association of childhood health with (annual) weeks worked at age 25, but a positive one with the change in weeks worked from age 25 onward. However, a potential drawback of his analysis is that he focuses on (at most) two years of an individual's work career and that the oldest individuals in his sample are still relatively young from a life-cycle perspective (namely, 47 years old).

Apart from Smith (2009), most of the previous studies that have analyzed the effects of early life circumstances on later life earnings have usually focused on a single age later in life. For instance, some twin studies that compared to sibling studies additionally control for virtually all genetic differences have explored how birth weight—as a measure for health in utero—relates to earnings later in life. For example, Black *et al*. (2007) link administrative data to a sample of Norwegian twins and find a positive association between birth weight and earnings in early adulthood (at ages 25–35) that is similar with or without controlling for twin fixed effects. Behrman and Rosenzweig (2004), instead, using an U.S. female sample of monozygotic (MZ) twins, find that the (positive) association between birth weight and hourly wages in adulthood (at ages 39–58) is significant when controlling for (MZ) twin fixed effects only.

Additional empirical support for these estimated associations is provided by several recent studies that find causal impacts of very specific exogenous early life events on later life earnings. For instance, Almond (2006) uses the 1918 Influenza Pandemic as measure of a health shock around birth (more specifically, as a natural experiment to test Barker's *fetal-origins hypothesis*), and shows that it reduces annual wage income of U.S. men of (about) ages 40, 50 or 60. When using a similar approach to Almond (2006), Nelson (2010) does not find a significant effect on hourly wages of relatively old (above age 65) individuals (and males) in Brazil. Chen and Zhou (2007) show that the 1959–1961 famine in China adversely affected the earnings of the survivors in rural areas at ages 24–37, but these effects are only marginally significant.

However, some studies in the literature on intergenerational earnings mobility suggest that the association between (annual) earnings and lifetime earnings is likely to increase over an individual's life cycle and empirical studies that consider only a specific age are, therefore, likely to suffer from a so called life-cycle bias (e.g., Haider and Solon, 2006). To tackle this issue, Brunello *et al*. (2012) examine the associations of early life circumstances with individual's total lifetime earnings. They find that the long-term association between access to books in the parental home (as a measure for parents' cultural background or education) and lifetime earnings for men in Europe is in part mediated through educational attainment, but provide no evidence on how these associations with accumulated earnings evolve over a life cycle .[44]

Our main contribution to the literature is that we examine in detail how early life circumstances in terms of health and parental SES are related to labor market outcomes over the entire life cycle. We quantify the associations of individual's health and (parental) SES during childhood at five-year age intervals between the ages 25–65 with individuals' earnings and other labor market outcomes such as average annual earnings and number of years worked. For this purpose we use data from the Survey of Health, Ageing and Retirement in Europe (SHARE), and in particular from its third wave called SHARELIFE which in addition to information on respondent's early life circumstances contains data on their full work histories.

Our findings provide valuable insights into some of the previous findings in the literature. For instance, we show that the associations between early life circumstances and (accumulated) labor market outcomes are not constant over an individual's life cycle. In particular for work effort (working years), we find a strong negative association with childhood SES at the beginning of the work career which decreases with age as individuals with a higher childhood SES also enter the labor market and those with a low childhood SES accumulate more employment gaps. This finding could explain Case *et al*.'s (2005) result for British men of a positive association between family income at age 16 and employment probability at age 42, one that is, however, insignificant at age 33. In addition, we show that there is an increasing association between childhood SES and accumulated earnings over the life cycle, one that for men, moreover, has the opposite sign at the beginning of the work career. These findings provide evidence on the possible role of the aforementioned life-cycle bias in, for

[44] Also Belfield *et al*. (2006), who study the effects the Perry Preschool Program—an early life intervention targeted to disadvantaged African American children ages 3–4 in the U.S., use retrospective interview data at ages 27 and 40 on the work careers of the participants and control group (in total 123 individuals) to estimate (three) different lifetime earnings profiles (for ages 18–65). They find that treated males and females have, respectively, 11 to 34 percent and 19 to 36 percent higher earnings than their controls. They do not test, however, if these differences are statistically significant.

instance, the estimated associations of intergenerational earnings mobility at different ages (Haider and Solon, 2006).[45]

The remainder of the paper is organized as follows. Section 2 describes the data and the main variables for analysis, for instance, how we construct our measure of lifetime earnings. Section 3 contains empirical models that investigate the associations of early life circumstances with lifetime earnings, and in particular, with labor market outcomes over the life cycle: (accumulated) earnings, (average) annual earnings, number of years worked, number of career gaps, and the probability of retiring. We also investigate if some of these associations over the life cycle differ between European country-groups. Section 4 analyzes the robustness of our main results. Section 5 summarizes the main findings and concludes.

4.2. Data and descriptive statistics

We use individual-level data from the first three waves of the Survey of Health, Ageing, and Retirement in Europe (SHARE; http://www.share-project.org/), a multidisciplinary and representative cross-national panel of the European population aged 50 and over. The first two waves were conducted in 2004/2005 and 2006/2007, respectively. These waves include information on sociodemographic background characteristics, current health and socioeconomic status (e.g., education, employment, and income), and expectations (on, e.g., retirement age). Most of our data, however, stem from the third wave, carried out in 2008/2009 and referred to as SHARELIFE. This third wave contains retrospective information on the entire life-histories of about 75 percent of the individuals who participated in waves one or two, which ranges from early life circumstances, to work careers, and to other social, economic and health events occurred during life. In our analysis, we combine this information with the one provided in the retrospective SHARE Job Episodes Panel Data (Brugiavini *et al*., 2013). This retrospective panel is basically a reshape of the work history section of SHARELIFE where each respondent contributes as many observations as there are years of age from birth to the age at which the respondent is observed at the time of the SHARELIFE interview. This retrospective panel contains (cleaned) information on the start and end

[45] For this, one needs to think of childhood SES as proxy for parental lifetime earnings. This introduces right-side measurement error in an OLS regression which is, however, most likely to result in an attenuation bias of the estimated intergenerational earnings elasticity (cf. Haider and Solon, 2006).

dates of all the job spells that respondents had during their working life, plus some job characteristics such as job income, and some additional information on year of retirement, pension benefits and unemployment spells.

Our sample consists of 11,015 male and 13,180 female European respondents and spouses aged 50 and over in the interview year of SHARELIFE.[46] We drop male and female respondents who never worked or did not report any wage in SHARELIFE (1,388 and 3,900 cases, respectively), as well as those that worked for less than 5 years (261 cases) to exclude individuals with very short employment careers. We also exclude male and female respondents for whom only one wage point is available (1,379 and 1,465 cases, respectively). Trimming compounded labor income by 1 percent from above and below in each country sets 304 values to missing. After dropping missing values in the childhood SES variables (430 cases), childhood health variables (58 cases) and height (112 cases), we end up with our final sample of 7,740 male and 7,158 female respondents (and spouses) from the following thirteen countries: Sweden, Denmark, the Netherlands, Switzerland, Austria, Germany, France, Belgium, Spain, Italy, Greece, Czech Republic, and Poland. Table 4.1 reports the number of individuals (i.e. respondents), N, by country and gender.

Lifetime earnings

We construct our measure of lifetime earnings in a similar way to Alessie *et al*. (2013).[47] Our measure of compounded labor income at age t is given by $L_{0t} = \sum_{\tau=1}^{t} (1+r)^{t-\tau} E_{\tau}$, where r is a constant real interest rate, and E_{τ} are annual earnings from employment at age τ. For each job spell, the retrospective SHARE Job Episodes Panel Data (Brugiavini *et al*., 2013) provides on top of cleaned start and end dates, the first net monthly wage or net income in nominal local currencies, depending on whether the respondent worked as an employee or as a self-employed during that job spell. If the respondent retired already by the time of interview, also the last net monthly wage in

[46] We do not restrict the sample to men as in previous studies such as Brunello *et al*. (2012).

[47] We do, however, not include pension benefits in our measure of lifetime earnings. The reason for this is that we want to avoid a possible problem of double counting as would be the case if some pension benefits are funded by savings on net income from employment, as we have in our sample (see also Brunello *et al*., 2012). In any case, Weiss (2012), who uses also SHARELIFE data, reports a correlation of 0.95 between lifetime earnings with and without pension benefits.

the main job is reported (or instead, for the self-employed, the last net monthly income from work). To obtain a complete wage path, we use linear interpolation between the first wage on each job and the last wage of the main job. For those still working at the time of the SHARELIFE interview, we add the current net monthly wage (or, the current net monthly income for the self-employed) in that year from the original SHARELIFE wave to the retrospective panel to use it as an additional point on the wage path. Similarly, we also add net monthly wages from waves 1 and 2, and for the self-employed also net monthly income from wave 2 (not available in wave 1) to the retrospective job panel if wages or incomes in the corresponding years are missing.[48] During unemployment years, we assign the respondent a wage equal to 80 percent of their last earnings. We convert all incomes (irrespective of in which country and in which year these amounts were earned) to annual PPP-adjusted German Euros of 2006 following the procedure explained in Trevisan *et al*. (2011). Period 1 is taken to be the start of the working career, and we compound up to the SHARELIFE interview year for the non-retired, and the year before retirement (or the year of retirement if the individual reports to work in the year of retirement) for the retired, using an annual real interest rate of 2 percent (cf. Brunello *et al*., 2012; Haider and Solon, 2006). After compounding, we have a cross-sectional dataset, with one observation per individual.

For those individuals that are still working at the time of the SHARELIFE interview, we need to calculate also their future labor income, which is given by $L_{1t} = \sum_{\tau=t+1}^{R} (1+r)^{t-\tau} E_{\tau}$, and is computed under the assumption of constant real annual earnings $(E_{\tau} = E_t,\ \tau = t+1,...,R)$. Retirement R starts in the year in which the individual reaches his or her expected retirement age, obtained from waves 1 and 2 (more specifically, the age at which they expect to collect pension benefits), or the statutory retirement age (in 2010, usually 65 for men, and 65 or 60 for women, as reported in Table A4.1) in case of item non-response to that question. We use country- and gender-specific 2009 (period) life tables from Eurostat (http://epp.eurostat.ec.europa.eu/) to

[48] We annualize earnings by multiplying monthly earnings by 12 to obtain annual earnings. Earnings are annualized because employment spells are in years.

weight all future incomes (that is, those earned after the SHARELIFE interview year) by the probability of survival.[49]

To sum up, for individuals that are retired at the time of the SHARELIFE interview, their lifetime earnings are measured by L_{0t}, while for individuals that are still working, their lifetime earnings are the sum of L_{0t} and L_{1t}. Table 4.1 shows sample statistics for average undiscounted annual earnings (computed as the sum of all annualized earnings from employment divided by years worked),[50] by country and gender. The cross-country pattern of median earnings, in particular for men, is encouraging for the reliability of these retrospective data, we believe. Eastern European countries such as Poland and the Czech Republic have considerably lower annual earnings compared to Western European countries, while annual earnings are the highest in Switzerland. Women's pattern of median annual earnings is somewhat less clear when compared to that of males, but all in all similar: annual earnings are the lowest in Eastern European countries and the highest in Switzerland.

Table 4.1: Annual Lifetime Earnings (Undiscounted, in PPP-adjusted German Euros of 2006)a

	Men			Women		
	Medians	Means	N	Medians	Means	N
Austria	15,919	18,386	184	9,587	11,429	196
Germany	18,844	21,746	629	10,459	11,630	628
Sweden	17,505	22,575	626	11,498	14,385	723
Netherlands	16,870	18,878	747	7,608	9,560	684
Spain	14,097	22,417	475	8,518	14,611	306
Italy	12,730	15,847	873	9,410	11,991	626
France	20,421	35,120	606	12,822	26,729	573
Denmark	17,396	19,662	738	11,171	12,978	744
Greece	17,124	26,733	533	13,006	19,436	310
Switzerland	35,007	41,336	438	16,725	19,456	457
Belgium	19,719	21,760	854	13,670	14,747	665
Czech Republic	8,461	9,689	555	6,562	7,311	773
Poland	6,652	15,589	482	4,843	15,584	473

[a] The table shows sample median and mean values for annualized earnings from employment obtained from the retrospective survey, as well as sample sizes (N) by country and gender. All amounts are undiscounted and in PPP-adjusted German Euros of 2006.

[49] We use within period survival probabilities, i.e., between age t and t+1, and allow these to vary across country, gender and age. We assume the survival probabilities remain constant after 2009.

[50] This variable is only used for the descriptive analysis.

Childhood SES

For measuring childhood SES we use four variables that capture different dimensions of the respondent's SES at age 10. First, we include the number of rooms per person and the number of facilities in the household (including fixed bath, cold and hot running water supply, inside toilet and central heating) as those have been shown to be good proxies for the parent's financial status (Cavapozzi *et al*., 2011). Second, we consider the estimated number of books at home, which is meant to capture the parents' cultural background or education (Cavapozzi *et al*., 2011). Last, we use the main breadwinner's occupation (in ISCO-88 skill levels) as a measure of the household's work status. We construct a single index of childhood SES using the Principal Component Analysis (PCA). We take the first principal component (PC), which explains the largest proportion of the total variance, as a measure of an individual's SES during childhood. We estimate the index using the pooled sample of all European countries and men and women. The index explains 50.5 percent of the total variance and all the factor loadings on the first PC have the expected positive sign (see Table 4.2).

Table 4.2: Childhood SES index[a]

	Pooled sample
Rooms per person in the household when 10 years old	0.434***
	(0.00738)
Number of books at home when 10 years old	0.569***
	(0.00461)
Main breadwinner's occupation when 10 (in ISCO-88 skill levels)	0.432***
	(0.00745)
Number of facilities in the household when 10 years old (range 0-5)	0.548***
	(0.00513)
Explained variance	0.505
N	14898

[a] The table shows the factor loadings on the first principal component with its explained variance. Standard errors are in parentheses. Significance levels: * p<0.05, ** p<0.01, *** p<0.001.

Childhood health

We follow a similar strategy for measuring childhood health where we combine subjective with objective health measures referred to when the respondent was less than 16 years old to generate a childhood health index (HI) for each respondent. As our subjective health measure we use childhood SRH, and group the original six categories (from 1 to 6: excellent, very good, good, fair, poor, and changing) into four (from 1 to 4: excellent; very good; good; fair, poor, or changing). Among the objective health measures, we consider the number of respiratory problems, infectious diseases, cardiovascular diseases, neurological and psychiatric diseases, disorders of the sense organs, and the number of neoplastic diseases and other serious health conditions an individual suffers during childhood.[51] As for childhood SES, we use the PCA and keep the first PC as a measure of an individual's childhood health (cf. Poterba *et al*., 2010). We estimate the index using the pooled sample of all European countries and men and women. The index explains 20.2 percent of the total variance and all the factor loadings on the first PC have the expected positive sign (see Table 4.3).

Table 4.3: Childhood Health Index (HI)[a]

	Pooled sample
Childhood SRH (1 = excellent, 4 = fair, poor or changing)	0.610***
	(0.0111)
Number of respiratory problems	0.423***
	(0.0173)
Number of infectious diseases	0.264***
	(0.0214)
Number of cardiovascular diseases	0.210***
	(0.0221)
Number of neurological and psychiatric diseases	0.364***
	(0.0191)
Number of disorders of the sense organs	0.347***
	(0.0191)
Number of neoplastic diseases and other serious health condition	0.288***
	(0.0222)
Explained variance	0.202
N	14898

[a] The table shows the factor loadings on the first principal component with its explained variance. Standard errors are in parentheses. Significance levels: * p<0.05, ** p<0.01, *** p<0.001.

Additional controls

We include dummies for birth-year in all equations to control for possible secular or cohort-specific changes in society, and especially after World War II, that occurred after an individual's childhood and which may have affected both an individual's labor market behavior over the life cycle and lifetime earnings. Moreover, because of the well-known differences in institutional settings between European countries, e.g. in labor market characteristics and health care systems, we also include country dummies.

[51] These count variables are constructed using the information in questions hs008 and hs009 in the SHARELIFE questionnaire where respondents are asked to report on a yes or no basis whether they had 20 specific childhood diseases between their birth and age 15. In particular, respiratory problems include asthma, and other respiratory problems and allergies. Infectious diseases include also polio, severe diarrhea, meningitis/encephalitis, and appendicitis. Cardiovascular diseases include diabetes or high blood sugar, and heart trouble. Neurological and psychiatric diseases include severe headaches or migraines, and epilepsy, fits or seizures, and emotional, nervous or psychiatric problems. Disorders of the sense organs include chronic ear problems, speech impairment, and difficulty in seeing even with eyeglasses. Finally, other serious health conditions are combined with neoplastic diseases.

For instance, with regard to the objective health measures that we use, Havari and Mazzonna (2011) find a large variation of response rates to these health measures across countries which they attribute to a different access to medical services and to a lack of good technology fifty years ago in diagnosing diseases (mainly, in the Mediterranean and Eastern European countries). This underscores the need to control for country effects when using these variables. In addition, even if Havari and Mazzonna (2011) find no evidence of recall error in these conditions,[52] they report some evidence of a negative association between age and reporting these conditions, which underscores the need to control also for birth (or age) effects when using these variables.

4.3. Empirical results

4.3.1. Early life circumstances and total lifetime earnings

We first examine the associations of early life circumstances with (total) lifetime earnings. For this purpose we estimate linear regressions on the log lifetime earnings of men and women. The childhood HI is turned into an index of good health, and both indices are transformed into terciles. All models in Sections 4.3 and 4.4 include both country dummies and birth-year dummies. The significance levels are based on robust standard errors.

As shown in columns (1) in Table 4.4, childhood SES is strongly associated with lifetime earnings, and most notably for women. For instance, men and women with a low childhood SES earn, respectively, up to 28 ($\exp(-0.243) - 1$) and 50 percent less income during their working life when compared to individuals who had a high SES during childhood. To a lesser extent, we also find a positive association with childhood health. Men and women with a low childhood HI earn up to 6 percent less income during their working life when compared to those who had a high HI during childhood.

[52] In particular, they do not find evidence that memory capacity—measured by two cognitive ability tests consisting of a verbal registration and recall of a list of ten items—is significantly associated with the reported number of childhood illnesses.

Table 4.4: Log lifetime earnings regressions for men and women in Europe[a]

	Men (1)	(2)	Women (3)	(4)
Low childhood HI	-0.056***		-0.062**	
	(0.019)		(0.027)	
Medium childhood HI	-0.042**		-0.034	
	(0.021)		(0.028)	
Low childhood SES	-0.243***		-0.406***	
	(0.022)		(0.030)	
Medium childhood SES	-0.109***		-0.184***	
	(0.019)		(0.024)	
Low HI * Low SES		-0.308***		-0.461***
		(0.035)		(0.047)
Low HI * Medium SES		-0.179***		-0.253***
		(0.030)		(0.041)
Low HI * High SES		-0.097***		-0.001
		(0.029)		(0.038)
Medium HI * Low SES		-0.311***		-0.396***
		(0.035)		(0.053)
Medium HI * Medium SES		-0.169***		-0.174***
		(0.033)		(0.043)
Medium HI * High SES		-0.063*		-0.054
		(0.034)		(0.041)
High HI * Low SES		-0.274***		-0.380***
		(0.035)		(0.051)
High HI * Medium SES		-0.141***		-0.141***
		(0.031)		(0.046)
Buffering Hypothesis[b]		0.908		0.108
R-squared	0.253	0.253	0.201	0.202
Observations	7740	7740	7158	7158

[a] The OLS regressions include both country dummies and birth-year dummies.

[b] The buffering hypothesis in columns (2) shows the resulting p-value when testing $\beta_{LowHI*LowSES}$ - $\beta_{LowHI*HighSES} < \beta_{HighHI*LowSES}$ - $\beta_{HighHI*HighSES}$, where HighHI*HighSES is the reference category. Robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

According to studies such as Case *et al*. (2002) and Currie and Stabile (2003), income buffers children from the negative effects of chronic conditions (which are also more common among low-SES children). To explore this so called buffering hypothesis in lifetime earnings and test if childhood health affects lifetime earnings non-linearly through the childhood SES distribution, we add interaction terms between the childhood health and SES terciles in columns (2). In particular, we want to test if having a higher SES during childhood reduces the negative impact on lifetime earnings of having a poor health during childhood. If childhood SES has such a protective effect, we would expect the effect of the interaction term LowHI*LowSES to be in absolute terms greater than the effect of the interaction term LowHI*HighSES, and hence, as a results of the negative signs corresponding these interaction terms (a consequence of the reference category being HighHI*HighSES), we test $\beta_{LowHI*LowSES} - \beta_{LowHI*HighSES} < 0$ where the βs are the corresponding parameters. However, in our sample, childhood SES is driving most of these interaction effects (see columns (1)). To be conservative, we argue that there is a buffering effect if the protective effect of childhood SES is larger for those individuals who were in relatively poor health during childhood than for those with a relatively good health during childhood (i.e., we test $\beta_{LowHI*LowSES} - \beta_{LowHI*HighSES} < \beta_{HighHI*LowSES} - \beta_{HighHI*HighSES}$). However, as the bottom part of the table shows, we do not reject the null of no buffering effect of childhood SES (the p-values are 0.908 for men and 0.108 for women).

4.3.2. How does the association between early life circumstances and lifetime earnings evolve over the life cycle?

Smith (2009) finds that the association of childhood health (and parental income) with (annual) individual earnings is larger when measured at age 40 than at age 25 which he argues is consistent with both the fact that some consequences of poor childhood health in terms of earlier life adult onset of disease do not appear until later in adult life and also that their impacts might be cumulative. Our main advantage over Smith's study is that while he considers (at most) two years of an individual's work career, our data allows us to explore how these associations evolve over the full work career of an individual. Moreover, we also slightly change the focus and look at the *accumulated results until a certain age* in the life cycle rather than at the *results at a certain age* in the life cycle, which is what previous studies (inclusively Smith, 2009)—to the best of our knowledge—have done. This approach, we believe, might be more informative of the possible cumulative impacts that early life circumstances have on earnings.[53] In the next section, we also present estimates on an individual's *cumulative* (average) annual earnings at different ages (which might be more comparable to the results of Smith (2009) and other studies discussed in Section 4.1).

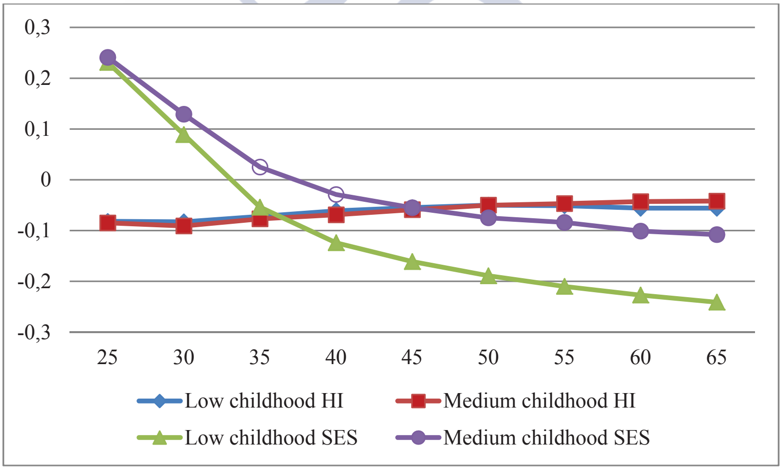
Figures 4.1 and 4.2 extend the analysis in columns (1) in Table 4.4 over men and women's work career, respectively. The figures show the estimates for the childhood HI and SES terciles obtained when estimating log lifetime earnings equations at different ages of men and women's work career. To perform such a life-cycle analysis, throughout the paper, we look at five-year age intervals between the ages 25–65. Similarly, Figures 4.3 and 4.4 extend the analysis in columns (2) in Table 4.4 and test the "buffering hypothesis" on lifetime earnings over men and women's work career.

[53] One may also argue that, for survey data in particular, outcomes measured over a longer period of time are likely to be less noisy than outcomes measured at a specific point in time.

Throughout this section, a full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors (the full estimation results are in tables A4.2 and A4.3 in the appendix).

Figure 4.1 shows that, compared to men with a high childhood HI, those with a low and medium childhood HI accumulate significantly less earnings over their whole career, but that these effects are not dramatic and remain more or less constant (between 5 and 9 percent). Instead, those with a low childhood SES accumulate more earnings at younger ages (around 26 percent (exp(0.231) − 1) more at age 25), most likely because they start working earlier (see next section) and have had less education (results not shown), but end up with about 27 percent lower lifetime earnings (at the age 65) compared to men with a high childhood SES. Individuals with a high childhood SES have already caught up in (accumulated) earnings around the ages 30–35.

Figure 4.1: Estimates from log lifetime earnings regressions over the life cycle I (Men)[a]

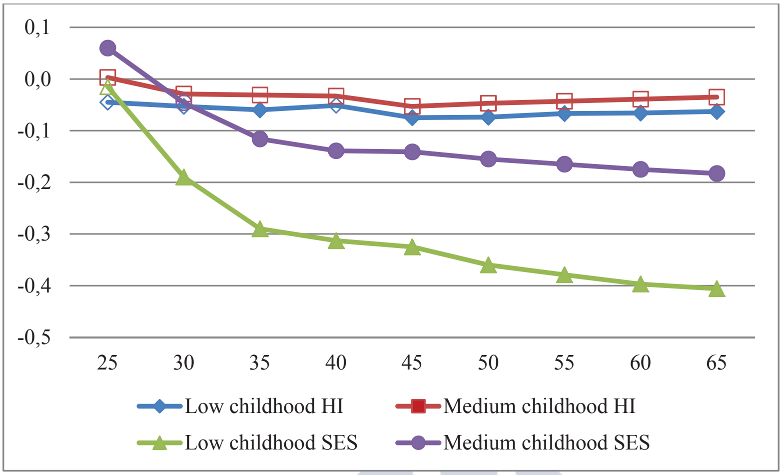


[a] The figure shows OLS estimates for low and medium childhood HI and low and medium childhood SES obtained from estimating linear log lifetime earnings equations at different ages over an individual's working life. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

Figure 4.2 shows that women with a low childhood HI present a similar pattern than that of men, and earn over most of the life cycle about 5–8 percent less income when compared to women with a high childhood HI. This association, however, becomes most evident at later ages than for men, from age 45 onwards. Instead, women with a medium and, in particular, a low SES during childhood start accumulating increasingly less earnings over their working life at an earlier age than their male counterparts, at age

30 already. Compared to women with a high childhood SES, those with a low childhood SES accumulate already 21 percent less earnings at age 30 and end up with 50 percent $(\exp(-0.406) - 1)$ less lifetime earnings at age 65.

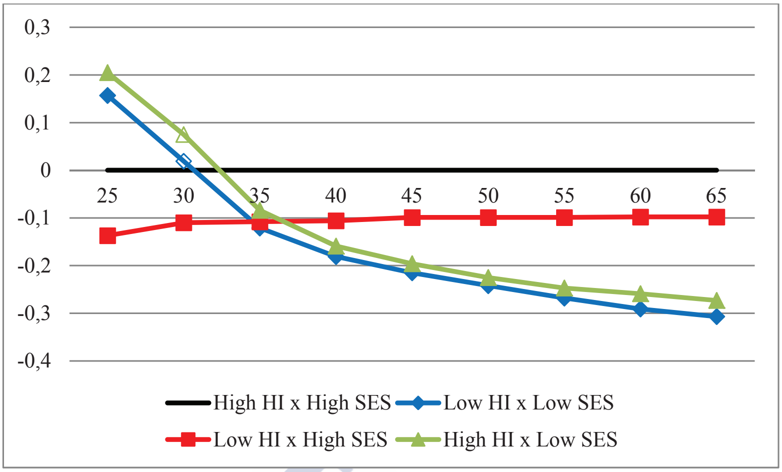
Figure 4.2: Estimates from log lifetime earnings regressions over the life cycle I (Women)[a]



[a] The figure shows OLS estimates for low and medium childhood HI and low and medium childhood SES obtained from estimating linear log lifetime earnings equations at different ages over an individual's working life. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

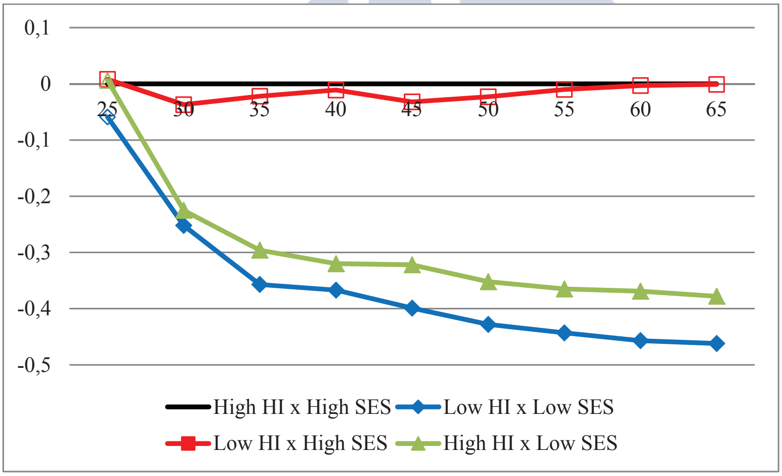
Figures 4.3 and 4.4 show the same picture for men and women, respectively, but with the interaction terms needed for testing the buffering hypothesis $\beta_{\text{LowHI*LowSES}} - \beta_{\text{LowHI*HighSES}} < \beta_{\text{HighHI*LowSES}} - \beta_{\text{HighHI*HighSES}}$. As shown in Figure 4.3, men who had a low childhood SES have a similar pattern independently of whether they were in the top or bottom part of the childhood health distribution. We interpret this as no evidence of a buffering effect, which is supported by the formal tests in the appendix table A4.3. Figure 4.4, instead, shows that for women the negative effect of having a low SES during childhood is larger for those who also had a low childhood HI when compared to those with a low childhood SES but a high childhood HI. However, when testing for it, we only find very limited evidence of a buffering hypothesis, and at a 10 percent significance level.

Figure 4.3: Estimates from log lifetime earnings regressions over the life cycle II (Men)[a]



[a] The figure shows only the interaction terms needed for computing the buffering hypothesis ($\beta_{LowHI*LowSES} - \beta_{LowHI*HighSES} < \beta_{HighHI*LowSES} - \beta_{HighHI*HighSES}$) obtained from estimating linear log lifetime earnings equations at different ages over an individual's working life (the reference category High SES x High HI is represented by the black zero line). All models include country dummies and birth-year dummies. A full square, diamond and triangle indicate significance at a 5% level based on robust standard errors. The full estimation results are in the appendix.

Figure 4.4: Estimates from log lifetime earnings regressions over the life cycle II (Women)[a]



[a] The figure shows only the interaction terms needed for computing the buffering hypothesis ($\beta_{LowHI*LowSES} - \beta_{LowHI*HighSES} < \beta_{HighHI*LowSES} - \beta_{HighHI*HighSES}$) obtained from estimating linear log lifetime earnings equations at different ages over an individual's working life (the reference category High SES x High HI is represented by the black zero line). All models include country dummies and birth-year dummies. A full square, diamond and triangle indicate significance at a 5% level based on robust standard errors. The full estimation results are in the appendix.

In sum, for both men and women we find evidence of a cumulative impact of childhood SES on lifetime earnings over the life cycle, although, in particular for men, this association is negative at the beginning of the work career. To a lesser extent, also childhood health shows a (positive) long-term association with lifetime earnings over the life cycle, and while for men most of this association is already present at age 25, for women it kicks in later, at about age 45. Finally, we do not find much evidence that a higher parental SES reduces the negative impact on lifetime earnings of poor health during childhood.

4.3.3. What is the implicit labor market behavior in the association between early life circumstances and earnings over the life cycle?

Smith's (2009) findings suggest that the positive association of childhood health with earnings operates in part through a greater adult work effort.[54] Similarly, some of the studies discussed in the introduction such as Chen and Zhou (2007) and Nelson (2010) find that early life circumstances affect, respectively, (annual) working hours in early adulthood and employment at older ages. Case *et al*. (2005), on their side, find, respectively, a negative and positive association of chronic conditions and parental income at age 16 with employment probability in mid adulthood. Instead, Black *et al*. (2007) show that the positive association between birth weight and the probability of working full time in early adulthood disappears after controlling for twin fixed effects.

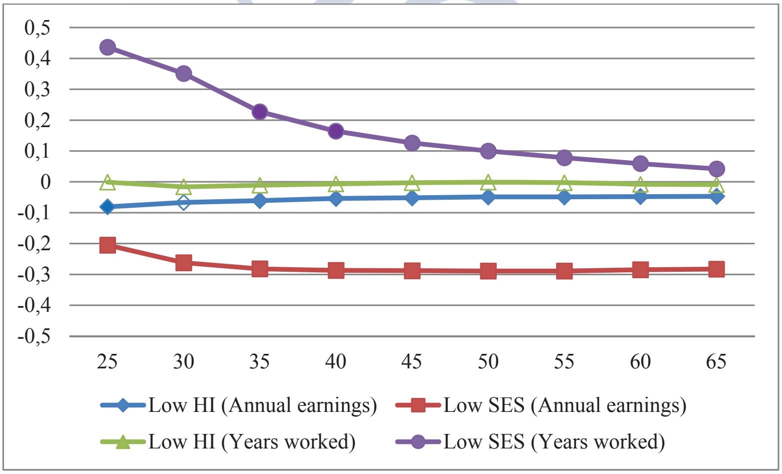
In the previous section we have shown how the associations of childhood health and SES with (accumulated) earnings vary over an individual's life cycle. To better understand the implicit labor market behavior that may cause this association, we further distinguish the importance of working years and annual earnings in it as the logarithm of lifetime earnings is equal to the logarithm of annual earnings plus the logarithm of years worked. This might shed light on whether the (cumulative) impact of early life circumstances on accumulated lifetime earnings operates through work effort (years worked) or through variations in human capital investment, and hence, also in labor market productivity (average annual earnings) (cf. Smith, 2009).

Figures 4.5 and 4.6 show for men and women, respectively, estimates for the bottom childhood health and SES terciles obtained from the estimation of linear regressions at different ages over an individual's work career on the log of (accumulated) years worked and on the log of (average) annual earning. As shown, men and women with a

[54] Instead, the one-year level association (in 1999) of parental income (and parental educational levels) with (annual) weeks worked in adulthood is insignificant.

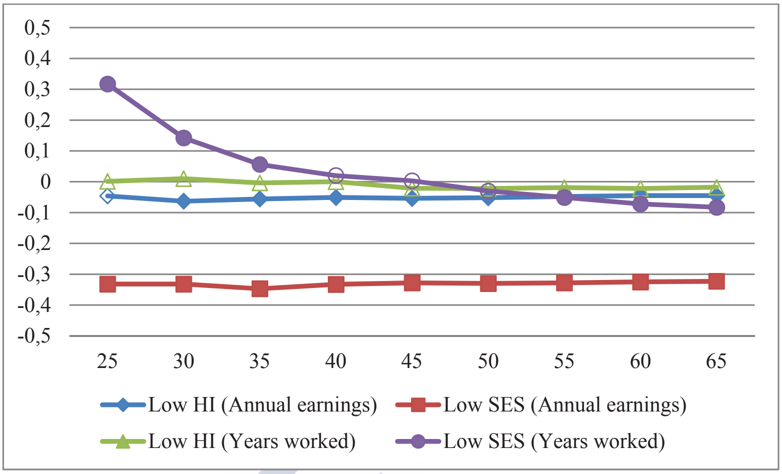
low childhood SES start working earlier, but during their work career individuals with a high childhood SES catch up, and women with a low childhood SES actually end up working less years than those with a high childhood SES. Men and women with a low childhood SES also have, respectively, about 23 ($\exp(-0.205) - 1$) and 39 percent lower annual earnings at age 25. But while for women this difference remains constant over their working life, for men it increases until more than 30 percent in the first ten years of their work career and remains constant afterwards. The figures also show that men and women with a low childhood health have lower annual earnings but do not work significantly less over the life cycle when compared to individuals with a high childhood health. However, we find that men with a medium childhood health work less years from age 30 until age 45 compared to men with a high childhood health (results not shown).

Figure 4.5: Estimates from regressions on log average annual earnings and log years worked over men's life cycle[a]



[a] The figure shows OLS estimates for low childhood HI and low childhood SES in linear regressions on the log (average) annual earnings and log years worked at different ages over an individual's working life. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

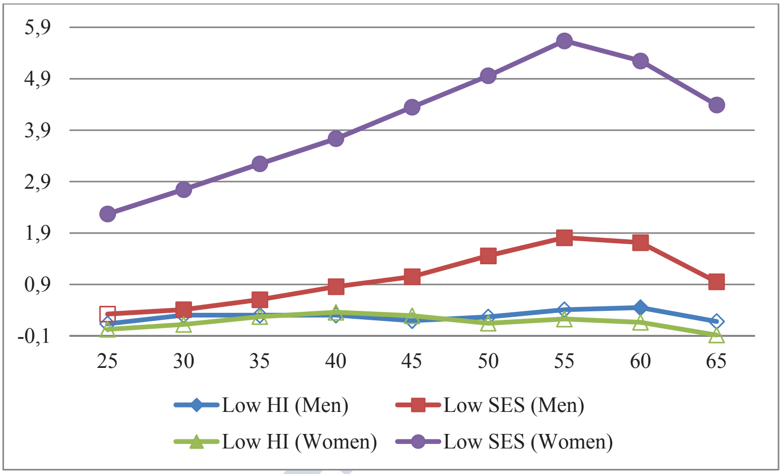
Figure 4.6: Estimates from regressions on log average annual earnings and log working year over women's life cycle[a]



[a] The figure shows OLS estimates for low childhood HI and low childhood SES in linear regressions on the log (average) annual earnings and log years worked at different ages over an individual's working life. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

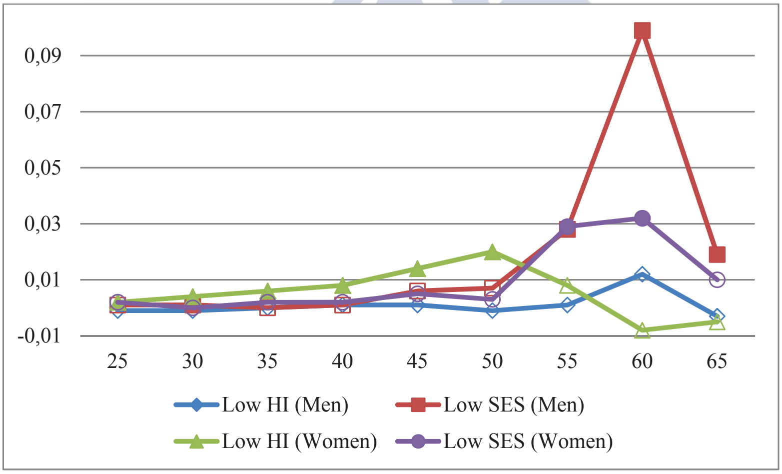
The previous findings for the number of years worked suggest that individuals with a low childhood SES may have more gaps during their work careers or perhaps are also more likely to leave the labor market earlier than individuals with a high childhood SES. This is analyzed in Figures 4.7 and 4.8, respectively, and for both men and women. Because of the many zero values in the number of career gaps we estimate Tobit models and present marginal effects in Figure 4.7. The figure confirms that individuals, and most notably women, with a low childhood SES accumulate more gaps almost from the beginning of their work careers (the difference diminishes after age 50 for males and after age 55 for females), which can explain why the negative association between childhood SES and working years diminishes over the life cycle. The estimates from simple linear probability models in Figure 4.8 show that women with a low childhood health are slightly more likely to retire until age 50 than women with a high childhood health, and that men and women with a low childhood SES are more likely to retire early, at ages 55–60, than individuals with a high childhood SES.

Figure 4.7: Marginal effects on the number of gaps over men and women's life cycle[a]



[a] The figure shows marginal effects for low childhood HI and low childhood SES obtained after the estimation of Tobit models on the (accumulated) number of gaps over men and women's work career. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

Figure 4.8: Estimates on the probability of leaving the labor market over men and women's life cycle[a]



[a] The figure shows estimates for low childhood HI and low childhood SES obtained from the estimation of linear (probability) models on the probability of leaving the labor market over men and women's life cycle. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

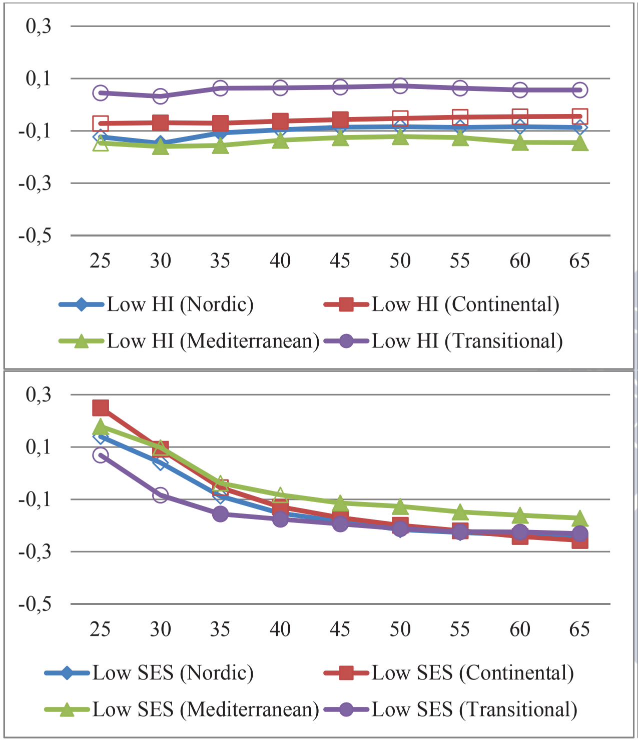
To summarize, both our results for total earnings and (average) annual earnings over the life cycle suggest a strong cumulative impact of childhood SES, but in general a much smaller one for childhood health. Moreover, our results for work effort might give us a different picture to that of Smith (2009). Individuals with a lower SES background start working earlier and have, in the case of men, actually longer work careers (although not for women). But they also retire earlier and accumulate more gaps over their work career. In addition, for women who had a poorer childhood health their probability of retiring is increasing until the age of 50 years, and men with a medium childhood health work actually less years during their mid-adulthood compared to men with a high childhood health (results not shown). These latter two findings together may explain Smith's result of a positive effect on annual weeks worked *at a certain age in adulthood* for those with better childhood health, although overall, their work effort during their career might be actually similar to that of individuals who had a poorer childhood health.

4.3.4. Are there heterogeneous life-cycle profiles between country-groups?

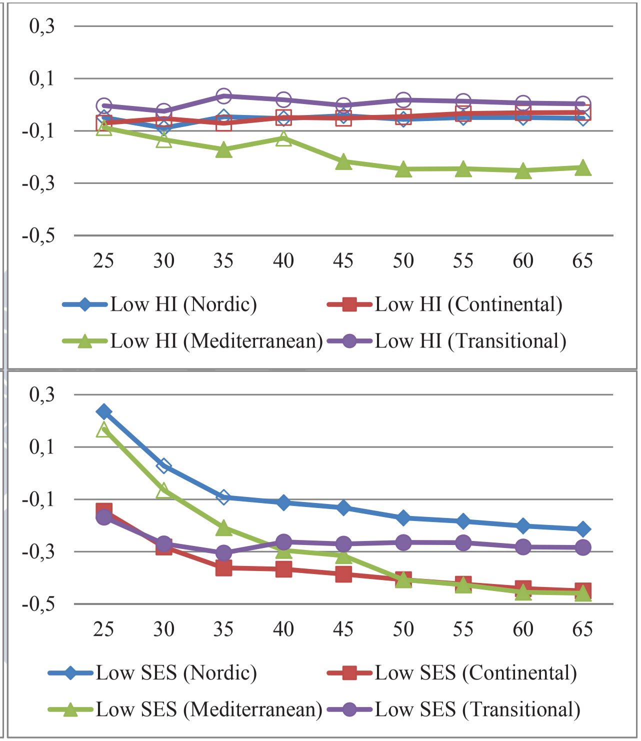
Up to this point in the discussion, labor market responses over the life cycle to childhood health and SES have been assumed homogeneous across our sample of European countries. However, large differences in the levels of development over the period the individuals in our sample were born and raised exist between the countries in our sample. These large differences in economic resources and access to medical treatments may affect associations between early life circumstances and later life outcomes as a more favorable environment in this respect may dampen the consequences of adverse health shocks early in life (Bengtsson and Mineau, 2009). To investigate this conjecture more closely, we classify the countries into Nordic (Sweden, Denmark), Continental (Netherlands, Switzerland, Austria, Germany, France, Belgium), Mediterranean (Spain, Italy, Greece) and Transitional (Czech Republic, Poland), and re-estimate the models in section 4.3.2 and the main models in section 4.3.3. Moreover, to ensure that the terciles of childhood SES and health are equally distributed with respect to country-groups, we use the country-group-specific distributions of childhood SES and health (instead of the distribution from the pooled sample) to create the terciles of childhood SES and health. Otherwise, for instance, the top (bottom) tercile of childhood SES would be composed mainly by Nordic (Mediterranean) respondents as these are better (worse) off in terms of childhood SES.

Figure 4.9: Estimates from log lifetime earnings regressions over men and women's life cycle in Nordic, Continental, Mediterranean and Transitional countries[a]

Panel A. Men



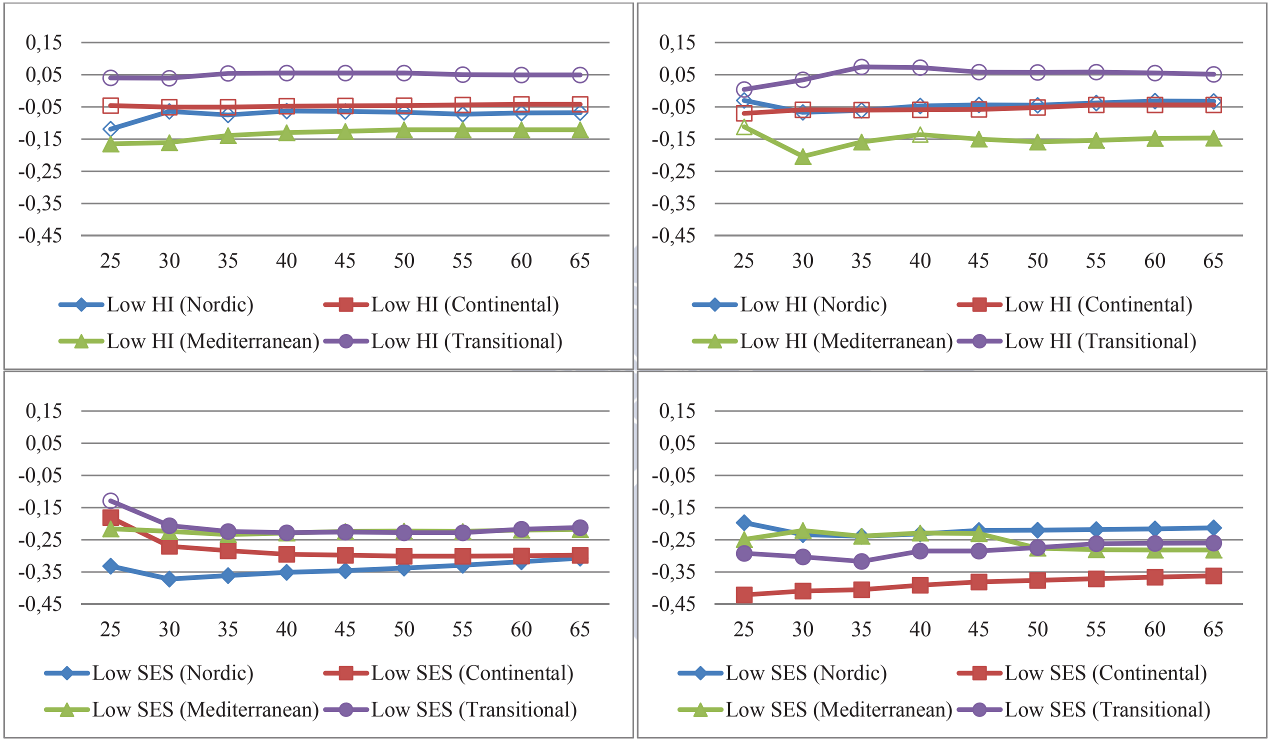
Panel B. Women



[a] The figure shows OLS estimates for low childhood HI and low childhood SES obtained from estimating linear log lifetime earnings equations at different ages over an individual's working life in the different country-groups and for men and women. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

Figure 4.10: Estimates from log average annual earnings regressions over men and women's life cycle in Nordic, Continental, Mediterranean and Transitional countries[a]

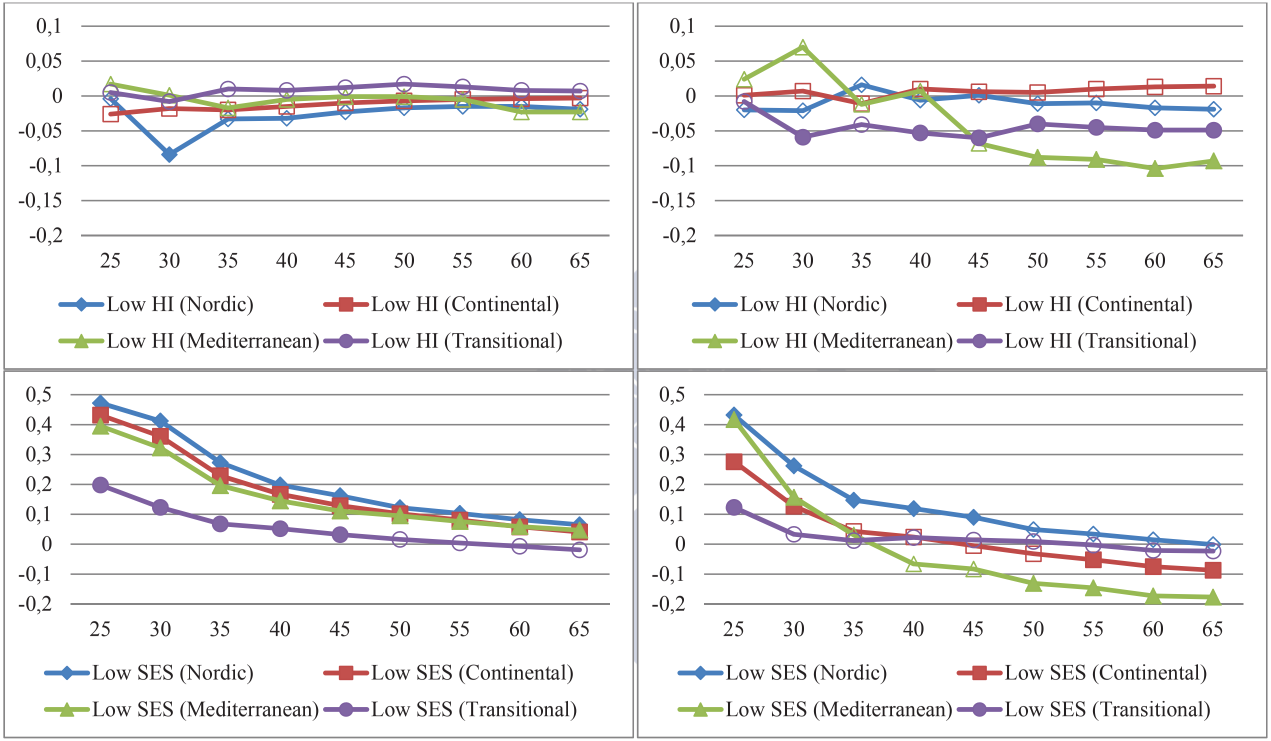
Panel A. Men **Panel B. Women**



[a] The figure shows OLS estimates for low childhood HI and low childhood SES obtained from estimating log average annual earnings equations at different ages over an individual’s working life in the different country-groups and for men and women. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

Figure 4.11: Estimates from log working years regressions over men and women's life cycle in Nordic, Continental, Mediterranean and Transitional countries[a]

Panel A. Men **Panel B. Women**



[a] The figure shows OLS estimates for low childhood HI and low childhood SES obtained from estimating log working years equations at different ages over an individual's working life in the different country-groups and for men and women. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies. A full square, diamond, triangle and dot indicate significance at a 5% level based on robust standard errors.

Figures 4.9 to 4.11 show estimates for low childhood HI and low childhood SES obtained from estimating linear regressions on, respectively, log lifetime earnings, log average annual earnings and log years worked at different ages over an individual's working life in the different country-groups and for men and women. These figures basically extend the results in Figures 4.1, 4.2, 4.5 and 4.6. The reference categories are, respectively, high childhood HI and high childhood SES. All models include country dummies and birth-year dummies.

As shown in the top panels in Figure 4.9, it is mostly in the Mediterranean countries where individuals with a low childhood health accumulate less earnings during their work career and to some extent also for men in Nordic and Continental countries, for whom having a medium childhood health is actually somewhat stronger associated with earnings over the life cycle (results not shown). Moreover, while for these men, most of this association is already present at the beginning of their work careers, for Mediterranean women this association kicks in a bit later, but is also larger and slightly increasing with age. To illustrate this, Mediterranean women with a lower childhood health accumulate 19 percent ($\exp(-0.171) - 1$) less lifetime earnings at age 35 which increases to about 27 percent at age 65. For Mediterranean men, these differences at age 35 and 65 are about the same (17 and 16 percent, respectively). The bottom panels show that although for men the profiles of the association between low childhood SES and earnings over the life cycle are similar in all country-groups, only in Continental and Mediterranean countries those with a low childhood SES accumulate (significantly) more earnings at younger ages (28 and 20 percent at age 25, respectively). Hence, only in these countries the association between low childhood SES and (accumulated) earnings reverses sign from positive to negative over the life cycle. At age 65, individuals with a low childhood SES have almost 30 percent lower lifetime earnings in all country-groups, except in the Mediterranean countries, where this difference amounts to 19 percent. For women instead, these profiles are more heterogeneous across country-groups, especially during the first part of the work career until approximately age 45. From that age onwards, Continental and Mediterranean women with a low childhood SES accumulate less earnings that their counterparts from Nordic and Transitional countries. For instance at age 65, the former have about 57 percent ($\exp(-0.450) - 1$) less lifetime earnings than their female peers with a high childhood

SES; for women from Nordic and Transitional countries this difference is of 24 and 33 percent, respectively.

The top panels in Figure 4.10 show that mostly in the Mediterranean countries individuals with a low childhood health have lower (average) annual earnings during their work career, and that most of this association is already present at the beginning of their work careers. For instance, average annual earnings up to age 30 are, respectively, already 18 and 23 percent lower for, respectively these men and women when compared to their counterparts with a high childhood health. These differences reduce, however, to, respectively, 13 and 16 percent at age 65. The bottom panels show that in all country-groups men and women with a low childhood SES accumulate lower annual earnings during their work career (especially women from Continental countries), and also that the profiles over the work career are rather flat with some notable exceptions, however, such as men from Continental countries for whom this associations increase at the beginning of the work career.

Finally, the top panels in Figure 4.11 show that for women mostly, and in particular from Mediterranean and Transitional countries, there is some evidence of a negative association between having had a low childhood health and accumulated work effort (working years) during the life cycle. Moreover, this association is not apparent at the beginning of the career. Also, in all country-groups men and women with a low childhood SES start working earlier, but during their work career individuals with a high childhood SES catch up, and women with a low childhood SES from Continental, and in particular from Mediterranean countries end up working less years than those with a high childhood SES. This latter difference in working years for Continental and Mediterranean women with a low and a high childhood SES becomes insignificant already at age 35.

In sum, concerning the differences between European countries, the relatively small and positive long-term association between childhood health and earnings over the life cycle, which appears to operate through skills (annual earnings) rather than through work effort (working years), is mainly localized in the Mediterranean countries. Instead, the relatively strong, cumulative impact of childhood SES on earnings over the life cycle operates in all country-groups and for men and women through both skills (annual earnings) and work effort (working years). However, it is mostly for men from

Continental and Mediterranean countries for whom the association between low childhood SES and (accumulated) earnings reverses sign from positive to negative over the life cycle. Finally, for women, we find that most of these associations (for instance, those with accumulated earnings) are larger in the Mediterranean and/or Continental countries when compared to Nordic and Transitional countries.

4.4. Sensitivity analysis

We performed several sensitivity analyses to test the robustness of our results. For instance, to take a better count of the discrete nature of the variables used to measure childhood SES (in particular, the variables number of facilities, number of books, and the main breadwinner's occupation) and childhood health (the variables childhood SRH and the number of different objective health conditions), we used the polychoric correlation matrix to perform the PCA. Doing so increases somewhat the explained variance by the first PC, but does not affect our estimation results for Europe. This finding is supported by Kolenikov and Angeles (2009), who show the relevance of using the polychoric correlation matrix when performing the PCA on dichotomous variables rather than on ordinal (and continuous) variables. Furthermore, we used the country- and gender-specific distributions to construct the terciles of childhood SES and childhood HI, but also this does not affect our main estimation results for Europe. To make our results more comparable to the ones of Brunello *et al*. (2012), we excluded those individuals that have been self-employed at any stage during their career, and obtained similar results. Finally, because median lifetime earnings seem more reliable than the mean values (see Table 4.1), we used median regression to estimate the log lifetime earnings equations. Also this did not change the main results and conclusions of our paper. The results from all these sensitivity analyses are available upon request.

4.5. Conclusions

This study is arguably the first to investigate how early life circumstances—as measured by two indices of childhood health and socioeconomic status (SES)—are associated with labor market outcomes over the entire life cycle. In particular, we focus on (accumulated) earnings, average annual earnings, number of years worked, number of career gaps, and the probability of retiring over the life cycle. The analysis is conducted using data from the Survey of Health, Ageing and Retirement in Europe which on top of information on respondent's early life circumstances contains retrospective data on their full work histories.

Our results show that childhood SES (or factors correlated with it) has in general a larger impact on an individual's life-cycle labor market outcomes than childhood health, and most notably for women. For instance, men and women with a low childhood SES earn, respectively, up to 28 and 50 percent less income during their working life when compared to individuals with a high SES during childhood. These differences reduce to 6 percent when comparing men and women with a low and high childhood health. But, our results also show that these associations, and especially those with childhood SES, are not constant over the life cycle. While women with a low childhood SES accumulate increasingly less earnings (almost) from the beginning of their work career (already 21 percent less at age 30), men with a low childhood SES accumulate significantly more earnings until that age (still about 9 percent more at age 30). These associations, we find, operate through skills (annual earnings), which show a persistent, rather constant effect during working life that favor individuals with a high childhood SES, but also through work effort (working years). This latter effect, instead, favors at the beginning of the life cycle individuals with a low childhood SES (which start working earlier), but as those with a high childhood SES enter the labor market and those with a low childhood SES accumulate more career gaps, its importance diminishes over the life cycle, and for women it actually reverses sign around the end of their work careers (from age 55 onwards) favoring women with a high childhood SES. With regard to childhood health, its smaller, rather persistent (positive) long-term association with lifetime earnings appears to operate rather through skills (annual earnings) than through work effort (working years). However, while for men most of this association with lifetime earnings is already present at the beginning of the life cycle (at age 25), for women it kicks in rather later (at age 45).

One possible explanation for the larger impacts of childhood SES that we find is that children might be exposed during a longer period to their parents' SES than to a specific health condition. Still, although some validation studies have tested the internal validity of the childhood health measures in SHARELIFE and find no evidence of recall bias related to memory capacity in reporting on these health conditions that we include in our index of childhood health, they also point to important age/cohort and country differences in reporting on these health conditions which might not be captured with a simple dummy variables approach. Hence, some caution is warranted as we cannot rule out the possibility that measurement error is more severe in our measure of childhood health which we would expect to result in an attenuation bias.

All in all, our empirical findings show that following a life-cycle approach like ours is important because, as some theoretical models stipulate and our results confirm, some consequences of adverse (health) events early in life may not become apparent until later in adult life and because some of their impacts, in particular those related to childhood SES, may change and accumulate over the life cycle.

Appendix to Chapter 4

Table A4.1: Official age of retirement[a]

	Men	Women
Sweden	65	65
Denmark	65	65
Switzerland	65	64
Netherlands	65	65
Germany	65	65
Belgium[b]	65	65
France[b]	60	60
Austria	65	60
Spain	65	65
Italy[b]	65	60
Greece[b]	65	60
Czech Republic	62,2	59,3
Poland	65	60

Source: OECD Pensions at a Glance (www.oecd.org/els/social/pensions/PAG). [a] The official age of retirement is shown for 2010 and corresponds to the age at which a pension can be received irrespective of whether a worker has a long insurance record of years of contributions. [b] For Belgium and France, workers can retire at age 60 with 40 years of contributions; for Greece, at age 58 with 35 years of contributions; and for Italy, at 57 (56 for manual workers) with 35 years of contributions.

Table A4.2: Log lifetime earnings regressions over the life cycle for men and women in Europe (I)[a]

	Until age 25	Until age 30	Until age 35	Until age 40	Until age 45	Until age 50	Until age 55	Until age 60	Until age 65
Men	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low childhood HI	-0.082***	-0.083***	-0.072***	-0.061***	-0.055***	-0.050**	-0.051***	-0.056***	-0.056***
	(0.030)	(0.025)	(0.022)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)
Medium childhood HI	-0.085***	-0.091***	-0.077***	-0.069***	-0.059***	-0.050**	-0.047**	-0.043**	-0.042**
	(0.032)	(0.027)	(0.024)	(0.023)	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)
Low childhood SES	0.231***	0.089***	-0.054**	-0.124***	-0.161***	-0.189***	-0.210***	-0.227***	-0.241***
	(0.034)	(0.029)	(0.025)	(0.024)	(0.023)	(0.023)	(0.022)	(0.022)	(0.022)
Medium childhood SES	0.241***	0.129***	0.025	-0.029	-0.055***	-0.075***	-0.084***	-0.101***	-0.108***
	(0.031)	(0.025)	(0.021)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)
R-squared	0.145	0.164	0.196	0.206	0.218	0.225	0.237	0.244	0.253
Observations	7002	7630	7709	7730	7735	7737	7737	7740	7740
Women	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low childhood HI	-0.045	-0.053*	-0.060**	-0.051*	-0.075***	-0.074***	-0.067**	-0.066**	-0.063**
	(0.030)	(0.029)	(0.028)	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.027)
Medium childhood HI	0.003	-0.029	-0.031	-0.033	-0.053*	-0.047	-0.043	-0.039	-0.035
	(0.032)	(0.030)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.028)	(0.028)
Low childhood SES	-0.015	-0.190***	-0.290***	-0.313***	-0.325***	-0.360***	-0.379***	-0.397***	-0.406***
	(0.033)	(0.032)	(0.031)	(0.032)	(0.031)	(0.031)	(0.030)	(0.030)	(0.030)
Medium childhood SES	0.060**	-0.046*	-0.116***	-0.139***	-0.141***	-0.155***	-0.165***	-0.175***	-0.183***
	(0.028)	(0.027)	(0.026)	(0.026)	(0.025)	(0.025)	(0.025)	(0.024)	(0.024)
R-squared	0.166	0.171	0.179	0.176	0.172	0.175	0.180	0.193	0.202
Observations	6487	6829	6953	7047	7114	7148	7155	7157	7158

[a] Based on the estimation of log lifetime earnings equations at different ages over an individual's working life by OLS. All models include dummy variables for birth-year and country. Robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

Table A4.3: Log lifetime earnings regressions over the life cycle for men and women in Europe (II)[a]

Men	Until age 25	Until age 30	Until age 35	Until age 40	Until age 45	Until age 50	Until age 55	Until age 60	Until age 65
Low HI * Low SES	0.157***	0.019	-0.121***	-0.181***	-0.215***	-0.242***	-0.268***	-0.291***	-0.307***
	(0.054)	(0.047)	(0.040)	(0.038)	(0.037)	(0.037)	(0.036)	(0.036)	(0.035)
Low HI * Medium SES	0.149***	0.043	-0.067*	-0.110***	-0.130***	-0.144***	-0.154***	-0.174***	-0.180***
	(0.050)	(0.042)	(0.035)	(0.033)	(0.032)	(0.031)	(0.031)	(0.031)	(0.030)
Low HI * High SES	-0.137***	-0.110***	-0.108***	-0.106***	-0.099***	-0.099***	-0.099***	-0.098***	-0.098***
	(0.051)	(0.040)	(0.033)	(0.032)	(0.031)	(0.030)	(0.030)	(0.029)	(0.029)
Medium HI * Low SES	0.105*	-0.020	-0.157***	-0.223***	-0.250***	-0.272***	-0.288***	-0.297***	-0.309***
	(0.058)	(0.049)	(0.042)	(0.040)	(0.038)	(0.037)	(0.036)	(0.036)	(0.035)
Medium HI * Medium SES	0.136**	0.025	-0.066*	-0.117***	-0.133***	-0.145***	-0.152***	-0.161***	-0.170***
	(0.054)	(0.046)	(0.038)	(0.036)	(0.035)	(0.034)	(0.034)	(0.033)	(0.033)
Medium HI * High SES	-0.074	-0.073	-0.088**	-0.083**	-0.075**	-0.068*	-0.070**	-0.067**	-0.066*
	(0.058)	(0.047)	(0.039)	(0.037)	(0.035)	(0.035)	(0.034)	(0.034)	(0.034)
High HI * Low SES	0.205***	0.075	-0.084**	-0.159***	-0.196***	-0.225***	-0.247***	-0.259***	-0.273***
	(0.055)	(0.047)	(0.040)	(0.038)	(0.037)	(0.036)	(0.035)	(0.035)	(0.035)
High HI * Medium SES	0.214***	0.126***	0.007	-0.054	-0.082**	-0.108***	-0.119***	-0.134***	-0.142***
	(0.052)	(0.044)	(0.037)	(0.035)	(0.034)	(0.033)	(0.032)	(0.032)	(0.031)
Buffering Hypothesis	0.889	0.813	0.908	0.948	0.947	0.952	0.948	0.918	0.911
R-squared	0.146	0.164	0.196	0.206	0.218	0.225	0.238	0.245	0.253
Observations	7002	7630	7709	7730	7735	7737	7737	7740	7740

Table A4.3 Continued

Women	Until age 25	Until age 30	Until age 35	Until age 40	Until age 45	Until age 50	Until age 55	Until age 60	Until age 65
Low HI * Low SES	-0.059	-0.252***	-0.357***	-0.367***	-0.399***	-0.428***	-0.443***	-0.457***	-0.462***
	(0.053)	(0.049)	(0.048)	(0.050)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Low HI * Medium SES	0.012	-0.135***	-0.196***	-0.211***	-0.231***	-0.244***	-0.244***	-0.247***	-0.253***
	(0.049)	(0.045)	(0.043)	(0.044)	(0.042)	(0.041)	(0.041)	(0.041)	(0.041)
Low HI * High SES	0.008	-0.037	-0.022	-0.011	-0.032	-0.023	-0.010	-0.003	-0.001
	(0.049)	(0.044)	(0.041)	(0.042)	(0.041)	(0.040)	(0.039)	(0.039)	(0.038)
Medium HI * Low SES	0.036	-0.197***	-0.282***	-0.308***	-0.340***	-0.367***	-0.376***	-0.389***	-0.399***
	(0.058)	(0.055)	(0.054)	(0.056)	(0.055)	(0.054)	(0.054)	(0.054)	(0.054)
Medium HI * Medium SES	0.094*	-0.060	-0.123***	-0.145***	-0.165***	-0.167***	-0.169***	-0.169***	-0.173***
	(0.050)	(0.046)	(0.045)	(0.046)	(0.044)	(0.043)	(0.043)	(0.043)	(0.043)
Medium HI * High SES	-0.017	-0.088*	-0.073*	-0.075*	-0.083*	-0.074*	-0.072*	-0.058	-0.054
	(0.055)	(0.048)	(0.044)	(0.045)	(0.044)	(0.042)	(0.042)	(0.042)	(0.041)
High HI * Low SES	0.006	-0.225***	-0.296***	-0.320***	-0.322***	-0.352***	-0.365***	-0.369***	-0.378***
	(0.060)	(0.056)	(0.054)	(0.056)	(0.053)	(0.052)	(0.052)	(0.051)	(0.051)
High HI * Medium SES	0.098*	-0.039	-0.092*	-0.112**	-0.109**	-0.114**	-0.122***	-0.129***	-0.140***
	(0.055)	(0.051)	(0.049)	(0.050)	(0.048)	(0.047)	(0.047)	(0.046)	(0.046)
Buffering Hypothesis	0.165	0.556	0.288	0.301	0.246	0.212	0.151	0.094	0.103
R-squared	0.167	0.171	0.180	0.177	0.173	0.175	0.181	0.194	0.202
Observations	6487	6829	6953	7047	7114	7148	7155	7157	7158

[a] Based on the estimation of log lifetime earnings equations at different ages over an individual's working life by OLS. All models include dummy variables for birth-year and country.

[b] The buffering hypothesis shows the resulting p-value when testing $\beta_{LowHI*LowSES} - \beta_{LowHI*HighSES} < \beta_{HighHI*LowSES} - \beta_{HighHI*HighSES}$, where HighHI*HighSES is the reference category. Robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

Concluding remarks

The aim of this thesis has been to contribute in two ways to the knowledge of the widely documented positive association between health and socioeconomic status (SES) in adulthood, also known as the SES-health gradient in the literature (Marmot and Wilkinson, 1999; Smith, 1999). In the first two chapters, I have chosen to study the impact that (adult) health has on (adult) labor market outcomes such as wages and employment, as these are key components of an individual's (adult) SES. Moreover, because the effect of health on labor market outcomes increases with age (Currie and Madrian, 1999), an understanding of these effects is especially important in regions with aging populations, as is the case across Europe (United Nations, 2009). On the other hand, there is a recent and growing literature that shows that the SES-health gradient in adulthood has its origins in an individual's early life (Case *et al.*, 2002; Currie and Stabile, 2003). Therefore, the last two chapters of this dissertation have explored the relationship between early life circumstances and later life outcomes such as health and employment at ages 50–64 and lifetime earnings.

The major role of health in determining employment among workers aged 50–64 years is already well documented in the literature on the health-employment nexus (Kalwij and Vermeulen, 2008; Lindeboom and Kerkhofs, 2009; Currie and Madrian, 1999, and references therein), for this reason the main contribution of Chapter 1 has been to disentangle health's direct effect on employment from its indirect effect through wages, something that although previously highlighted by Cai (2009, 2010) has received virtually no attention in the empirical literature. Yet quantifying the mediating role of older worker's wage rates in the health-employment nexus is important for both understanding individual's labor market behavior and designing policies aimed at keeping older workers with health limitations employed. The main empirical findings from this chapter showed that for European country groups (as well as for Europe as a whole) the mediating role of wages in the health-employment nexus is relatively small while the direct impact of health on employment is relatively large and rather similar across country-groups. This similarity may imply the existence of comparable schemes across these country groups that allow unhealthy workers to exit the labor market (Wise, 2012). Overall, and from a policy perspective, these findings suggest only a minor role for disability income policies likes wage subsidies to encourage the employment of (older) workers with health limitations, but an instrumental role for policy aimed at helping employers accommodate these workers on the job and keep them employed at older ages. Such an inference is very much in line with recent calls in the U.S. by Autor and Duggan (2010) and Burkhauser and Daly (2011, 2012) for supported work over cash benefits for people with disabilities and, in particular, increased employer incentives to accommodate work-limited employees.

The purpose of Chapter 2 was twofold. One one hand, to add to the empirical literature of health as a potential endogenous explanatory variable in wage equations by addressing problems such as unobserved heterogeneity, sample selection and measurement error (in the health variable) in one comprehensive framework. On the other hand, to gain insights into whether, and how, the Great Recession (GR) has altered the relationship between health and wages, an issue not yet addressed in the literature. The primary empirical findings showed that in Europe the positive impact of health on wages for (older) male workers in the period prior to the GR largely disappears during the GR, while for working-age women, there is rather no evidence of an effect of health on wages, both before and during the GR.

Although budget cuts during the GR have restricted (overall) access to health care (Karanikolos *et al.*, 2013), which we would expect to result in an increase in the impact of health on wages, *presenteeism* (i.e. attending work even though being sick) has become more common among workers (CareerBuilder, 2011). Also, there is some evidence of a reduction in the variable component of wages during the GR (Vandekerckhove *et al.*, 2012), the one that is likely to be more responsive to productivity-related components such as health. The latter two findings may explain why health has become less responsive to wages in the working-age (male) population during the GR.

Chapter 3 examined for thirteen European countries the associations of early life circumstances—measured by childhood health and SES—with educational attainment, and later life health and employment (at ages 50–64). In all countries and for men and women, favorable early life circumstances, and in particular a higher childhood SES, are associated with a higher level of education. And in most countries and in particular for women, favorable early life circumstances are associated with better later life health, also when education is controlled for. However, one of the main results in this chapter was that although for some countries, and mainly for men, there is evidence of significant associations between early life circumstances and later life employment when later life health is controlled for, most of the association between early life circumstances and later life employment appears to be transmitted through education and later life health.

However, as some theoretical models (e.g., *fetal-origins hypothesis* and *life course models*) suggest, some of these associations may change over the life-cycle. Therefore, Chapter 4 took a life-cycle approach to provide insights not only into which labor market outcomes are associated with adverse childhood events but also into if these associations are already present early or appear only later in adult life and if these are reduced or reinforced with age. All in all, the empirical findings from this chapter showed that following such a life-cycle approach is important because, as these theoretical models stipulate and the results confirm, some consequences of adverse (health) events early in life may not become apparent until later in adult life and because some of their impacts, in particular those related to childhood SES, may change and accumulate over the life cycle

The findings from Chapters 3 and 4 are important to policymakers because they may suggest that policies aimed at improving children's health and SES have long-lasting benefits for both the individual and society because of increased human capital accumulation, hence better employment opportunities, and better later life health (see also Marmot *et al.*, 2012). Examples of such policies are free health care for children and (means tested) income and in-kind support programs which cover the domains of parent's SES and children's health.

The previous paragraphs highlight the main results and implications of this thesis. Below, I would like to point out some possible extensions and future lines of research. A possibly restrictive assumption in the analyses in Chapters 1 and 2 is that there are no reverse impacts of wages and employment on health. Although finding credible exclusion restrictions in these instances is rather difficult (see, e.g., Currie and Madrian, 1999, pp. 3320, 3331), given the theoretical importance that simultaneity between health and employment, and between health and wages has in Grossman's 1972 model of health demand (see, Grossman, 2001, for a survey), this is an issue that deserves more attention in the current analysis. With regard to the interpretation of the findings in Chapter 2, I argue that *presenteeism* (i.e. attending work despite being ill) may reduce the impact of (poor) health on wages. But of course these are most likely short-run effects, and actually raises concern on the potentially negative long-run effects for these workers and on the negative impacts on public health, e.g., by affecting co-workers' health. For example, U.S. employees who attended work while infected with H1N1 are estimated to have caused the infection of as many as seven million co-workers (15 percent of the 44 million infected with H1N1) over just three months during the height of the H1N1 pandemic in 2009 (Drago and Miller, 2010). These long-run and contagion effects are very relevant questions for further research. Also with respect to Chapter 2, it has already been mentioned that EU-SILC is a four-year rotational panel (except for France and Luxemburg). However, the empirical techniques used in this chapter are expected to yield useful results when applied to longer longitudinal data sources such as the U.S. Panel Study of Income Dynamics or the British Household Panel Survey.

Overall, the empirical findings from Chapters 3 and 4 suggest that public policies which invest in children's health and parents' SES may benefit children in terms of better education, (later life) health and employment opportunities. However, it is still an open question what the most effective and cost efficient ways are to implement such policies, as well as the optimal timing when to intervene (e.g., Almond and Currie, 2011b), even if with regard to the latter point there is an increasing consensus on the advantages for intervening as early as possible (e.g., Doyle *et al.*, 2009). The importance of intervening early in childhood is also highlighted in the new health policy framework for Europe "Health 2020" which calls for action on the so-called "social determinants of health" and emphasizes investments in an individual's early years as a basic pillar of this strategy (Marmot *et al.*, 2012; Wolfe *et al.*, 2013). Within SHARELIFE, it is in principle possible to test if, for instance, childhood health at age 0–5 is more relevant than childhood health at ages 5–10 or 10–15 for later life outcomes such as health and lifetime earnings. Some caution, however, is warranted when performing such an analysis as there is some evidence that the (self-reported) childhood health conditions, and in particular those in the 0–5 age interval, may suffer from systematic (age-related) recall bias (van den Berg *et al.*, 2011)

Keeping this problem in mind, one possible line of future research could be to extend the analysis in Chapter 4 to obtain insights into the *causal* effects that early life circumstances have on an individual's life-cycle labor market behavior. One concern into the analysis in Chapter 4 (and Chapter 3) was that unobserved "third or confounding factors" may be driving the correlations between early life variables and later life outcomes. Some of the studies discussed in these two chapters usually use a temporary state of the macro environment into which the child is born as an exogenous variation in an individual's early life conditions. Therefore, and in a similar way to van den Berg *et al.* (2011), I could select the three SHARELIFE countries whose birth cohorts were exposed to a famine during the 1940s, namely, the Netherlands, Germany and Greece to estimate the average causal effect of a nutritional shortage early in life on an individual's life-cycle labor market behavior. These authors use the occurrence of a famine as an instrumental variable (IV) for the self-reported hunger periods during childhood that is asked in SHARELIFE. Moreover, to deal with the systematic age-related recall bias in the hunger periods variable, they suggest using two-sample IV estimation.

Also within this literature, more research is needed to identify the mechanisms that drive the relationships between early life circumstances and later life outcomes. A potentially important mediating factor is education. Some previous studies exploit the differences in institutions both across countries and within countries over time to control for the endogeneity of education. For instance, changes in the level of compulsory education have been shown to provide exogenous variation in the number of years of schooling (Brunello *et al.*, 2009). Hence, using the number of years of compulsory education an individual faced during schooling age to instrument his or her number of schooling years will shed light on the causal effect of education and on its mediating role between early life circumstances and, e.g., an individual's life-cycle labor market behavior.

Resumen

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Esta tesis se compone de cuatro capítulos que investigan la asociación positiva que hay entre la salud y el estatus socioeconómico (SES) en la edad adulta, a menudo referida como el gradiente social en salud en la literatura (Marmot y Wilkinson, 1999; Smith, 1999); y lo hacen de dos maneras. En primer lugar, como argumentan Currie y Madrian (1999) en su capítulo del *Handbook of Labor Economics*, la salud (en la edad adulta) es un factor determinante de los resultados en el mercado laboral (en la edad adulta) tales como los salarios, las horas trabajadas y el empleo, que por su parte son componentes clave del SES (en la edad adulta). Según algunos modelos económicos teóricos, la salud, como componente del capital humano, afecta al empleo no sólo de manera directa, sino también de forma indirecta a través del salario. Por lo tanto, una persona con mala salud no solo tendrá una menor productividad—y por ende un salario menor (véase, por ejemplo, Becker, 1962, 1964; Mushkin, 1962), sino que también, y quizás de forma más importante, tendrá un salario de reserva mayor. Este último efecto puede ser el resultado de factores tales como una mayor valoración del tiempo de ocio para cuidar la salud (Brown *et al.*, 2010;. Cai, 2009), el acceso a prestaciones de incapacidad (Layard *et al.*, 1994), o un aumento de la desutilidad del trabajo (Gordon y Blinder, 1980). Si el salario cae por debajo del salario de reserva ya sea debido a que un empeoramiento de la salud reduce la productividad y/o aumenta el salario de reserva, el resultado será el abandono del mercado de trabajo. Sin embargo, a pesar de que la salud, los salarios y el empleo están relacionadas entre sí, la mayoría de los estudios previos analizan las relaciones salud-empleo y salud-salarios por separado. El Capítulo 1, "**What do wages add to the health-employment nexus? Evidence from older European workers**", pretende contribuir a esta literatura a través de la cuantificación de la importancia que tienen los salarios en el nexo empleo-salud, un asunto que a pesar de haber sido destacado previamente por Cai (2009, 2010), no ha recibido atención en la literatura empírica con la posible excepción de Haveman *et al.* (1994). En particular, lo que se propone es medir el efecto directo de la salud, así como su efecto indirecto a través de los salarios en el empleo. Cuantificar el papel mediador que tienen los salarios en el nexo empleo-salud para los trabajadores de más edad es importante tanto para entender mejor el comportamiento en el mercado laboral de estos trabajadores como para diseñar políticas de empleo dirigidas a mantener a los trabajadores de más edad con problemas de salud empleados. El Capítulo 2, "**The impact of health on wages: Evidence from Europe before and during the Great Recession**", en cambio, analiza más en profundidad el efecto directo de la salud en los salarios y contribuye a la literatura que trata la salud como una variable endógena en una ecuación de salarios. Para ello se utiliza un método de estimación reciente propuesto por Semykina y Wooldridge (2010) que permite controlar simultáneamente la heterogeneidad no observada, el sesgo de selección y el error de medida (en la variable de salud). Por otra parte, al usar datos correspondientes y previos al periodo de la Gran Recesión—que se inicia en Europa en el año 2008 (Arpaia y Curci, 2010)—se busca comprender cómo la actual crisis ha alterado la relación entre la salud y los salarios. Al margen de esto, entender los efectos que la salud tiene en el mercado laboral es especialmente importante en regiones donde la población está envejeciendo, como es el caso para Europa (United Nations, 2009), ya que con el tiempo en estas regiones un mayor número de personas alcanzarán la edad en la que la salud tiene un mayor impacto en las variables relacionadas con el mercado laboral (Currie y Madrian, 1999). En el Capítulo 1 se utilizan microdatos de panel para trabajadores de más edad de la *Survey of Health, Ageing, and Retirement in Europe* (SHARE) y en el Capítulo 2 se utilizan microdatos de panel de la *European Union Statistics on Income and Living Conditions* (EU-SILC) para estimar el efecto de la salud en los salarios para la población en edad de trabajar, pero también se investiga si el efecto de la salud en los salarios es distinto entre grupos de edad.

En segundo lugar, hay una creciente literatura que establece que el gradiente social en salud que se observa en la edad adulta tiene sus orígenes en la vida temprana de un individuo (Case *et al.*, 2002; Currie y Stabile, 2003). Dos capítulos del último *Handbook of Labor Economics* (Almond y Currie, 2011b; Black y Devereux, 2011) también muestran que los eventos adversos de salud en la vida temprana y el SES de los padres tienen efectos de largo plazo sobre la salud y las variables relacionadas con el SES en la edad adulta tales como los ingresos y la oferta de trabajo de un individuo. Dentro de esta literatura se ofrecen varias teorías para explicar una posible relación entre las condiciones en la infancia y (la salud) en la edad adulta que dan soporte teórico a los hallazgos de estos estudios. Por una parte, la *hipótesis de los orígenes fetales* (Barker, 1995) propone que la exposición a estrés o malnutrición durante los periodos críticos de la etapa prenatal está ligada a un mayor riesgo de enfermedad coronaria, ictus, diabetes tipo II e hipertensión en edades adultas. Por otra parte, los *modelos de ciclo vital* indican que la enfermedad y las privaciones en la infancia pueden tener consecuencias de largo plazo para la salud, ya sea de forma directa a través de la propia enfermedad o de forma indirecta restringiendo los logros educativos y las oportunidades a lo largo de la vida (Kuh y Wadsworth, 1993). Por último y de manera alternativa, los *modelos de senda* sostienen que el gradiente social en salud que se observa en la edad adulta no es directamente atribuible a las condiciones en la infancia, y que los vínculos entre los primeros años de vida y la salud en la edad adulta se debilitan e incluso desaparece su efecto directo cuando se tiene en cuenta su efecto indirecto a través del SES finalmente alcanzado en la edad adulta y a través de los hábitos de salud (Marmot *et al.*, 2001). Los dos últimos capítulos de esta tesis utilizan microdatos de SHARE, y en particular de su tercera ola SHARELIFE, para estudiar los posibles efectos de largo plazo que las condiciones en la infancia tienen a lo largo de la vida de un individuo. En el Capítulo 3, "**The associations between early life circumstances and later life health and employment in Europe**", se estiman las asociaciones de la salud y del SES en la infancia con el nivel educativo, y con la salud y el empleo a los 50–64 años. Además de presentar nueva evidencia empírica para trece países europeos, se analizan las asociaciones entre las condiciones en la infancia y el empleo a los 50–64 años controlando por diferencia en educación y salud, que son potenciales mediadores de las asociaciones entre estas condiciones en la infancia y el empleo en edades avanzadas. Por último, el Capítulo 4, "**Early life circumstances and life-cycle labor market outcomes**", investiga cómo estas condiciones en la infancia—medidas a través de dos índices de salud y SES en la infancia—se asocian con los resultados del mercado laboral a lo largo de todo el ciclo vital de un individuo. Adoptar un enfoque de este tipo es importante porque no solo nos informa sobre qué resultados del mercado laboral se asocian con qué eventos adversos de la infancia, sino también sobre si estas asociaciones están ya presentes al inicio de la vida laboral o sobre si aparecen más tarde en la vida adulta y si se reducen o refuerzan con la edad.

A continuación se detallan los resultados y las implicaciones para la política económica de cada capítulo. Dentro de la primera parte de esta tesis, en el Capítulo 1 se encuentra que en Europa los hombres (mujeres) de entre 50 y 64 años que tienen mejor salud (medido a través de un incremento de una unidad o de 0.8 desviaciones estándar en un índice de salud) tienen, en promedio, un salario-hora un 8 por ciento más alto, que a su vez se traduce en una probabilidad de empleo 2 (4) puntos porcentuales más alta. También se muestra que la salud tiene un impacto directo considerable en el empleo: los hombres (mujeres) que tienen mejor salud tienen una probabilidad de empleo 16 (12) puntos porcentuales más alta. Sin embargo, las relaciones que hay entre la salud, los salarios y el empleo no tienen por qué ser homogéneas entre países europeos. Parece plausible que estas relaciones estén condicionadas, entre otros aspectos, por las diferencias institucionales relacionadas con el mercado laboral entre estos países. Por ejemplo, es probable que el empleo responda en mayor o menor medida a los salarios según se trate de un mercado laboral más o menos flexible. Para explorar esta posibilidad, se clasifica a los países de la muestra en diferentes "modelos sociales" (Sapir, 2006), a saber, el modelo Nórdico, Continental, Mediterráneo y de Transición. Pese a que los resultados muestran algunas diferencias entre estos grupos de países europeos, también indican que para todos los grupos de países la importancia que tienen los salarios en el nexo empleo-salud es relativamente pequeña, mientras que el efecto directo de la salud en el empleo es relativamente grande y bastante parecido entre estos grupos de países. Esta similitud podría implicar la existencia de regímenes de bienestar comparables entre estos grupos de países que permiten a los trabajadores con peor salud abandonar el mercado laboral (Wise, 2012). En conjunto, los hallazgos de este capítulo sugieren un papel menor para las políticas de discapacidad que pretendan fomentar el empleo de los trabajadores (mayores) con problemas de salud mediante subsidios salariales hacia estos trabajadores. En cambio, indican un papel clave para las políticas que ayuden a los empresarios a adaptar y acomodar a estos trabajadores con problemas de salud en sus puestos de trabajo con el fin de mantenerlos empleados en edades más avanzadas. Tales recomendaciones están muy en línea con algunas propuestas realizadas recientemente para los EE.UU. por Autor y Duggan (2010) y Burkhauser y Daly (2011, 2012) a favor de políticas de soporte en el empleo, más que de incentivos económicos, para las personas con alguna discapacidad, y sobre todo, a favor de las políticas que aumentan los incentivos de los empleadores para acomodar a los trabajadores con alguna discapacidad en su puesto de trabajo.

El Capítulo 2 muestra que en el período anterior a la Gran Recesión, los hombres en edad de trabajar (de entre 20 y 64 años) que tienen una mejor salud (medido a través de un incremento de una unidad en un índice de salud) tienen, en promedio, un salario-hora un 9 por ciento más alto. Este efecto se concentra (y es mayor) entre los trabajadores de más edad (de entre 50 y 64 años). En cambio, durante la Gran Recesión, este impacto positivo de la salud en los salarios desaparece. Una posible explicación a estos resultados es que el *presentismo* (es decir, asistir al trabajo pese a estar enfermo) se ha vuelto más común durante la crisis actual. Por ejemplo, un estudio reciente realizado por CareerBuilder (2011) en los EE.UU. encuentra que más del 70 por ciento de los trabajadores suelen ir a trabajar cuando están enfermos. Al menos en el corto plazo, este fenómeno podría reducir el impacto de la (mala) salud en los salarios. Por otra parte, hay cierta evidencia que apunta a que durante el periodo de la Gran Recesión ha habido una reducción de la parte variable de los salarios a través de recortes en las primas y en otros beneficios salariales (Vandekerckhove *et al.*, 2012). Esta reducción de la parte variable de los salarios (que *a priori* se esperaría que fuese más sensible a las variables relacionados con la productividad como lo es la salud de un trabajador) también podría explicar por qué los salarios de los hombres se han vuelto menos sensibles a la salud durante la crisis actual. En cambio, para las mujeres en edad de trabajar (de entre 20 y 59 años) no se encuentra evidencia de un efecto de la salud sobre los salarios, tanto en el periodo anterior como en el correspondiente a la Gran Recesión.

Estos dos primeros capítulos también proporcionan evidencia empírica robusta sobre la importancia de corregir el error de medida en la variable de salud autopercibida cuando se estima su impacto sobre el empleo y los salarios, que de no tenerse en cuenta resultaría (mayoritariamente) en un sesgo de atenuación en el coeficiente de la salud. Y en particular el Capítulo 2, también muestra la importancia de controlar la heterogeneidad no observada y el sesgo de selección cuando se estima el efecto de la salud sobre los salarios.

En la segunda parte de esta tesis, se analizan las asociaciones que hay entre las condiciones en la infancia, en términos de salud y SES, con diversas variables en edades posteriores. En el Capítulo 3 se analizan trece países europeos de forma separada y aunque los resultados empíricos muestran que existen diferencias entre estos trece países en cuanto a la importancia de las asociaciones entre las distintas variables de salud y SES en la infancia con las variables en edades posteriores, también muestran similitudes que nos permiten sacar conclusiones generales. En todos los países y tanto para hombres como para mujeres se encuentra que unas mejores condiciones en la infancia, y en particular un mayor SES durante la infancia, se asocian positivamente con un mayor nivel educativo. En la mayoría de estos países, y en particular para las mujeres, unas mejores condiciones en la infancia se asocian positivamente con una mejor salud a los 50–64 años, también cuando se controlan por diferencias en niveles educativos. Por último, y aunque para algunos países (y sobre todo para los hombres) se encuentra evidencia de una asociación positiva entre las condiciones en la infancia y el empleo a los 50–64 años que se mantiene cuando se controla por diferencias en salud a los 50–64 años, la mayor parte de la asociación que hay entre las condiciones en la infancia y el empleo en edades avanzadas parece ser transmitida a través de la educación y la salud (a los 50–64 años).

Por último, los resultados del Capítulo 4 demuestran que adoptar un enfoque de ciclo vital es importante porque, como algunos modelos teóricos establecen (por ejemplo, *hipótesis de los orígenes fetales* y *modelos de ciclo vital*) y los resultados de este capítulo confirman, algunas consecuencias de eventos adversos (de salud) en la infancia pueden no volverse evidentes hasta entrada la vida adulta y porque algunos de sus efectos, en particular aquellos relacionados con el SES en la infancia, pueden variar y acumularse a lo largo del ciclo vital. Por ejemplo, en Europa, tanto para los hombres como para las mujeres en Europa se encuentra una fuerte evidencia de un impacto acumulativo del SES en la infancia en los ingresos de una persona a lo largo de su vida y que opera tanto a través de un mayor número de años trabajados (que aproxima un *efecto esfuerzo*) como a través de unos mayores ingresos anuales (que aproxima un *efecto productividad*). Por otra parte, para los hombres esta asociación entre SES en la infancia e ingresos laborales se invierte de signo pasando de negativa a positiva durante la primera etapa de la vida laboral. Los resultados también muestran una asociación positiva de largo plazo (aunque de menor importancia) entre la salud en la infancia y los ingresos a lo largo del ciclo vital que opera principalmente a través de unos mayores ingresos anuales (*efecto productividad*) y sólo en menor medida también a través de unas carreras laborales más largas (*efecto* esfuerzo).

Los hallazgos de los Capítulos 3 y 4, creo, deben ser relevantes para los responsables políticos, ya que sugieren que las políticas destinadas a mejorar la salud y el SES de los niños y niñas pueden tener beneficios duraderos tanto a nivel individual como para la sociedad en su conjunto, debido a la mayor acumulación de capital humano, y por lo tanto, de mejores oportunidades de empleo y una mejor salud a lo largo de la vida. Ejemplos de este tipo de políticas son las políticas universales de salud en la infancia y los programas de transferencias monetarias y en especie (con evaluación financiera) que cubren los distintos ámbitos del SES de los padres y la salud de los niños (véase Marmot *et al.*, 2012 , pp. 1016-7).

Para finalizar, me gustaría señalar algunas vías que permitan extender y mejorar los trabajos contenidos en esta tesis. Un supuesto que puede resultar algo restrictivo en los análisis de los Capítulos 1 y 2 es el de la no causalidad inversa de los salarios y el empleo en la salud. Pese a que encontrar restricciones de exclusión creíbles en estos casos no es tarea sencilla (véase, por ejemplo, Currie y Madrian, 1999, pp. 3320, 3331), dada la importancia teórica que en el modelo de Grossman de 1972 tiene la simultaneidad entre la salud y el empleo, y entre la salud y el salario (véase Grossman, 2001), ésta es una cuestión que merece más atención. Por otra parte, una de las limitaciones de los análisis en los Capítulos 3 y 4 es la posibilidad de que existan factores de confusión que estén *causando* las correlaciones que observamos entre las variables de salud y SES en la infancia y las variables en edades posteriores. Varios de los estudios que se revisan en esos capítulos utilizan variaciones temporales en el entorno macro en el que nace un individuo como una fuente de variación exógena en las condiciones en la infancia. Estos "experimentos naturales" habitualmente utilizan episodios tales como hambrunas o pandemias. Entre los países analizados en los Capítulos 3 y 4 hay tres (Alemania, Grecia y los Países Bajos) en los que las cohortes que participan en SHARELIFE estuvieron expuestas a hambrunas durante la década de 1940. Siguiendo la metodología propuesta en van den Berg *et al.* (2011) se podría extender el análisis del Capítulo 4 para obtener una medida del efecto causal promedio de un déficit nutricional en la infancia en el comportamiento en el mercado laboral de un individuo a lo largo del ciclo vital.

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