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

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ABSTRACT

This paper adds to the empirical literature on health as an important determinant of employment at older ages by exploring the role in the health-employment nexus of the wage rates of 50 to 64-year-old workers. To do so, we use individual-level panel data from the Survey of Health, Ageing and Retirement in Europe to estimate a system of equations for health, wages and employment. Our model also takes into account both the potential for measurement error in the health variable and selectivity issues related to the wage equation. We find that for men (women) a one-unit (one standard deviation) increase in health yields, on average, a 7 (8) percentage higher hourly wage rate, resulting in a 2 (4) percentage point higher employment probability. We also show a direct impact of health on employment: a similar increase in health raises the employment probability of men (women) by 16 (13) percentage points. As regards differences between European countries, our findings suggest 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, our findings indicate 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.

Keywords: Health, wages, employment
JEL Classification: D00, I10, J14, J20, J30

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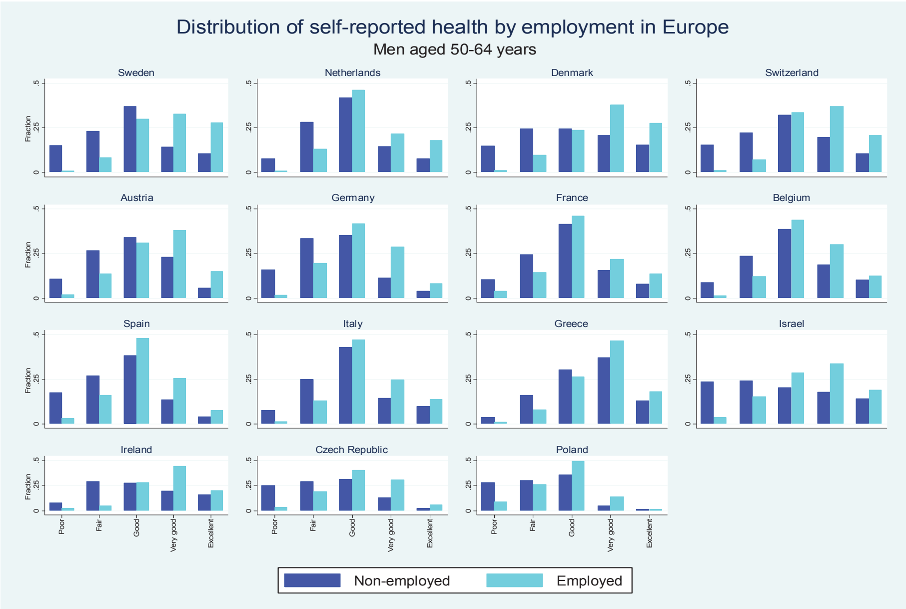
1. Introduction

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 and 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.[3] 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).

[3] 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: 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 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; Grossman, 1972)—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.[4]

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 through wages on work-time.

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.

[4] 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).[5] 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).[6] 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 correct for measurement error in SRH by using a Health Index (HI) based on both self-assessed objective and doctor diagnosed health indicators (cf. Bound et al., 1999). Finally, and also as an extension of Haveman et al.'s (1994) model, we take selectivity into account when estimating the wage equation.[7]

Our primary empirical findings for Europe support the theoretical prediction of health's impact on employment through wages; that is, we show that better health results in a higher wage rate, which in turn increases the incidence of employment. This result 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 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

[5] 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 the validity of this restriction in section 3.

[6] 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 SRH health as a continuous variable and not, as we do in this paper, as a categorical variable.

[7] 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.

in Mediterranean countries. This latter finding is consistent with the less flexible labor markets in this group 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 market (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 2 describes the data and the main analytical variables. Section 3 outlines the empirical model and discusses a number of related econometric issues. Section 4 reports the estimation results and analyzes their robustness. Section 5 summarizes the main findings and concludes.

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,[8] 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.

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 51,696 observations for 37,196 respondents from the following countries: Austria, Germany, Sweden, the Netherlands,

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

Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel, Czech Republic, Poland, and Ireland. Missing values force a 17 percent reduction in sample size. The result is an unbalanced panel comprising 43,129 total observations for 14,153 male and 18,016 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). 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 paid workers only. Employment, which includes self-employment, is defined as working a positive number of hours per week. Detailed information on health limitations for both men and women is reported in Table 1 together with the sample means for other demographic and socioeconomic characteristics used in the empirical analysis. The definitions of all variables are provided in appendix Table A1.

Table 1: Descriptive Statistics (average)

	Men	Women
Dependent variables		
Self-reported health (1-5)	3.21	3.14
Hourly net wage rate[a]	14.08	12.04
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
Overweight (BMI 25–29.9)	0.49	0.34
Obese (BMI 30+)	0.19	0.19
Grip strength (0–100)	45.27	27.8
Missing grip strength	0.05	0.05
Socioeconomic characteristics		
Age (50-64)	57.79	57.51
Educational attainment		
ISCED 0–2	0.34	0.40
ISCED 3-4	0.40	0.38
ISCED 5-6	0.25	0.22
Living with spouse/partner	0.86	0.80
Household size	2.57	2.40
Number of grandchildren	1.27	1.71
Monthly income from nonemployment (wave 1)[b]	2773	3251
Monthly income from nonemployment (waves 2 and 4)[b]	5728	5088
Homeownership	0.78	0.78
Country representation		
Austria	0.08	0.08
Germany	0.07	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)	18810	24319

[a] Defined for waves 1 and 2 and for wage-earners only. In PPP-adjusted 2005 US$. N = 5555 for men and N = 5665 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 for more information).

3. The empirical model

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

$$E_{it}^{*} = \gamma_0 + \gamma_1 H_{it}^{*} + \gamma_2 w_{it}^{*} + \gamma_3 Z_{it} + \upsilon_{it}^{E} \quad (1)$$

$$w_{it}^{*} = \beta_0 + \beta_1 H_{it}^{*} + \beta_2 Educ_{it} + \beta_3 X_{it} + \upsilon_{it}^{W} \quad (2)$$

Equation (1) is an employment equation, and equation (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*, w_{it}^{*} is the logarithm of individual *i*'s hourly net market wage at time *t*, and H_{it}^{*} is individual *i*'s health at time *t*. 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 that are assumed to affect employment but not wages. $Educ_{it}$ is an individual's educational attainment,[9] 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.

In estimating the model, we must deal with two econometric issues: sample selection (i.e., the fact that we not observe the wages of nonemployed individuals) 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 A.1. When identifying the Heckman model, 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

[9] 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.

across individuals (Kapteyn et al., 2007; Meijer et al., 2011).[10] 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 $Educ_{it}$ and a vector Z_{it} containing other assumed exogenous socioeconomic characteristics, but also as 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) and (2):

$$H^*_{it} = \alpha_0 + \alpha_1 HL_{it} + \alpha_2 Educ_{it} + \alpha_3 Z_{it} + \upsilon^H_{it} \, , \qquad (3)$$

where υ^H_{it} is an error term. The health limitations are assumed to be 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 for details). We exclude the health limitations of depression (or mental health) and the Global Activity Limitation Indicator (GALI) as instruments because they are likely to be correlated with the SRH measurement error (Meijer et al., 2011).

The assumed exogeneity of health limitations also implies that these limitations are not directly affected by current employment and wages.[11] 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, identify 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.

[10] 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).

[11] Currie and Madrian (1999) and Grossman (2001) discuss a theoretical model on the related issue of reverse causality of employment and wages on health.

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 our use of both mild and severe chronic diseases as instruments in equation (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 as SRH instruments. 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. Our choice of instruments is further validated by the sensitivity test performed in section 4.2, which restricts the number of health limitations to only severe chronic conditions, grip strength (GS), and BMI with no changes to our main results.

The three error terms in equations (1) to (3) are assumed to follow a multivariate normal distribution. Identification of the effects of health on employment and wages is guaranteed by excluding the objective (self-reported) health limitations (HL_{it}) from the wage and employment equations. Hence, the model in equations (1) to (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.[12] 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 A.1. Finally, we estimate the model outlined above separately for men and women.

4. Estimation results

Table 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.

[12] We substitute the wage equation in the employment equation to obtain a triangular system of equations (see Appendix A.1).

Table 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	-0.786***	-0.786***	-0.961***	-0.675***	-0.677***	-0.827***
	(0.024)	(0.024)	(0.024)	(0.023)	(0.023)	(0.022)
1+ mild chronic diseases	-0.530***	-0.530***		-0.617***	-0.619***	
	(0.018)	(0.018)		(0.016)	(0.016)	
1+ limitations with ADL	-0.484***	-0.484***		-0.592***	-0.593***	
	(0.043)	(0.043)		(0.037)	(0.037)	
1+ limitations with IADL	-0.566***	-0.566***		-0.477***	-0.474***	
	(0.040)	(0.040)		(0.027)	(0.027)	
1+ limitations with mobility, arm function and fine motor limitations	-0.658***	-0.658***		-0.579***	-0.579***	
	(0.021)	(0.021)		(0.017)	(0.017)	
Missing/underweight (<18.5)	-0.103	-0.104	-0.241***	-0.260***	-0.261***	-0.357***
	(0.087)	(0.087)	(0.087)	(0.042)	(0.042)	(0.045)
Overweight (25-29.9)	-0.032*	-0.032*	-0.103***	-0.124***	-0.124***	-0.234***
	(0.019)	(0.019)	(0.020)	(0.017)	(0.017)	(0.017)
Obese (30+)	-0.162***	-0.162***	-0.364***	-0.264***	-0.265***	-0.535***
	(0.025)	(0.025)	(0.025)	(0.021)	(0.021)	(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	0.261***	0.260***	0.442***	0.173***	0.169***	0.427***
	(0.061)	(0.061)	(0.062)	(0.048)	(0.048)	(0.050)
Log lik.	-39704.80	-39666.49	-41666.97	-48358.63	-48326.32	-51158.76
Observations	18810	18810	18810	24319	24319	24319

[a] 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 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 health has a positive impact on wages for older male workers in Europe. 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, rather similar to the effect of health on wages for men. For instance, an older male (female) worker with a one-unit larger health stock (approximately equivalent to a one standard deviation increase or to as much as a 25 and 50 percentile increase for women and men, respectively) has on average a 7 (8) percentage 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 (female) worker with the highest level has on average a 37 (38) percentage higher hourly wage rate.

Table 3: Estimation results of the wage equation 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)
ISCED 3-4	0.161***		0.167***	0.150***	0.149***		0.157***	0.139***
	(0.017)		(0.017)	(0.017)	(0.017)		(0.017)	(0.018)
ISCED 5-6	0.373***		0.384***	0.350***	0.381***		0.398***	0.364***
	(0.019)		(0.018)	(0.020)	(0.019)		(0.018)	(0.020)
Health[b]	0.071***		0.037***	0.120***	0.077***		0.033***	0.107***
	(0.016)		(0.007)	(0.021)	(0.014)		(0.007)	(0.020)
ISCED 3-4 Nordic		0.113***				0.108***		
		(0.022)				(0.024)		
ISCED 3-4 Continental		0.114***				0.081***		
		(0.030)				(0.031)		
ISCED 3-4 Mediterranean		0.296***				0.338***		
		(0.046)				(0.044)		
ISCED 3-4 Transitional		0.191***				0.220***		
		(0.052)				(0.054)		
ISCED 5-6 Nordic		0.287***				0.257***		
		(0.024)				(0.023)		
ISCED 5-6 Continental		0.379***				0.387***		
		(0.032)				(0.033)		
ISCED 5-6 Mediterranean		0.482***				0.688***		
		(0.049)				(0.049)		
ISCED 5-6 Transitional		0.447***				0.516***		
		(0.086)				(0.068)		

Table 3 continued	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Health Nordic[b]		0.077***				0.055***		
		(0.017)				(0.016)		
Health Continental[b]		0.077***				0.098***		
		(0.019)				(0.018)		
Health Mediterranean[b]		0.056**				0.065***		
		(0.025)				(0.022)		
Health Transitional[b]		0.074**				0.156***		
		(0.033)				(0.026)		
Testing for homogeneity in the effect of health[c]								
Chi2 (3)		0.93				19.89		
p-value		0.8170				0.0002		
Log lik.	-39704.80	-39666.49	-16938.99	-41666.97	-48358.63	-48326.32	-19270.12	-51158.76
Observations	18810	18810	18810	18810	24319	24319	24319	24319

[a] 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. Column (2) shows 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 column (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 one-standard deviation increase or to as much as a 25 and 50 percentile increase for women and men, respectively.

[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 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. This latter study, however, does not control for nonlabor income, meaning that their finding may be the result of offsetting income and substitution effects. The bottom part of table 4 (see columns (1)) reports the estimates of the correlation coefficients between the error terms in equations (1) to (3). These estimates allow us to evaluate the importance of unobserved factors that simultaneously affect health, wages, and employment. 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. In particular, the latter correlation is about three times larger than the former, which indicates the existence of relevant unobserved factors that exert a negative impact on health and simultaneously increase the employment probability.[13]

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).

[13] Poverty, for example, may be one such unobserved factor.

Table 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 (1)	HI (2)	SRH (3)	Restricted HI (4)	HI (1)	HI (2)	SRH (3)	Restricted HI (4)
Health[b]	0.435***		0.251***	0.423***	0.334***		0.196***	0.309***
	(0.024)		(0.015)	(0.037)	(0.028)		(0.017)	(0.044)
Ln(hourly wage rate)[c]	0.073***		0.103***	0.073***	0.125***		0.162***	0.129***
	(0.013)		(0.013)	(0.014)	(0.014)		(0.016)	(0.016)
Health Nordic[b]		0.428***				0.339***		
		(0.040)				(0.044)		
Health Continental[b]		0.381***				0.265***		
		(0.036)				(0.058)		
Health Mediterranean[b]		0.441***				0.333***		
		(0.028)				(0.028)		
Health Transitional[b]		0.534***				0.308***		
		(0.042)				(0.059)		
Ln(hourly wage rate) Nordic[c]		0.118***				0.191***		
		(0.030)				(0.035)		
Ln(hourly wage rate) Continental[c]		0.102***				0.152***		
		(0.026)				(0.045)		
Ln(hourly wage rate) Mediterranean[c]		0.025**				0.071***		
		(0.013)				(0.010)		
Ln(hourly wage rate) Transitional[c]		0.069***				0.105***		
		(0.024)				(0.024)		
System errors correlation matrix								
SRH/Ln(hourly wage rate)	-0.083**	-0.086**		-0.196***	-0.110***	-0.104***		-0.174***
	(0.034)	(0.034)		(0.045)	(0.030)	(0.031)		(0.044)
SRH/employment	-0.279***	-0.279***		-0.278***	-0.264***	-0.251***		-0.254***
	(0.021)	(0.021)		(0.031)	(0.018)	(0.018)		(0.026)
Ln(hourly wage rate)/employment	-0.027	-0.009	-0.092*	0.025	-0.020	0.015	-0.021	-0.002
	(0.051)	(0.058)	(0.052)	(0.060)	(0.043)	(0.045)	(0.046)	(0.073)
Log lik.	-39705	-39667	-16939	-41667	-48359	-48326	-19270	-51159
Observations	18810	18810	18810	18810	24319	24319	24319	24319

[a] Coefficient estimates. 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. Column (2) shows the interaction terms between the education and health variables and country group dummies. The estimates in column (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 one-standard deviation increase or to as much as a 25 and 50 percentile increase for women and men, respectively.

[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 3 and 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 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 (13) 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 (7) percentage higher hourly wage rate (see columns (1), table 3) results in a 4 (2) percentage points higher employment probability.

Table 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]	0.027***	0.050***
	(0.005)	(0.006)
Health[c]	0.162***	0.133***
	(0.009)	(0.011)
Indirect health[d]	0.019***	0.038***
	(0.006)	(0.009)
Country groups		
Ln(hourly wage rate) Nordic[b]	0.044***	0.076***
	(0.011)	(0.014)
Ln(hourly wage rate) Continental[b]	0.038***	0.060***
	(0.010)	(0.018)
Ln(hourly wage rate) Mediterranean[b]	0.009**	0.028***
	(0.005)	(0.004)
Ln(hourly wage rate) Transitional[b]	0.026***	0.042***
	(0.009)	(0.010)
Testing for homogeneity in the effect of the ln(hourly wage rate)[e]		
Chi2 (3)	14.11	14.48
p-value	0.0028	0.0023
Health Nordic[c]	0.159***	0.135***
	(0.015)	(0.018)
Health Continental[c]	0.142***	0.105***
	(0.014)	(0.023)
Health Mediterranean[c]	0.164***	0.132***
	(0.011)	(0.011)
Health Transitional[c]	0.199***	0.122***
	(0.016)	(0.023)
Testing for homogeneity in the effect of health[e]		
Chi2 (3)	10.73	1.89
p-value	0.0133	0.5949
Indirect health Nordic[d]	0.034***	0.042***
	(0.011)	(0.016)
Indirect health Continental[d]	0.029***	0.059***
	(0.011)	(0.022)
Indirect health Mediterranean[d]	0.005	0.018***
	(0.004)	(0.007)
Indirect health Transitional[d]	0.019*	0.065***
	(0.011)	(0.021)
Testing for homogeneity in the indirect effect[e]		
Chi2 (3)	9.45	8.74
p-value	0.0238	0.0329

[a] Cluster-robust standard errors in parentheses (see Appendix A1 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 one-standard deviation increase or to as much as a 25 and 50 percentile increase for women and men, respectively.
[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).

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* (see Appendix A.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) to (3) with interaction terms between the health and wage variables and country group dummies. The results are reported in columns (2) of tables 2 to 4 and in the bottom part of table 5. We do not discuss the health equation results and system errors correlation matrix in columns (2) of tables 2 and 4, respectively, however, because they remain virtually the same as those in columns (1).

Columns (2) of table 3 reveal the 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. We admit, however, that the coefficients of educational attainment in *Transitional* countries are 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. Likewise, 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 (16 and 6 percent, respectively). Columns (2) of table 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 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 (i.e., the null 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 4 (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 in the *Mediterranean* countries—even to the point of being statistically insignificant for *Mediterranean* men—and strongest in the *Nordic* and *Continental* countries for men and in the *Continental* and *Transitional* countries for women. Both the virtual absence of an indirect effect of health on employment and the lower responsiveness of wages to employment in the *Mediterranean* countries is consistent with their relatively less flexible labor markets.

4.2 Sensitivity analyses

To throw light on the quantitative importance of taking SRH measurement error into account, we estimate the employment and wage equations (equations (1) and (2)) with SRH assumed to be an exogenous regressor having no measurement error. These results are given in columns (3) of tables 3 and 4, and in table 6 for both men and women. As table 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 (see table 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 exogenous 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 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 2, in columns (4) of tables 3 and 4, and in table 6. These results clearly 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 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***	0.064***	0.027***	0.051***
	(0.005)	(0.006)	(0.005)	(0.006)
Health[c]	0.093***	0.078***	0.157***	0.123***
	(0.005)	(0.007)	(0.014)	(0.017)
Indirect health[d]	0.014***	0.021***	0.033***	0.055***
	(0.003)	(0.005)	(0.009)	(0.014)

[a] Cluster-robust standard errors in parentheses (see Appendix A1 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 one-standard deviation increase or to as much as a 25 and 50 percentile increase for women and men, respectively.
[d] Measures the increase in employment probability corresponding to the indirect effect of a one-unit increase in health on employment through wages.

In sum, our sensitivity analyses suggest that the main source of health endogeneity to be considered in any empirical analysis using SRH as a health measure is 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.

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 one standard deviation) larger health stock has on average a 7 (8) percentage 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 (13) 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 strongest in the *Nordic* and European *Continental* countries for men and in the *Continental* and European *Transitional* countries for women. We attribute such variation to differences in labor market flexibility. 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).

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REFERENCES

Autor, D.H., and Duggan, M.G., 2007. Distinguishing income from substitution effects in disability insurance. American Economic Review, Papers and Proceedings 97 (2), 119–124.

Autor, D.H., and Duggan, M.G., 2010. Supporting work: A proposal for modernizing the U.S. disability insurance system. Washington, DC: Center for American Perspective and the Hamilton Project.

Becker, G.S., 1964. Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education. Chicago: University of Chicago Press for the National Bureau of Economic Research.

Bonsang, E., Adam, S., and Perelman, S., 2012. Does retirement affect cognitive functioning. Journal of Health Economics 31 (3), 490–501.

Bound, J., 1991. Self-reported versus objective measures of health in retirement models. Journal of Human Resources 26 (1), 106–138.

Bound, J., Brown, C., and Mathiowetz, N., 2001. Measurement error in survey data, In: Heckman, J.J., and Leamer, E. (Eds.), Handbook of Econometrics, vol. 5, New York: Elsevier Science, pp. 3705–3843.

Bound, J., Schoenbaum, M., Stinebrickner, T., and Waidmann T. 1999. The dynamic effects of health on the labor force transitions of older workers. Labour Economics 6 (2), 179–202.

Brown, S., Roberts, J., and Taylor, K., 2010. Reservation wages, labour market participation and health. Journal of the Royal Statistical Society: Series A, 173 (3), 501–529.

Burkhauser, R.V., and Daly, M.C., 2011. The declining work and welfare of people with disabilities: What went wrong and a strategy for change. Washington, DC: AEI Press.

Burkhauser, R.V., and Daly, M.C., 2012. Social Security Disability Insurance: Time for fundamental change. Journal of Policy Analysis and Management 31 (2), 454–461.

Burkhauser, R., Glenn, A., and Wittenburg, D.C., 1997. The Disabled Worker Tax Credit, In: Reno, V., Mashaw, J., Gradison, W. (Eds.), Challenges for Social Insurance, Health Care Financing, and Labor Market Policy, Washington, D.C.: National Academy of Social Insurance, pp. 47–65.

Cai, L., 2009. Effects of health on [the] wages of Australian men. Economic Record 85 (270), 290–306.

Cai, L., 2010. The relationship between health and labour force participation: Evidence from a panel data simultaneous equation model. Labour Economics 17 (1), 77–90.

Castro-Costa, E., Dewey, M., Stewart, R., Banerjee, S., Huppert, F., Mendonca-Lima, C., Bula, C., Reisches, F., Wancata, J., Ritchie, K., Tsolaki, M., Mateos, R., and Prince, M., 2008. Ascertaining late-life depressive symptoms in Europe: An evaluation of the survey version of the EURO-D scale in 10 nations. The SHARE project. International Journal of Methods in Psychiatric Research 17 (1), 12–29.

Coe, N.B., and Zamarro, G. 2008. Retirement effects on health in Europe, RAND Labor and Population Working Paper No. WR–588.

Contoyannis, P., and Rice, N., 2001. The impact of health on wages: Evidence from the British Household Panel Survey. Empirical Economics 26 (4), 599–622.

Crossley, T.F., and Kennedy, S., 2002. The reliability of self-assessed health status. Journal of Health Economics 21 (4), 643–658.

Currie, J., and Madrian, B.C., 1999. Health, health insurance and the labor market. In: Ashenfelter, O., Card, D. (Eds.) Handbook of Labor Economics, vol. 3. Amsterdam: Elsevier Science B.V., pp. 3309–3415.

Daly, M.C., and Bound, J., 1996. Worker adaptation and employer accommodation following the onset of a health impairment. Journal of Gerontology 51 (2), S53–S60.

Disney, R., Emmerson, C., and Wakefield, M., 2006. Ill health and retirement in Britain: A panel data based analysis. Journal of Health Economics 25 (4), 621–649.

Gordon, R., and Blinder, A., 1980. Market wages, reservation wages, and retirement decisions. Journal of Public Economics 14 (2), 277–308.

Grossman, M., 1972. On the concept of health capital and the demand for health. Journal of Political Economy 80 (2), 223–255.

Grossman, M., 2001. The Human Capital Model. In: Culyer, A.J., Newhouse, J.P. (Eds.) Handbook of Health Economics, vol. 1A. Amsterdam: Elsevier Science B.V., pp. 347–408.

Haveman, R., Wolfe, B., Kreider, B., and Stone, M., 1994. Market work, wages, and men's health. Journal of Health Economics 13 (2), 163–82.

Heckman, J.J., 1979. Sample selection bias as a specification error. Econometrica 47 (1), 153–161.

Jäckle, R., and Himmler, O., 2010. Health and wages: Panel data estimates considering selection and endogeneity. Journal of Human Resources 45 (2), 364–406.

Kalwij, A., Kapteyn, A., and De Vos, K., 2010. Retirement of older workers and employment of the young. The Economist 158 (4), 341–359.

Kalwij, A., and Vermeulen, F., 2008. Health and labour force participation of older people in Europe: What do objective health indicators add to the analysis? Health Economics 17 (5), 619–638.

Kapteyn, A., Smith, J.P., and Van Soest, A., 2007. Vignettes and self-reports of work disability in the United States and the Netherlands. American Economic Review 97 (1), 461–473.

Layard, R., Nickell, S., and Jackman, R., 1994. Unemployment: Macroeconomic Performance and the Labour Market. Oxford: Oxford University Press.

Lazear, E., 1986. Retirement from the labor force. In: Ashenfelter, O., Layard, R. (Eds.) Handbook of Labor Economics, vol. 1. Amsterdam: Elsevier Science B.V., pp. 305–355.

Lee, L.-F., 1982. Health and wage: A simultaneous equation model with multiple discrete indicators. International Economic Review 23 (1), 199–221.

Lindeboom, M., and Kerkhofs, M., 2009. Health and work of the elderly: Subjective health measures, reporting errors and endogeneity in the relationship between health and work. Journal of Applied Econometrics 24 (6), 1024–1046.

Llena-Nozal, A., Lindeboom, M., and Portrait, F., 2004. The effect of work on mental health: Does occupation matter? Health Economics 13 (10), 1045–1062.

Meijer, E., Kapteyn, A., and Andreyeva, T., 2011. Internationally comparable health indices. Health Economics 20 (5), 600–619.

Mincer, J., 1974. Schooling, Experience, and Earnings. New York: Columbia University Press for the National Bureau of Economic Research.

OECD, 2012. Employment protection annual time series data 1985–2008. Available at http://www.oecd.org/employment/employmentpoliciesanddata/oecdindicatorsofemploymentprotection.htm.

Rohwedder, S., and Willis, R.J., 2010. Mental retirement. Journal of Economic Perspectives 24 (1), 119–138.

Roodman, D., 2009. Estimating fully observed recursive mixed-processes models with CMP. Center for Global Development Working Paper No. 168.

Sapir, A., 2006. Globalisation and the reform of European social models. Journal of Common Market Studies 44 (2), 369–390.

Snyder, S.E., and Evans, W.N., 2006. The effect of income on mortality: Evidence from the social security notch. Review of Economics and Statistics 88 (3), 482–495.

Stern, S., 1989. Measuring the effect of disability on labor force participation. Journal of Human Resources 24 (3), 361–95.

Westerlund, H., Vahtera, J., Ferrie, J.E., Singh-Manoux, A., Pentti, J., Melchior, M., Leineweber, C., Jokela, M., Siegrist, J., Goldberg, M., Zins, M., and Kivimäki, M., 2010. Effect of retirement on major chronic conditions and fatigue: French GAZEL occupational cohort study. British Medical Journal 341, c6149.

Wise, D.A., 2012. Social Security and Retirement around the World: Historical Trends in Mortality and Health, Employment, and Disability Insurance Participation and Reforms. Chicago: University of Chicago Press.

APPENDIX

A.1. Estimation procedure

Our empirical model, given by equations (1) to (3), is estimated as a triangular (i.e., recursive) system of equations for health, wages, and employment using full information maximum likelihood (FIML) with freely correlated error terms. More precisely, the equation for health (SRH) is an ordered probit model. In the health equation (3), which includes all (assumed) exogenous variables, instead of observing H_{it}^{*}, we observe an ordered categorization 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 3 for more details)

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

Substituting equation (3) into equation (A1) yields

$$SRH_{it}^{*} = \alpha_0 + \alpha_1 HL_{it} + \alpha_2 Educ_{it} + \alpha_3 Z_{it} + \upsilon_{it}^{H} + \varepsilon_{it}^{H} . \tag{A2}$$

SRH_{it} is related to its unobservable counterpart SRH_{it}^{*} by assuming that $SRH_{it} = j$ if $\mu_{it,j-1} < SRH_{it}^{*} \leq \mu_{it,j}$, 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.

To obtain a triangular system of equations, we substitute the wage equation (2) into the employment equation (1), which gives

$$E_{it}^{*} = \pi_0 + \pi_1 H_{it}^{*} + \pi_2 Educ_{it} + \pi_3 X_{it} + \gamma_3 Z_{it} + u_{it}^{E} \tag{A3}$$

where $\pi_0 = \gamma_0 + \gamma_2\beta_0$, $\pi_1 = \gamma_1 + \gamma_2\beta_1$, $\pi_2 = \gamma_2\beta_2$, $\pi_3 = \gamma_2\beta_3$, and $u_{it}^{E} = \upsilon_{it}^{E} + \gamma_2\upsilon_{it}^{W}$.

The employment equation (A3) is a probit model in which $E_{it} = 1\left[E_{it}^{*} \succ 0\right]$ and zero otherwise, and the error term u_{it}^{E} in equation (A3) is assumed to be standard normally distributed.

The structural coefficients of interest in the employment equation, γ_1 and γ_2, are estimated using the nonlinear combinations of coefficients in equations (2) and (A3). Because *Educ* in equations (2) and (A3) 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 $\gamma_1 = \pi_1 - \gamma_2\beta_1$. To implement this calculation in Stata we use the *nlcom* command, which employs the Delta method for computing standard errors.

Finally, we wish to estimate a wage equation for all individuals aged 50–64 while observing the wage rate for wage-earners only (and only in waves 1 and 2, see section 2). To avoid a nonrandomly selected sample generated by individuals self-selecting into wage-earning jobs, we employ the procedure proposed by Heckman (1979) and add to our model (equations (A2), (2) and (A3)) a selection equation for wages, where $w_{it}^{*} = w_{it}$ if $S_{it} = 1$ (unobserved otherwise) and

$$S_{it}^{*} = \pi_0 + \pi_1 HI_{it} + \pi_2 Educ_{it} + \pi_3 Z_{it} + \upsilon_{it}^{S}; \qquad S_{it} = 1\left[S_{it}^{*} \succ 0\right]. \tag{A4}$$

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 3, the vector Z_{it} contains exclusion restrictions that drive selection but can at the same time be omitted from the wage equation (2) (i.e., excluded from X_{it}). Because equation (A4) 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}^{E}, υ_{it}^{W}, u_{it}^{H}, and υ_{it}^{S} are freely correlated and are assumed to follow a multivariate normal distribution. 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).

Table A1: 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$. They are defined for paid workers and obtained by dividing the amount of net wage earnings by the number of hours worked. Both variables are for the primary job because net wages for a second job are only available in wave 1, and in wave 4 there is no similar information about wages (net or gross). We do not compute the hourly net wage for the self-employed since their reported earnings and hours are a poor proxy for their wage rate (see, e.g., Jäckle and Himmler, 2010). In addition, for the self-employed, it is only possible to compute an hourly net wage in wave 2. We use unfolding bracket values for net wages to reduce the number of missing values, and treat extreme values in hourly net wages (e.g., those below 1 and above 300 PPP-US$) 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 household income minus individual income from employment. 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. Monthly household income from nonemployment is obtained by subtracting (average) individual monthly earnings from employment and/or self-employment in the previous year from (average) monthly household income in the previous year. We use unfolding bracket values for the income and earnings variables to reduce the number of missing values, except for household income 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).
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.

A.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 A2, 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 A2).

[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 A2: 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.

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