DISSERTATION

THE ECONOMIC CONSEQUENCES OF HEALTH SHOCKS

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Sophie McKee

Department of Economics

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Doctoral Committee:

Advisor: Sammy Zahran
Co-Advisor: David Mushinski

Anita Pena
Lorann Stallones

ABSTRACT

THE ECONOMIC CONSEQUENCES OF HEALTH SHOCKS

This dissertation is composed of three chapters which examine the extent of *reverse causation* or the causal pathway in going from health to financial components of social economics status (SES) on the heath-SES gradient in Western Europe.

In Chapter 1, I construct two population health metrics for survey-based data suitable for analysis across time and populations. To do so, I combine objective health indicators with the information available in the Survey of Health, Ageing, and Retirement in Europe (SHARE) dataset regarding health functioning and prognosis, and develop a strategy to assess and quantify a multidimensional concept of health that minimizes the influence of subjective factors (country, wave, age, and labor status) in the assessment process. The first variable, *Health Stock*, is an objective comprehensive health metric, which is a composite of an individual's level of function at a point in time as well as their expected transition to other levels of health in the future. The second variable - referred to as *Functioning Stock* – is restricted to the objective measures of an individual's level of function.

In Chapter 2, I investigate the short term impacts of negative health shocks on the labor outcomes of working individuals across levels of education and country of residence in Western Europe. I propose a new definition of negative health shock as the onset of a decrease between two consecutive periods in the *Functioning Stock*, whose magnitude exceeds a given threshold (in percentage terms). The analysis identifies three countries (Switzerland, Sweden, and Spain) that are best at mitigating the occurrence of negative health shocks, other things held equal. I

then show that on average in the European countries examined, labor outcomes are dose-responsive with the intensity of the health shock, and that the impact of a health shock is "U-shaped" across levels of education: compared to workers with a medium or high levels of education, the probability of having work as the only source of personal income ("working only") for low-skilled workers and for college-educated workers is less affected by the occurrence of a health shock. Assuming the loss of earned income is not fully compensated by benefits, we could infer that in the short term, reverse causation for negative health shocks could be steepening the slope of the SES-Wealth gradient for workers with the middle range level of education.

I then investigate the cross-country variation in the magnitude of the impact of a health shock on the probability to continue "working only". First, we find that the rates of people left without labor income or benefits are extremely low in every country considered, indicating that social safety nets are effective. Without delving into the complexities of the country-specific social insurance systems and the associated variation in benefit generosity, it is impossible to conclude on the relative magnitude of reverse causation across countries. However, two groups of countries stand out by the way workers maintain a connection to employment following a decline in health. In Switzerland, where health impaired workers have the highest probability to continue working, the short term impact of reverse causation is smallest. A hybrid labor force status is prevalent in Sweden, Spain, Belgium, and to a lesser extent in France and Denmark, where a substantial fraction of health impaired workers start receiving benefits but do not sever ties completely with work.

In Chapter 3, I investigate the determinants of the probability of working in the second period for middle-age male individuals in Western Europe, examining in particular the weight of their work force status in the first period. I show that the impact of the initial work force status is magnified in the case of an improvement in health: individuals whose mental or physical capacities improve and who were working while receiving benefits are about 25% more likely to have work as their only source of income in the following two-year period than comparable individuals whose health did not improve. By contrast, these numbers hover around zero for males who had severed all ties with work, confirming the existence of a *benefit trap*. Flexible benefit schemes that enable work *and* the receipt of benefits appear to perform the dual function of *catch and release*: such schemes cushion individuals from the impact of a decline in health with the receipt of benefits while maintaining an attachment work, allowing closer alignment of the individual's work trajectory with their preferences and capacities.

As European populations age and become more frail, results from this dissertation suggest that the impact of reverse causation should steepen the health-wealth gradient, particularly for individuals with secondary school education. To limit this effect, public policies should (1) mitigate the occurrence of health shocks in the first place, (2) support individuals who wish to continue working as long as they are physically and mentally able, and (3) offer hybrid solutions that incentivize work together with the receipt of benefits to health impaired individuals. Other European countries could draw on the experiences of Switzerland and Sweden, who have proven to be most successful at implementing such policies.

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Chapter I: An Operational Measure of Health - Computing Health across Subpopulations

1. Introduction

The lack of a comprehensive metric of health suitable for analysis across time and populations is an important problem with respect to the inclusion of health in economic models. Even when health is assessed by indicators such as activities of daily living (ADLs) and instrumental activities of daily living (IADLs), the presence of chronic conditions such as cancer or diabetes, or asking the elderly to rate their health, we do not really measure health but compile a series of subjective assessments and objective states that are correlated with underlying health. Further, individual assessments of health are potentially influenced by different social and cultural perceptions across countries and subpopulations. Given similar objective health limitations, females and older adults, for instance, are somewhat more inclined to self-report good health. Certain countries (e.g., Italy, France and Spain) rank very low in the subjective health distribution but high in the life-expectancy distribution, while others (e.g., the United States and Denmark) have a much more positive subjective assessment of their health than would be indicated by their life-expectancy at age 50 or disease prevalence (Banks & Smith 2012). Hence failing to correct for differences in reporting behavior may yield misleading results when including health in economic models.

In this chapter, I develop a method to eliminate the value judgments in surveys (which arise from purely social, cultural, or linguistic biases) to construct an objective individual-specific comprehensive health metric – referred to as *Health Stock*. Because economic models may also more narrowly need a measure of the ability of an individual to perform work tasks, I also construct a second variable – which I call *Functioning Stock* – which quantifies an individual's functional capaibilies. To that end, I assemble “objective” health indicators from the information available in the Survey of Health, Ageing and Retirement in Europe, and estimate their individual contribution to health while minimizing the influence of subjective factors in the self-assessment process.

2. SHARE (Survey of Health, Ageing and Retirement in Europe)

To undertake my study, I use the Survey of Health, Ageing and Retirement in Europe (SHARE)[2], which is a multidisciplinary and cross-national panel database of micro data on health, socio-economic status, and social and family networks of individuals aged 50 or older. It is harmonized in both structure and purpose with the United States Health and retirement Study (HRS)[3]. Eleven countries contributed data to the 2004 SHARE baseline study. They are a balanced representation of the various regions in Europe, ranging from Scandinavia (Denmark and Sweden) through Central Europe (Austria, France, Germany, Switzerland, Belgium, and the Netherlands) to the Mediterranean (Spain, Italy and Greece). Further data were collected in 2005-06 in Israel. Two new EU member states – the Czech Republic and Poland – as well as Ireland participated in the second wave of data collection in 2006-07. The survey’s third wave (SHARELIFE) collected detailed retrospective life histories in thirteen countries in 2008-09. The questions asked in SHARELIFE differ substantially from the set of questions asked in the other waves. The fourth wave (2010-11) also included Estonia, Hungary, Portugal and Slovenia. SHARE’s rigorous procedural guidelines and programs ensure a cross-nationally ex-ante

[2] www.share-project.org. release 6.0.0

[3] http://hrsonline.isr.umich.edu

harmonized design which permits international comparisons of health, economic and social outcomes in Europe. A detailed description of SHARE is provided by Börsch-Supan et al. (2013). To both maximize the number of observations available, and ensure methodological comparability, I restrict my study to the countries surveyed in the 4 comparable waves (waves 1, 2, 4, and 5[4]): Austria, Germany, Sweden, Spain, Italy, France, Denmark, Switzerland, and Belgium.

3. Self-Reported Health Status

3.1 A Reliable Health Index

The most widely used measure of health is self-reported health (SRH). It is a categorical variable ranging from 1: Excellent, to 5: Poor. It is one of the health indicators recommended by the World Health Organization (WHO) and the European Commission (European Commission, Robine et al. 2002). SRH is a comprehensive measurement that incorporates multiple dimensions of health (Simon et al. 2005), and is a major independent predictor of mortality and the use of physician services (Appels et al., 1996; Burstrom e& Fredlund, 2001; DeSalvo et al. 2006; Frankenberg & Jones, 2004; Miilunpalo et al. 1997; Murata et al. 2006). Differences across countries, genders, and age groups in SRH levels have been reported and are at least partly attributable to underlying differences in true health (Jylha et al. 1998, Bardage et al., 2005; Carlson, 1998; Grant et al. 1995). Hence, SRH appears to be a dependable (but as we will see incomplete) proxy for latent health.

[4] Wave 6 was available at the time of the study but was not used because information on smoking behavior is missing for most observations.

3.2 Construction of SRH

Health Stock can be operationally defined as a composite of an individual's level of function at a point in time and his or her expected transition to other levels, more or less favorable, at future times (Bush et al. 1972). Therefore to assess their own health, people use a combination of information about current or past specific diagnosed health problems, general physical functioning (Benyamini et al. 2003; Krause and Jay 1994 ; Mäntyselkä & al. 2003), mental health (Moussavi et al. 2007 ; Singh-Manoux et al. 2006), labor market activity (Alavinia & Burdorf, 2008 ; Bound 1991 ; Currie & Madrian 1999 ; Baker et al. 2004, McGarry 2004), and forward-looking components like current health behaviors and expected mortality (Bailis et al. 2003). I will generally refer to these dimensions of health and health assessment as health indicators.

3.3 Reporting Heterogeneity

Differences among levels of function are primarily value judgments about conformity to social norms of well-being and role performance (Patrick et al. 1973). Since self-assessment of health is directly contingent on social experience, the major conceptual difficulty in operationalizing a definition of health is eliminating the value judgments inherent in a self-assessment, which arise from purely social, cultural, or linguistic biases. Comparability across populations—or population subgroups—is indeed problematic if sub-groups of a population use systematically different standards for "threshold levels" when assessing their health, despite having the same level of "true" health. This tendency, referred to as *reporting heterogeneity*, has been demonstrated using hypothetical scenarios – formally referred to as vignettes – that make it possible to compare self-reports from respondents with different personal characteristics (King et al., 2007; Salomon et al. 2004). Failing to account for differences in reporting styles may yield misleading results in subgroup comparisons.

To illustrate the issue, Banks & Smith (2012) presented countries' rankings of self-assessed health (based on SHARE, ELSA5, and HRS 2004 – ages 55-64) and their ranking of life-expectancy at age 50 (see Figure 1 below). One cluster of countries – Italy, France and Spain – rank very low in the subjective health distribution but high in the life-expectancy distribution. And a number of other countries – the United States and Denmark– had a much more positive subjective assessment of their health than would be indicated by their life-expectancy at age 50.

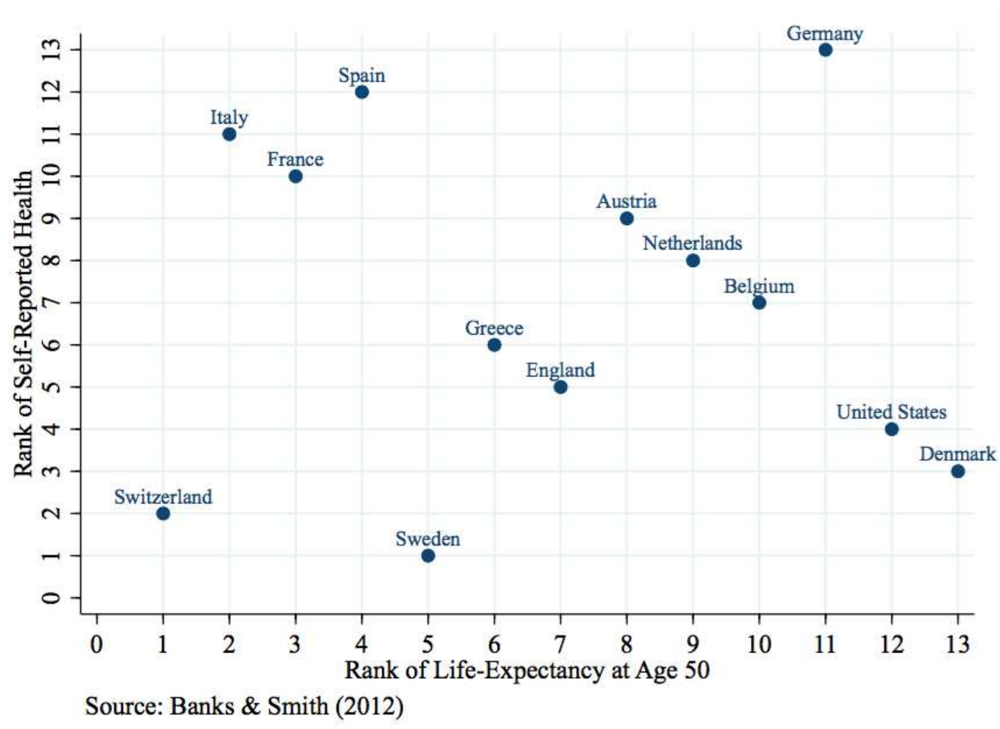

Figure 1. Rankings of Self-Reported Health Status and Life Expectancy at 50

[5] English Longitudinal Study of Ageing http://www.elsa-project.ac.uk/about-ELSA

Table 1 presents the average SRH[6] across selected European countries[7] and compares it with both quantitative health information - life expectancy at age 50[8], and a more qualitative indicator of healthy life years at age birth - focusing on the quality of life spent in a healthy state (also called disability-free life expectancy)[9]. Again, it is difficult to discern a link between the subjective report of health and any of the two indicators of life expectancy. For example, Denmark has the highest rankings in terms of SRH in the group, while it is last in terms of life expectancy at age 50 and second in terms of healthy life years at age birth.

Table 1. Self-Reported Health Status (50-65), Life Expectancy at 50, and Healthy Life Years at Birth

Country	Self-Reported Health[6]	Rank	Life Expectancy at 50	Rank	Healthy Life Years at Birth	Rank
Sweden	3.549	2	32.82	3	70.15	1
Denmark	3.602	1	30.65	5	61.10	4
Germany	2.944	5	31.63	4	57.60	5
Spain	2.949	4	33.25	2	62.60	3
Switzerland	3.517	3	33.58	1	64.10	2

What could explain this apparent disconnect? For each country, the distribution across self-reported health levels may be attributable not only to differences in true health but also to differences in perception or reporting of one's health. The latter could be explained partly by cognitive bias or unrealistic optimism bias (Weinstein 1980) that leads some people to think they are less likely than others to experience illness or another negative event. Cross-cultural research

[6] I used a new variable SRH_5 defined as $SRH_5 = 5 - SRH$. Th. This variable ranges more intuitively from 1:Poor, to 5: Excellent.

[7] Using 4 waves of SHARE data, ages 50-65, wave-, age, and sex- standardized

[8] From www.mortality.org at in 2010

[9] From www. ec.europa.eu/health/indicators/healthy_life_years in 2009

has indeed raised questions about the universality of these biases (Markus and Kitayama 1991) and self-enhancing tendencies may be less prominent in the motivational repertoire of people from cultures outside North America (Heine & Lehman 1995). To illustrate this point, Figure 2 shows the distribution of the overall feelings of happiness in a few selected countries over the period 2005 - 2009: people living in the United States and Sweden seem more amenable to report they felt very happy than people in Spain or Germany.

Figure 2: Feeling of Happiness by Selected Country10 (Wave 5: 2005 – 2009)

More broadly, optimism bias is widely considered to be one of the most reproducible, prevalent and robust biases observed in psychology and behavioral economics (Sharot, 2011), and could potentially explain divergent reporting patterns across various social categorizations. Lindeboom and Doorslaer (2004) found that given similar objective health limitations, females and older adults are somewhat more inclined to self-report good health, but they did not find evidence of different health ratings across income levels, education or language within a country.

[10] Source: worldvaluessurvey.org

Ploubidis & Grundy (2011) found that men tend to overstate health-related problems or limitations and that older participants overestimate their health status.

Recall that the construct of health is conceivably composed of two dimensions: *function level* and *prognosis* (Bush et al. 1972). Using this structure, the first part of my operationalization of heath status will be to select the elements in the 4 waves of SHARE that constitute objective health indicators, and to identify strategies to minimize the influence of subjective factors on the assessment process.

An obvious series of objective measures of health included when measuring health stock is diagnosed indicators of health. I include a series of dummy variables indicating whether a respondent was ever diagnosed with chronic diseases: high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, arthritis, hip fracture, other condition or no condition. I also include hospitalization in the previous year. The following self-diagnosed and observer-measured indicators are also included: BMI (underweight, overweight, obese)[11], grip strength (refused to measure, or lower tercile, sex and age standardized), joint pain, and functional limitations (difficulties in gross motor, large muscle, or fine muscle activities). A third set of variables ("expectations") is intended to capture the forward-looking component of self-reported health. It includes present behavior (smoking and physical activity), and a measure of the parental lifespan. If both parents deceased prematurely according to the OECD definition (that is, before age 70), the respondent is labelled as having *low parental lifespan*, and if they are alive or deceased after age 80 (i.e. above Europe's life expectancy), the respondent is assessed as *high parental lifespan*. Finally, mental health is rated using the Euro-D scale (ranging from 0 to 12), a

[11] Underweight: BMI<18.5; overweight: 25<=BMI<30; obese: BMI>=30 (WHO 2000)

common European depression symptoms scale (Prince et al 1999). I assume that these self-reported health conditions and observer-measured indicators reflect their true values.

Several other factors - gender, age, and labor force status - are more ambiguous with respect to their inclusion in a measure of health stock: they are known to influence health or the assessment of health but necessitate a deeper investigation. With regard to gender: women report more negative health conditions but rate their health more favorably than men. They are also less likely to die than same-aged men throughout life in virtually every country on earth, indicating that they may actually resist death better than men (Singh et al. 2013, Crimmins et al. 2010; Spiers et al. 2003; Idler 2003). While the issue is not entirely resolved, the consensus now seems to reject the popular notion that women have more endurance than men and to attribute the gender difference to fundamental biological and behavioral differences between the sexes (Oksuzyan et al. 2008; Case & Paxson, 2005). This led me to reject the existence of mere reporting heterogeneity between genders, and to consider gender an objective health indicator, likely to indicate a more pessimistic prognosis for men than for women.

According to Grossman's human capital model (Grossman 1972), health is a durable capital stock that depreciates with age and can be increased with health-enhancing investments. Age could thus be considered an indicator for the natural depreciation of health with time. However, it has also been shown that older participants overstate their health status (Ploubidis & Grundy 2011). Processes of aging, selective survivorship, and cohort differences all appear to play a role in creating this pattern (Idler 1993). Therefore age simultaneuously tends to decrease the objective measure of health while increasing the positive bias in self-reported health. Because of its equivocal nature –I chose not to include age in my array of indicators but to focus exclusively on a population with a limited age span - 50 to 65 - where the effects of aging operate similarly.

Lastly, the relationship between self-reported health status and labor force participation is complex. On the one hand, there appears to be what is referred to as *justification bias*. Individuals who have reduced their hours or exited the labor force may be more likely to report that they have poor health status or functional limitations, either to justify their reduced labor supply, or because government programs give them a strong incentive to say that they are unhealthy (Baker et al. 2004). On the other hand, the difference in self-reported health may indicate a difference in true health: labor market activities may directly affect an individual's health, although the direction of the impact is ambiguous. Stress and poor working environment can worsen health (Houtman et al. 2007; Cottini & Lucifora 2013), boredom or general lack of activity may also lead to a deterioration of health (Stern 1989; Sickles and Taubman 1986). Conversely, increased income may lead to improvements in housing, diet, and healthcare (Cai 2010). To eliminate the concern about labor force participation justification bias, I confine my sample to the working population.

4. Method

The descriptive statistics of the unweighted data by country (Self-Reported Health and Health Indicators by category) are shown in Table 2. The health indicators are grouped into diagnosed conditions (chronic diseases and hospitalization), self-diagnosed indicators (age, BMI, pain, grip strength, ADLs, and IADLs), expectations (behavior and parental lifespan), and mental health.

In order to allow cross-cultural comparison of SRH, the data are first wave-standardized across the 9 countries. I start by scaling the weights for each wave so that each wave is given equal importance in my analysis. Then in order to eliminate differences in observed rates for each health condition as a result of differences in population age and sex composition, I adjust the weights distribution so that each country has the same age and sex distribution of individuals aged 50 to 64 (based on Eurostat data, 2009). Note that this wave-age-sex-standardization is only used to construct the latent health stock variable[12].

To construct my latent health (or *Health Stock*) index, I expand on the econometric approach used by Juerges (2007), based on Terza (1985). My dependent ordinal variable is self-reported health (SRH_5 - ranked from 1 (Poor) to 5 (Excellent). My independent variables include the objective indicators of health: gender and the previously described health indicators (X_i).

For each observation i in wave *t*, the continuous *latent* self-reported health variable $SRH5^*_{it}$, is defined as

$$SRH5^*_{it} = X_{it}\beta + e_{it},$$

where, $e_{it}$is an error term with a standard normal distribution. $SRH5_{it}$ (the observed ordinal variable), takes on values 1 through 5 according to the following scheme:

$$SRH5_{it} = j \Leftrightarrow \mu_{(j-1)k} < SRH5^*_{it} \leq \mu_{jk},$$

where k is the country-wave combination for observation i in wave *t*. In the rest of the document, I designate the β for each health indicator as its "factor loading".

12 Each observation has a cross-sectional weight. (1) I aggregate these individual weights by wave. (2) I rescale the individual weights so that the new aggregated weights are equal across waves (Every wave is now given the same importance). (3) I aggregate the newly created individual weights by country, age, and gender. (4) I rescale the individual weights again so that the aggregated weights for each country match the gender/age distribution in Europe (based on Eurostat data, 2009).

Table 2: Self-Reported Health Status and Health Indicators (unweighted) by country

	Austria	Germany	Sweden	Spain	Italy	France	Denmark	Switzerland	Belgium
Self-Reported Health (1 - 5)	3.51	3.19	3.75	3.22	3.31	3.25	3.86	3.63	3.43
	(0.95)	(0.95)	(1.00)	(0.88)	(0.96)	(0.95)	(0.98)	(0.90)	(0.89)
Gender									
Gender (0 male - 1 female)	0.48	0.51	0.54	0.44	0.44	0.53	0.50	0.50	0.48
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Conditions									
Ever had high blood press.	0.26	0.31	0.26	0.23	0.27	0.21	0.24	0.21	0.27
	(0.44)	(0.46)	(0.44)	(0.42)	(0.44)	(0.41)	(0.43)	(0.41)	(0.45)
Ever had diabetes	0.06	0.06	0.06	0.07	0.06	0.06	0.04	0.04	0.06
	(0.23)	(0.23)	(0.24)	(0.25)	(0.23)	(0.24)	(0.21)	(0.20)	(0.23)
Ever had cancer	0.02	0.05	0.05	0.03	0.03	0.04	0.05	0.04	0.04
	(0.15)	(0.22)	(0.22)	(0.16)	(0.16)	(0.19)	(0.22)	(0.20)	(0.19)
Ever had lung disease	0.04	0.05	0.02	0.03	0.04	0.04	0.04	0.03	0.03
	(0.18)	(0.21)	(0.15)	(0.17)	(0.19)	(0.19)	(0.21)	(0.17)	(0.17)
Ever had heart problems	0.04	0.05	0.05	0.04	0.04	0.05	0.05	0.03	0.05
	(0.20)	(0.21)	(0.23)	(0.19)	(0.20)	(0.22)	(0.22)	(0.18)	(0.22)
Ever had stroke	0.02	0.01	0.01	0.00	0.01	0.01	0.02	0.01	0.01
	(0.13)	(0.11)	(0.11)	(0.07)	(0.10)	(0.11)	(0.14)	(0.09)	(0.12)
Ever had arthritis	0.11	0.15	0.11	0.14	0.19	0.22	0.20	0.14	0.19
	(0.31)	(0.36)	(0.31)	(0.35)	(0.39)	(0.42)	(0.40)	(0.35)	(0.39)
Ever had cholesterol	0.14	0.14	0.13	0.23	0.14	0.17	0.16	0.11	0.24
	(0.35)	(0.35)	(0.33)	(0.42)	(0.35)	(0.37)	(0.36)	(0.31)	(0.43)
Ever had a hip fracture	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
	(0.08)	(0.07)	(0.09)	(0.06)	(0.06)	(0.07)	(0.08)	(0.07)	(0.09)
Ever had another condition	0.15	0.15	0.20	0.17	0.12	0.11	0.15	0.12	0.12
	(0.36)	(0.36)	(0.40)	(0.38)	(0.32)	(0.31)	(0.35)	(0.33)	(0.32)
Never had any condition	0.44	0.37	0.40	0.40	0.44	0.41	0.40	0.50	0.36
	(0.50)	(0.48)	(0.49)	(0.49)	(0.50)	(0.49)	(0.49)	(0.50)	(0.48)
Hospitalized within a year	0.12	0.12	0.07	0.06	0.07	0.09	0.07	0.09	0.11
	(0.33)	(0.33)	(0.25)	(0.23)	(0.26)	(0.29)	(0.26)	(0.28)	(0.31)
Self-Diagnosis									
>=1 gross motor difficulty	0.04	0.04	0.02	0.04	0.05	0.04	0.03	0.02	0.05
	(0.20)	(0.20)	(0.15)	(0.20)	(0.23)	(0.19)	(0.16)	(0.14)	(0.21)
>= 1 large motor difficulty	0.19	0.26	0.21	0.14	0.19	0.20	0.15	0.16	0.24
	(0.39)	(0.44)	(0.41)	(0.34)	(0.39)	(0.40)	(0.36)	(0.37)	(0.43)

	Austria	Germany	Sweden	Spain	Italy	France	Denmark	Switzerland	Belgium
>= 1 fine motor difficulty	0.03	0.04	0.03	0.02	0.03	0.04	0.02	0.02	0.04
	(0.16)	(0.19)	(0.17)	(0.14)	(0.16)	(0.19)	(0.14)	(0.15)	(0.19)
Reports joint pain	0.62	0.73	0.63	0.67	0.62	0.64	0.64	0.56	0.65
	(0.49)	(0.44)	(0.48)	(0.47)	(0.49)	(0.48)	(0.48)	(0.50)	(0.48)
No hand grip measured	0.09	0.04	0.02	0.04	0.08	0.05	0.01	0.02	0.02
	(0.28)	(0.18)	(0.13)	(0.20)	(0.26)	(0.21)	(0.10)	(0.16)	(0.14)
Low hand grip measured	0.14	0.16	0.19	0.29	0.21	0.26	0.16	0.17	0.17
	(0.35)	(0.37)	(0.39)	(0.45)	(0.41)	(0.44)	(0.37)	(0.37)	(0.37)
Underweight	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01
	(0.10)	(0.07)	(0.08)	(0.08)	(0.10)	(0.13)	(0.10)	(0.12)	(0.12)
Overweight	0.40	0.41	0.42	0.47	0.44	0.37	0.40	0.36	0.40
	(0.49)	(0.49)	(0.49)	(0.50)	(0.50)	(0.48)	(0.49)	(0.48)	(0.49)
Obese	0.18	0.18	0.14	0.17	0.13	0.15	0.15	0.13	0.18
	(0.38)	(0.38)	(0.34)	(0.38)	(0.34)	(0.35)	(0.35)	(0.34)	(0.38)
Expectations									
Currently smokes	0.29	0.24	0.17	0.25	0.28	0.21	0.24	0.25	0.25
	(0.45)	(0.43)	(0.38)	(0.44)	(0.45)	(0.41)	(0.43)	(0.44)	(0.43)
Not active	0.17	0.18	0.20	0.38	0.37	0.31	0.21	0.21	0.28
	(0.38)	(0.38)	(0.40)	(0.49)	(0.48)	(0.46)	(0.41)	(0.41)	(0.45)
Very active	0.53	0.56	0.56	0.44	0.40	0.44	0.56	0.52	0.47
	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)	(0.50)
High Parental Lifespan	0.36	0.29	0.35	0.39	0.39	0.38	0.32	0.52	0.44
	(0.48)	(0.45)	(0.48)	(0.49)	(0.49)	(0.49)	(0.47)	(0.50)	(0.50)
Low Parental Lifespan	0.07	0.08	0.05	0.05	0.05	0.06	0.07	0.03	0.05
	(0.25)	(0.27)	(0.22)	(0.22)	(0.21)	(0.23)	(0.25)	(0.18)	(0.21)
Mental Health									
EuroD (0 - 12)	1.50	1.86	1.67	1.64	2.07	2.48	1.61	1.71	2.13
	(1.71)	(1.83)	(1.63)	(1.93)	(2.08)	(2.10)	(1.74)	(1.67)	(2.00)
N=	2153	3692	3810	2731	2501	3889	3884	3242	4335

Notes: (1) Gross motor difficulties include difficulties walking across a room, walking 100 meters, climbing a flight of stairs, going in and out of bed, and bathing; Large muscle difficulties include difficulties sitting for two hours getting up from a chair, stooping, kneeling, or crouching, and pushing or pulling a large object; Fine muscle difficulties include difficulties picking up a small coin, eating, and dressing. Very active indicates that the respondent engages in vigorous physical activity (sports, heavy housework, a job that involves physical labor) more than once a week. Not active indicates that he/she does so hardly ever or never. (2) To be included in the sample, a respondent must be self-declared as "working", observed any time between waves 1 and 5 (except wave 3), and have replied to all the questions used to calculate the health stock.

To account for country- and wave- specific reporting heterogeneity (see section 3.3), the ordered probit thresholds are modelled as a function of the country of residence and the survey wave. In order to ensure that thresholds are increasing with their order, threshold equations are specified by the following set of equations:

$$\mu_{0k} = -\infty$$

$$\mu_{1k} = D'_k \gamma_1$$

$$\mu_{jk} = \mu_{(j-1)k} + \exp(D'_k \gamma_j) \text{ , for } j \in [2, J-1] \qquad (1)$$

$$\mu_{Jk} = +\infty$$

where μ_{jk} is the jth threshold for the country-wave combination k, γ_j is a vector of parameters in the jth threshold equation, and D_k is a vector of country + wave dummies. J is the number of categories of the dependent variable (i.e. five). Very importantly, while thresholds are allowed to vary across countries and waves, the factor loadings are constrained to be the same in each country and wave.

The parameters are estimated using the maximum likelihood estimator (Appendix A.1 identifies the likelihood function). For each individual and every time period, I then construct a continuous latent health index using the predicted values of the latent variable $SRH5^*$ (i.e. the z-score of the weighted ordered probit regression), normalized to the unit interval, with 1 being the highest possible health score value (a respondent reporting no negative health condition and a healthy behavior); and 0 being the reverse (a respondent reporting every negative health condition and unhealthy behavior) -- see Juerges (2007)).

The individual probit coefficients are the factor loadings corresponding to each of the health indicators. Most of the factors loadings are likely negative, but some should be positive (no chronic condition ever diagnosed, very active, high parental lifespan). So when evaluating her health, an individual can compensate for negative health indicators (eg: cholesterol) with positive ones (eg: both parents still alive). I take into account only the factor loadings and not the coefficients of the thresholds when constructing the latent health variable to make my health variable free from potential country- and wave-specific reporting biases.

It could be argued that by expunging the latent health variable of country-specific effects and constraining the factor loadings to be identical across countries, I am also losing real country-specific institutional information of relevance to analyses that follow. Some countries will indeed be institutionally more efficient than others at preventing adverse conditions or encouraging favorable ones, due to health-enhancing social norms (smoking bans, healthy eating habits, etc.) or an effective preventive health care system. This aspect will not be lost in the process (individuals from these countries will on average report fewer negative conditions).

Additionally, there is no reason to assume that these last three groups of variables could have country-specific impacts on health (for example, smoking is as detrimental to health in every country). Different factor loadings will in that case be explained by the prevalence of that condition or by reporting bias, both of which we want to eliminate. In contrast, the point is admissible regarding chronic diseases. Indeed, one could argue that having a stroke in one country has objectively a different impact on an individual's level of function and on his expected transition to other levels of health than in another country. As a matter of fact, there is among the countries studied considerable variation in the approaches to chronic disease management that are being implemented in different health care settings. Unfortunately, with the exception of mortality (McKee & Nolte 2004), there are very few comparable data available that would allow for such a systematic assessment (Pomerleau, Knai & Nolte 2008). Several studies assessing disability weights for the calculation of Diasability Adjusted Life Years (DALYs) validate the use of identical factor loadings for health conditions across the European countries studied. For example, to investigate the sources of cross-national variation in DALYs in the European Disability Weights Project, Essink-Bot et al. (2002) assessed the cross-national stability of disability weights across Denmark, England and Wales, France, the Netherlands, Spain, and Sweden. Thirteen diseases were selected which covered a range of severity and different dimensions of disability and were relevant to the European situation. Each was subdivided into homogeneous stages with respect to functional status, treatment, and prognosis. Three valuation methods, preceded by a ranking procedure, were employed[13]. For each country the burden of dementia in women, used as an illustrative example, was estimated in DALYs. The authors concluded that cross-national comparison of scores for these diseases showed almost identical ranking orders, and that the use of European rather than country-specific disability weights did not lead to a significant change in the burden of disease estimates for dementia.

This result is strengthened by the fact that the European countries studied are relatively homogeneous in terms of health outcomes, and a majority of the population reported no unmet care needs, according to the 2010 EU Statistics on Income and Living Conditions survey (EU-SILC). More broadly, Salomon et al (2012) re-estimated disability weights for the Global Burden of Disease Study 2010 through a large-scale empirical investigation in which judgments about health losses associated with 220 causes of disease and injury were elicited from the general public in diverse communities in five countries (Bangladesh, Indonesia, Peru, Tanzania, and the US). The primary mode of eliciting responses was a paired comparison question, in which

[13] VAS method with 15 disease stages; time trade-off (TTO) with nine disease stages; and a newly developed variant of person trade-off (PTO) with nine disease stages. In the VAS method, panellists located the health state descriptions on a scale with anchored end-points (''best'' to ''worst'' imaginable health state) in order of preference. In TTO, panellists hypothetically traded off a number of healthy life years in order to avoid years lived in the health state being valued. We used the standard individual TTO with a time horizon of 10 years (14). In PTO, panellists were asked to prioritize between two preventive programmes A and B, where A saved one hundred healthy lives and B prevented a chronic disease state. Panellists determined the number of persons in B if they were indifferent between A and B.

respondents were presented with descriptions of two hypothetical people, each with a particular health state, and then asked which person they regarded as healthier. The results were then used to to estimate disability weights for each health state as a number on a scale from zero to one that represents the severity of health loss associated with the state. As in my present research, the authors mention a central theme in some critiques of disability weights as the contextualisation of disability within a particular social and cultural environment. They conclude that they did not observe evidence to support the hypothesis that comparative assessments of disability weights are undermined by extensive cultural variation. On the contrary, they reported strong evidence that many aspects of individuals' assessments of individual relative health outcomes seem to reflect common values, affirming universal aspirations for averting negative health outcomes such as pain or depression and for enjoying high levels of functioning in domains of health such as mobility.

So far, I have articulated a method to construct a latent health variable (referred to as *Health Stock*). To do so, I combined objective health indicators with the information available in the SHARE dataset regarding functioning and prognosis, and described a strategy to estimate the contribution of individual indicators to health, while minimizing the influence of non-health related factors (country, wave, age, and labor status) in the assessment process.

5. Results

Table 3 contains my parameter estimates and presents these coefficients by category, ranked from most penalizing to most beneficial to an individual's health stock. All the coefficients of my generalized ordered probit model are statistically significant at the 1% level. My results are in agreement with the literature: male gender, diagnoses of chronic conditions, a hospital stay in the past year, BMI out of the normal range (as defined by the World Health Organization), refusal to have grip strength measured or grip strength in the lowest tercile, joint pain, ADLs and IADLs, current smoking, lack of physical activity, having both parents perish before the age of 70, and a positive score on the EURO-D depression symptoms scale all have a statistically significant negative impact on self-reported health. By contrast, having no diagnosed chronic condition, exercising often, and having both parents either alive or deceased after age 80 all impact self-reported health positively.

Interestingly, the factor loadings assigned by respondents to most forward-looking indicators (smoking, not exercising, having both parents perish before the age of 70, or having both parents either alive or deceased after age 80) have the same order of magnitude than that of most chronic diseases, corroborating that respondents have a dynamic assessment of their health as they anticipate the future consequences of unhealthy behaviors or of their genetic heritage on their expected transition to other levels of function. Because the description of the health conditions used to assess disability weights (see Essink-Bot et al. 2002 and Salomon et al 2012) are much more detailed in their diagnostic, duration, and intensity, it is impossible to proceed to a sound comparison between the rankings of disability weights and and that of factor loadings. Nevertheless, some common trends emerge: in both assessments, the impact on health of motor difficulties is of the same order of magnitude as that of moderate to severe cardiovascular and circulatory diseases, and cancer. Additionally, both type of measurements indicate a profound connection between mental health and overall health assessment. Indeed, it is well known that mental disorders increase risk for communicable and non-communicable diseases, and contribute to unintentional and intentional injury. Conversely, many health conditions increase the risk for mental disorder, and comorbidity complicates help-seeking, diagnosis, and treatment, and influences prognosis (Prince et al. 2007).

To construct each individual's health stock variable, I add up all the vector of factor loadings weighted by that individual's health indicators. The health stock variables are then normalized so that all possible values lie in the interval [0, 1], the worst outcome being 0 and the best 1.

Table 3: Factor Loadings on Health Indicators

Category	Health indicator	
Gender		
	Female	0.141***
		(1.43E-04)
Conditions		
	Ever had diabetes	-0.443***
		(2.81E-04)
	Ever had lung disease	-0.435***
		(3.24E-04)
	Ever had heart problems	-0.418***
		(3.00E-04)
	Hospitalized within a year	-0.354***
		(2.22E-04)
	Ever had another condition	-0.350***
		(1.94E-04)
	Ever had cancer	-0.348***
		(3.25E-04)
	Ever had arthritis	-0.293***
		(1.95E-04)
	Ever had stroke	-0.260***
		(5.41E-04)
	Ever had high blood pressure	-0.195***
		(1.65E-04)
	Ever had a hip fracture	-0.132***
		(7.80E-04)
	Ever had cholesterol	-0.043***
		(1.85E-04)
	Never had any condition	0.295***
		(1.77E-04)

Category	Health indicator	
Self-Diagnosis		
	>=1 gross motor difficulty	-0.477***
		(3.69E-04)
	>=1 large muscle difficulty	-0.391***
		(1.79E-04)
	>=1 fine muscle difficulty	-0.307***
		(3.91E-04)
	Obese	-0.261***
		(1.89E-04)
	Reports joint pain	-0.244***
		(1.46E-04)
	No hand grip measured	-0.186***
		(3.38E-04)
	Underweight	-0.157***
		(6.37E-04)
	Overweight	-0.090***
		(1.36E-04)
	Low hand grip measured	-0.065***
		(1.85E-04)
Expectations		
	Currently smokes	-0.202***
		(1.40E-04)
	Not active	-0.184***
		(1.79E-04)
	Low Parental Lifespan	-0.135***
		(2.62E-04)
	Very active	0.021***
		(1.49E-04)
	High Parental Lifespan	0.113***
		(1.30E-04)
Mental Health		
	Euro-D (0 - 12) - 1 point	-0.130***
		(3.56E-05)
N =		30,211

Notes: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Gross motor difficulties include difficulties walking across a room, walking 100 meters, climbing a flight of stairs, going in and out of bed, and bathing; Large muscle difficulties include difficulties sitting for two hours getting up from a chair, stooping, kneeling, or crouching, and pushing or pulling a large object; Fine muscle difficulties include difficulties picking up a small coin, eating, and dressing. Very active indicates that the respondent engages in vigorous physical activity (sports, heavy housework, a job that involves physical labor) more than once a week. Not active indicates that he/she does so hardly ever or never.

The cut-off values for the ordered probit by country are presented in Appendix A.2. The Danes and the Swedes have the lowest threshold values compared to the other countries, which means that for the same set of health indicators, they are more likely to report having better health – in other words, they are optimistic in their assessment of health. Conversely, the Germans and the Spaniards have the highest thresholds, which implies that for a given set of health indicators, they tend on average to under-rate their health compared to residents of other countries – they are pessimistic in their assessment of health. Interestingly, these trends match what we observed in Figure 2 “Feeling of happiness by selected country”, which showed residents of Germany and Spain as less likely than residents of Sweden to report being “very happy”, and confirms the argument that differences in self-reported health can be partly traced back to subjective linguistic or cultural differences (King et al. 2004).

Both the distributions of my newly defined health stock and the self-reported health among the population ages 50 to 65 (wave-, sex-, and age-standardized) are shown in Figure 3. What stands out from this comparison is that the apparent variation in self-reported health among the countries studied is strikingly reduced when using the newly constructed Health Stock variable.

The descriptive statistics for the health stock variable for the population aged 50-65 (sex-, sge-, and wave- standardized) are shown in Table 4 below, ranked from highest to lowest weighted mean. Like in Chung and Muntaner’s (2007) study, which compared infant mortality rate and low birth weight rate across 49 countries, the *Social Democratic* countries of Sweden and Denmark appear to have the healthiest population aged 50-65, but based on the definition of the health stock variable, the country with the highest mean health stock is Switzerland. Interestingly, these three countries also present the smallest variation in health stock.

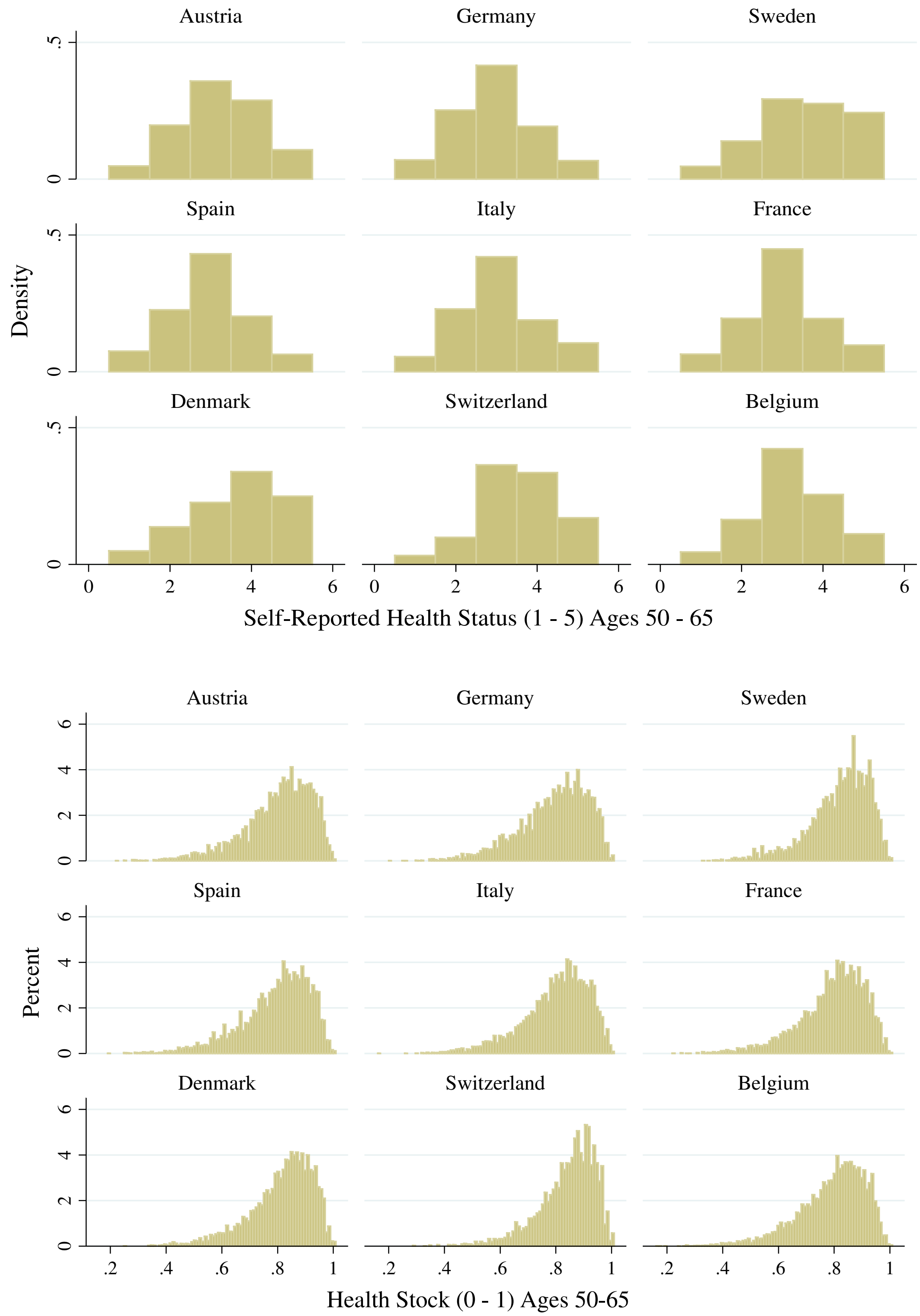

Figure 3 : Distributions of Self-Reported Health Status and Health Stock across population ages 50-65 (Sex-, Age-, and Wave- Standardized)

Table 4: Health Stock (Ages 50-65) by Country (Wave, Age, and Sex Standardized)

	Mean	Std. Dev.	Min	Max	N
Switzerland	0.843	0.101	0.291	1	4748
Sweden	0.823	0.107	0.332	1	5559
Denmark	0.816	0.112	0.254	1	5842
Austria	0.804	0.119	0.224	1	5861
Italy	0.801	0.118	0.167	1	6763
Germany	0.796	0.122	0.205	1	6894
France	0.795	0.117	0.221	1	8092
Spain	0.793	0.124	0.194	1	6277
Belgium	0.792	0.120	0.161	1	9517

When ranking according to mean Health Stock, Denmark loses the first position it had achieved to it in terms of self-reported health (see statistics featured in Table 1), which is more consistent with the country's ranking in terms of life expectancy at age 50 and healthy life years at age birth.

6. Conditions impairing functioning and "Functioning Stock"

When including a health variable in a model, one may want to restrict its definition to the concept of functioning or the extent to which an individual is able to carry out typical daily activities? In this view, someone is healthy if physically and mentally able to do the things she or he wishes and needs to do. For example, a diagnosis of a high level of cholesterol does not necessarily impede the performance of day-to-day activities. It only influences one's perception of the likelihood of performing these activities in the future. Hence it should be a component of the *health stock* variable but not of a distinct *functioning stock* variable.

Based on Bush et al.'s (1972) definition of health as incorporating two dimensions, I divide the components of health in Table 2 into two groups: *functioning* and *prognosis*. To be labelled as belonging to the "functioning" category, a health indicator must be both potentially impairing and diagnosable by a third party (as medical assessment is required for benefits eligibility). The conditions satisfying these critera are lung disease, heart problem, cancer, stroke, hip fracture, "other condition", hospitalization, ADL, and depression[14]. When assessing mental health for the construction of the health stock, I used the EuroD indicator. Because I now focus on diagnosable conditions, I replace the mental health indicator with the diagnosis of a depression. The factor loadings estimated using the method described in Section 4 when using the dummy variable answer to the question "Have you ever been diagnosed with depression?" instead of the EuroD indicator are presented in Appendix A.3. This new set of factor loadings is normalized so that an individual having never been diagnosed with a functioning imparing condition will have a functioning stock of 1. In the same way, a respondent having been diagnosed with every possible imparing condition will have a functioning stock of 0.

As represented in Figure 4, the distribution of Functioning Stock within countries is notably different from that of the Health Stock: in each of the countries studied a sizeable fraction (about one third) of the population ages 50-65 has a Functioning Stock equal to 1 (the maximum value), implying that they were fully able to perform day-to-day activities at the time of the survey. However, the ranking of the countries (presented in Table 5) by declining mean Functioning Stock is not notably different from that of the ranking by mean Health Stock. That is not surprising given that the Health Stock variable integrates a prognosis component, which is merely an anticipation of the decline in functioning at a later point in time[15].

[14] Side note on mental health: depression is a commonly occurring and potentially seriously impairing disorder, ranging from major depression, to atypical depression, to dysthymia. Symptoms of depression include decreased effort and anhedonia (diminished interest or pleasure in activities), which, by definition may affect the ability to work, and can stretch from relatively minor through to very severe.

[15] Correlation Coefficient = 0.917 ; Life expectancy at 50 is positively correlated with the functioning stock variable (r= 0.4191) and the health stock variable (r= 0.1583), but negatively correlated with self-reported health (r= -0.3671).

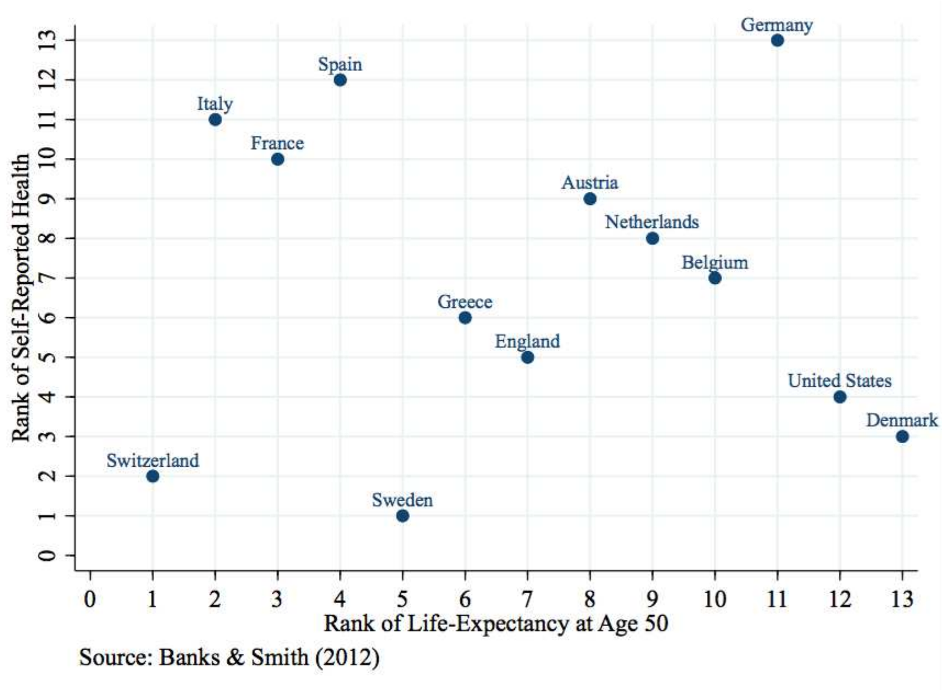

Figure 4 : Distributions of Functioning Stock across population ages 50-65 (Sex-, Age-, and Wave-Standardized)

Table 5: Functioning Stock (Ages 50-65) by Country (Wave, Age, and Sex Standardized)

	Mean	Std. Dev.	Min	Max	N
Switzerland	0.904	0.113	0.152	1	4746
Sweden	0.888	0.128	0.218	1	5557
Denmark	0.881	0.135	0.078	1	5828
Italy	0.880	0.136	0.095	1	6736
Spain	0.874	0.142	0.109	1	6211
Austria	0.874	0.140	0.169	1	5768
France	0.868	0.138	0.190	1	8065
Belgium	0.863	0.146	0.123	1	9500
Germany	0.858	0.146	0.095	1	6887

7. Conclusion

When including health in economic models, the conventional strategy is to use Self-Reported Health. But this variable has been shown to suffer from reporting heterogeneity for a given level of 'true health'. Hence failing to correct for differences in reporting behavior may yield biased results when making comparisons across countries or subpopulations.

In this chapter, I have constructed two population health metrics for survey-based data suitable for analysis across time and populations. To do so, I combined objective health indicators with the information available in the SHARE dataset regarding functioning and prognosis, and detailed a strategy to estimate the contribution of individual indicators to latent health, while minimizing contamination from non-health related factors (country, wave, age, and labor status). The first variable, *Health Stock*, is an objective comprehensive health metric, which is a composite of an individual's level of function at a point in time as well as forward looking compenents with repect to expected health. The second variable - referred to a *Functioning Stock* – is restricted to objective measures of an individual's health that distinctly impair activities of living.

I will use these variables in the next two chapters when assessing the economic impacts of a decline in health and in likelihoods of transitioning back to work after a health recovery. As we will see, I will define negative (and positive) health shocks as dummy variables equal to one if and only if the respondent experienced a decrease (or an increase) between two consecutive periods in their *functioning stock* of a given minimum magnitude. Additionally, the *health* stock variable will be used as a control in the treatment equation to account for the baseline health level of an individual in their likelihood of experiencing a health shock. The *functioning* stock variable will serve as a control variable in the outcome equation to account for the respondent's baseline ability to perform work tasks.

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Appendix

A.1 Log-likelihood and gradient functions for the maximum likelihood estimation of the health stock

I adopt the econometric approach used by Juerges (2007), based on Terza (1985). For each observation *i* in wave *t*, the continuous latent self-reported health variable $SRH5^*_{it}$, can be defined as:

$SRH5^*_{it} = X'_{it}\beta + e_{it}$ where e_{it} is an error term with a standard normal distribution.

$SRH5_{it}$, the observed ordinal variable, takes on values 1 through 5 according to the following scheme:

$$SRH5_{it} = j \Leftrightarrow \mu_{(j-1)k} < SRH5^*_{it} <= \mu_{jk},$$

where k is the country-wave combination for observation *i* in wave *t*.

To account for country and wave specific reporting styles, the ordered probit thresholds are modelled as a function of the country of residence and the wave of the survey the respondent participated in. In order to ensure that thresholds are increasing with their order, threshold equations are specified by the following set of equations:

$$\mu_{0k} = -\infty$$

$$\mu_{1k} = D'_k\gamma_1$$

$$\mu_{jk} = \mu_{(j-1)k} + \exp(D'_k\gamma_j)\text{, for } j \in [2, J-1] \qquad (1)$$

$$\mu_{Jk} = +\infty$$

where μ_{jk} is the j-th threshold for the country-wave combination k, γ_j is a vector of parameters in the j^{th} threshold equation, and D_k is a vector of country + wave dummies.

I define a set of ordinal variables equal to 1 if $SRH5_{it}$ falls in the j^{th} category, and 0 otherwise.

$$d_{ijt} = \begin{cases} 1, & iff\ SRH5_{it} = j \\ 0, & otherwise \end{cases}$$

N : number of observations

J: number of levels of the dependent ordered categorical variable

Prob $(d_{ijt} = 1)$ = P_{ijt} $= \Phi(\mu_{ijt} - X'_{it}\beta) - \Phi(\mu_{i(j-1)t} - X'_{it}\beta)$, where Φ is the cumulative standard normal.

The likelihood function for the model is:

$$L = \prod_{i=1}^{N}\prod_{j=1}^{J}[\Phi(\mu_{ijt} - X'_{it}\beta) - \Phi(\mu_{i(j-1)t} - X'_{it}\beta)]^{d_{ijt}}$$

And the log-likelihood function to maximize is:

$$LL = \sum_{i=1}^{N}\sum_{j=1}^{J} d_{ijt}\ln[[\Phi(\mu_{ijt} - X'_{it}\beta) - \Phi(\mu_{i(j-1)t} - X'_{it}\beta)]$$

The gradient of the log-likelihood function is:

- with respect to β

$$\frac{\partial LL}{\partial \beta} = \sum_{i=1}^{N}\sum_{j=1}^{J}\frac{d_{ij}}{P_{ij}}[\phi(\mu_{ij} - X'_{i}\beta) - \phi(\mu_{i(j-1)} - X'_{i}\beta)] * (-X_i)$$

where ϕ is the standard normal distribution.

- with respect to γ_1

$$\frac{\partial LL}{\partial \gamma_1} = \sum_{i=1}^{N}\sum_{j=1}^{J}\frac{d_{ij}}{P_{ij}}\left[\phi\left(\mu_{ij} - X'_i\beta\right) - \phi\left(\mu_{i(j-1)} - X'_i\beta\right)\right] * (D_i)$$

- with respect to γ_p, p>1

I define T as the lower 5X5 unit triangular matrix.

$$\frac{\partial LL}{\partial \gamma_p} = \sum_{i=1}^{N}\sum_{j=1}^{J}\frac{d_{ij}}{P_{ij}}\left[T_{jp} * \phi\left(\mu_{ij} - X'_i\beta\right) - T_{(j-1)p} * \phi\left(\mu_{i(j-1)} - X'_i\beta\right)\right] * \exp\left(D'_i\gamma_p\right) * D_i$$

A.2 Ordered Probit Cutoffs by Country and Wave

Country	Wave1				Wave 2				Wave 4				Wave 5			
	mu1	mu2	mu3	m4	mu1	mu2	mu3	m4	mu1	mu2	mu3	m4	mu1	mu2	mu3	m4
Austria	0.48	0.65	0.84	1.01	0.51	0.68	0.86	1.01	0.50	0.68	0.85	1.01	0.48	0.66	0.83	0.99
Germany	0.48	0.69	0.90	1.04	0.50	0.72	0.92	1.05	0.50	0.72	0.91	1.05	0.47	0.69	0.89	1.02
Sweden	0.49	0.65	0.81	0.93	0.51	0.67	0.82	0.94	0.51	0.67	0.82	0.94	0.49	0.65	0.80	0.92
Spain	0.49	0.68	0.91	1.05	0.51	0.71	0.92	1.05	0.51	0.71	0.91	1.05	0.48	0.68	0.89	1.02
Italy	0.48	0.67	0.89	1.01	0.50	0.70	0.90	1.01	0.50	0.70	0.89	1.01	0.47	0.67	0.87	0.98
France	0.51	0.66	0.89	1.01	0.53	0.69	0.90	1.01	0.53	0.69	0.90	1.01	0.50	0.67	0.87	0.99
Denmark	0.48	0.62	0.77	0.93	0.50	0.65	0.79	0.94	0.49	0.65	0.79	0.93	0.47	0.62	0.76	0.91
Switzerland	0.48	0.62	0.85	1.00	0.50	0.65	0.85	1.00	0.50	0.65	0.85	1.00	0.47	0.62	0.83	0.97
Belgium	0.43	0.62	0.86	1.00	0.45	0.65	0.87	1.00	0.45	0.64	0.86	1.00	0.43	0.62	0.84	0.98

A.3 Factor Loadings on Health Indicators when Using the Diagnostic of a Depression as the Indicator on Mental Health

Category	Condition	Factor Loading
Gender		
	Female	0.141***
		(1.43E-04)
Conditions		
	Ever had heart problems	-0.470***
		(3.49E-04)
	Ever had lung disease	-0.470***
		(3.90E-04)
	Ever had diabetes	-0.415***
		(3.24E-04)
	Ever had cancer	-0.410***
		(3.81E-04)
	Hospitalized within a year	-0.362***
		(2.55E-04)
	Ever had another condition	-0.349***
		(2.24E-04)
	Ever had arthritis	-0.317***
		(2.22E-04)
	Ever had stroke	-0.277***
		(6.38E-04)
	Ever had high blood press.	-0.191***
		(1.90E-04)
	Ever had a hip fracture	-0.061***
		(8.88E-04)
	Ever had cholesterol	-0.057***
		(2.11E-04)
	Never had any condition	0.298***
		(2.04E-04)
Self-Diagnosis		
	>1 gross motor difficulty	-0.535***
		(4.33E-04)
	>1 large motor difficulty	-0.432***
		(2.04E-04)
	>1 fine motor difficulty	-0.353***
		(4.45E-04)
	Reports joint pain	-0.276***
		(1.67E-04)

Category	Condition	Factor Loading
	Obese	-0.229***
		(2.16E-04)
	No hand grip measured	-0.212***
		(3.93E-04)
	Underweight	-0.182***
		(7.06E-04)
	Low hand grip measured	-0.068***
		(2.12E-04)
	Overweight	-0.058***
		(1.57E-04)
Expectations		
	Not active	-0.199***
		(2.02E-04)
	Currently smokes	-0.189***
		(1.60E-04)
	'Bad genes'	-0.156***
		(3.05E-04)
	Very active	0.016***
		(1.71E-04)
	'Good genes'	0.112***
		(1.49E-04)
Mental Health		
	Depression	-0.279***
		(1.51E-04)

Notes: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. Gross motor difficulties include difficulties walking across a room, walking 100 meters, climbing a flight of stairs, going in and out of bed, and bathing; Large muscle difficulties include difficulties sitting for two hours getting up from a chair, stooping, kneeling, or crouching, and pushing or pulling a large object; Fine muscle difficulties include difficulties picking up a small coin, eating, and dressing. Very active indicates that the respondent engages in vigorous physical activity (sports, heavy housework, a job that involves physical labor) more than once a week. Not active indicates that he/she does so hardly ever or never.

Chapter II: Economic Consequences of a Decline in Health: Evidence from Western European Countries

1. The Health-Wealth Gradient in Industralized Countries

The ubiquity of socio-economic differentials in health across industrialized countries is now extensively documented (for example: Marmot 2005; Cutler et al. 2006; Mackenbach 2006) and the relationship between health and economic resources (Social Economic Status or SES) is referred to as a "gradient" to emphasize the gradual relationship between the two dimensions. The gradient has been replicated using virtually every measure of health outcome, including mortality, morbidity, disability, and perceived health status (Dutton & Levine 1989).

There is abundant evidence of a quantitatively large association between many measures of SES and a variety of health outcomes. However, debate remains about the direction of causation and about why the association arises (See Smith 1999). We can posit three causal chains. (1) The obvious and most documented pathway goes from SES to health: economic resources affect health - individuals with more wealth can live in healthier environments and afford better medical care; this causal relationship begins before birth (Barker 1997). (2) Health affects economic resources (referred to as *reverse causation*) - healthier individuals may be able to work more than those who are ill, enabling them to accumulate more wealth; moreover, health problems may deplete an individual's wealth, either directly through out-of-pocket medical expenses or indirectly through employment effects. (3) Third factors (genetic, environmental, or intergenerational) may determine both health and economic resources - for example, more patient individuals (that is with a low rate of time preference[16]) may undertake investments in human capital that enhance future earnings as well as engage in behaviors that improve future health.

These three causal chains are likely to operate simultaneously. The relative importance of each chain may vary across countries, at different times, for different aspects of health, and at different points in the life course. Using life cycle theory, and to illustrate the complexity of the causal pathways underlying the health-wealth gradient, Smith (2005) proposed that in a given country in period t, current SES for each individual i (Y_{it}) reflects a dynamic history of health (H_{it-1}), SES (Y_{it-1}), and other relevant forces (X_{it-1}), which can be conceptually summarized as follows:

$$Y_{it} = \alpha_0 + \alpha_1 H_{it-1} + \alpha_2 Y_{it-1} + \alpha_3 \Delta H_{it} + \alpha_4 X_{it-1} + u_{1it} \quad (1)$$

$$H_{it} = \beta_0 + \beta_1 H_{it-1} + \beta_2 Y_{it-1} + \beta_3 \Delta Y_{it} + \beta_4 X_{it-1} + u_{2it} \quad (2)$$

where X_{it-1} represents a vector of possibly non-overlapping time and non-time varying factors influencing health and SES, and u_{1it} and u_{2it} are possibly correlated stochastic shocks to health and SES. In each country, the key parameters α_3 and β_3 measure respectively the effects of new innovations of health on SES and of new innovations of SES on health.

If we were to represent the gradient graphically with a measure of current SES on the x-axis and a measure of current health on the y-axis, the steepness of the gradient would be accentuated by high levels α_3 for given values of β_3. Concentrating on the less studied causal pathway going from health to economic status (reverse causation), to estimate α_3, an exogenous variation in health is required that is not induced by SES. The standard approach in the literature

[16] Time preference can be defined as the inclination of a consumer towards current consumption over future consumption, or as the current relative valuation placed on receiving a good at an earlier date compared with receiving it at a later date (Malhotra et al. 2002)

is to concentrate on *health shocks*, typically defined as sudden deteriorations in a person's health that might be brought about by accidents or by unanticipated diseases. This has two advantages: first, to disentangle the causal relationship from health to wealth, as sudden health changes can be considered exogenous, but also to distinguish the effects of health from other environmental factors. In the same vein, one could estimate α_3 for positive health shocks, defined as a sudden improvement of a person's health. The magnitude of α_3 for negative health shocks ($\alpha_3 N$) could be used to measure a country's or a group of countries' ability to cushion its population from health problems, and the magnitude of α_3 for positive health shocks ($\alpha_3 P$) would represent the country's or a group of countries' propensity to let its population capitalize on a health recovery. Best performing institutions in terms of the Health to Wealth relationship would be those having both $\alpha_3 N$ with a small magnitude and $\alpha_3 P$ with a large magnitude.

Two broad questions regarding state policies and reverse causation thus become apparent. First, there is the question of how well different social safety net arrangements effectively ensure income security to the people who suffer negative health shocks (estimating the magnitude of $\alpha_3 N$). In Chapter II, I will thus focus on negative health shocks and "reverse causation" in Western Europe. Social policy is best understood in the context of an ongoing policy debate on public spending, increasing life expectancy, and the appropriate balance of adequacy in benefit provision and promoting independence and self-sufficiency for claimants. In that context, the second question is whether social safety nets also enable transitioning back to self-reliance (estimating the magnitude of $\alpha_3 P$). For that matter, I will then evaluate in Chapter III to what extent these social safety nets enable transitioning back to work in case of a health recovery.

2. Reverse Causation: Literature Review

As Angus Deaton (2002) has noted: "it is unfortunate and divisive that much of the public health literature on the gradient takes the position that the effects of health on socioeconomic status are negligible." Yet there is sizeable literature showing significant economic impacts of health shocks. In the United States, a variety of studies have investigated how health can impact wealth and income directly, or through employment and consumption effects (Smith (1999, 2004, 2005); Lee and Kim (2003, 2008); Adams et al. (2003); Hurd and Kapteyn (2003); Wu (2003); Ward-Batts (2001)). With the exception of Adams et al. (2003), all these studies have found that health impacts the financial component of *social economic status*. For many individuals, especially those middle aged, health feedbacks to labor supply, household income, or wealth may be quantitatively important. Note that the objectives and conclusions of Adams et al. (2003) were limited, as they studied only elderly Americans (over 70), for whom Medicare provides relatively homogeneous and comprehensive health care at limited out-of-pocket costs to the individual. Additionally, this population is retired, so that new health problems do not impact earnings.

Smith (1999) focused both on Americans in pre-retirement age and over 70. Among others, he dealt with how health influences economic status by sketching out reasons why health may alter household savings (and eventually wealth) and then providing estimates of the empirical magnitude of these effects. In middle and at older ages, he found pronounced effects of new health events on household income and wealth. Smith (2004, 2005) examined whether a new health event has a significant impact on four dimensions of SES: out-of-pocket medical expenses, labor supply, household income, and household wealth for the same two groups of Americans. He used the Health and Retirement Survey (HRS) and estimated the impact of a health shock across HRS waves. He found that, at least among people in their fifties, pathways from health to the financial measures of SES are not trivial. Especially as time unfolds, negative health events have a quantitatively large impact on work, income, and wealth, and the principal risk people face when poor health arrives is not medical expenses but rather non-insured losses of work and income.

Dobkin et al. (2015) examined some economic consequences of hospitalizations linking individuals with a (non-pregnancy related) hospital admission to a 10-year panel of their consumer credit reports. For prime-age adults with health insurance, they found that hospital admissions increased unpaid medical bills, reduced access to credit, reduced borrowing, and increased bankruptcy rates. For uninsured, prime-age adults, they found much larger impacts on unpaid medical bills and bankruptcy, but similar effects on access to credit and borrowing. For elderly (65+) adults, they found impacts only on unpaid medical bills. Beyond the sole impact of uncovered medical expenses, their results suggest an important role for uninsured income consequences in explaining this finding.

Wu (2003) and Ward-Batts (2001) showed that serious health conditions had strong effects on household wealth, but that the effects for women were larger and more significant than the effects for men. To explain the source of this asymmetry, Wu (2003) suggested that general living expenses increased when wives became seriously ill, while for husbands, health shocks did not affect these expenditures.

In Europe, a few papers have investigated the impact of health shocks on labor outcomes in specific countries. For example, Riphahn (1999) found that a health shock trebles the probability of leaving the labor force and almost doubles the unemployment risk in Germany . The financial effects of health shocks are small on average and those individuals with the highest remaining earnings potential are least affected by the health shock. García-Gómez et al. (2013) showed that, in the Netherlands, an acute hospital admission lowers the employment probability by seven percentage points and results in a five percent loss of personal income two years after the shock. Focussing on France, Duguet & Le Clainche (2014) found that chronic illness and injuries have negative effects on career outcomes and that women are more likely to claim minimum assistance revenue when such events occur.

Hurd and Kapteyn (2003) spearheaded a multi-country analysis by considering longitudinal data from two countries with very different institutional environments, the United States and the Netherlands. They used data from HRS, from the Dutch Socio-Economic Panel (SEP), and from the Dutch CentER Savings Survey (CSS). The definitions of the variables in the three datasets are not always comparable, but some key trends are identifiable: the results show a much steeper gradient of health with income, wealth, and education for HRS than for CSS/SEP. There is a strong effect of health level on percentage wealth changes in the United States data whereas the relation between wealth changes and health is much weaker in the Dutch datasets. Income and wealth have a significant influence on health transitions in both countries, but the effect appears to be considerable larger in the United States than in the Netherlands.

Within Europe, García-Gómez (2011) investigated the relationship between health shocks and labor market outcomes across nine European countries using the European Community Household Panel (ECHP) using matching techniques. Her results suggest that there is a significant causal effect of health on the probability of employment and that the impact differs across countries, with the largest employment effects being found in the Netherlands, Denmark, Spain and Ireland, and the smallest in France and Italy. She used two measures of health shocks. The first is based on self-assessed health. From the five possible responses in the ECHP (very good, good, fair, bad and very bad), she considered that the respondent had undergone an adverse health shock if he or she reports "fair", "bad" or "very bad" in any given period. The second health measure used is based on responses to the question on chronic illnesses "Do you have any chronic physical or mental health problem, illness or disability?". She models the likelihood of experiencing a shock on a series of sensible pre-treatment characteristics, but does not include any behavioral variables.

What stands out from this literature review is that:

(1) Most of the studies mentioned have examined the impact of health on wealth[17], primarily in the United States due to the early availability of HRS. The impact of negative health shocks tends to be highest for working age people, suggesting that the leading underlying cause of changes in the financial components in SES is the impact of health shocks on labor outcomes for working age people (on average over and above out-of-pocket medical expenditures). This should be even more accurate in Europe as comprehensive health care insurance systems limit uncovered medical costs to the individual.

(2) Cross-country comparisons have been attempted but methodological issues remain when defining the health and health shock variables cross-nationally. In particular, well documented concerns of reporting heterogeneity between countries for a given level of "true health" (see Chapter 1) have not been addressed systematically before conducting econometric analysis, which may yield misleading results.

[17] This causal relationship is complex and often indirect: changes in wealth result from modifications mainly in household income through labor supply, but also in out-of-pocket medical expenses, living expenses, as well possible adjustments in the savings behavior and variation in bequests.

3. Research Question

Based on these findings, I restrict my comparative study to European countries, for which an ex-ante harmonized cross-national comparative social survey (SHARE) is now available with five comparable waves.

European countries redistribute a large share of their GDP (about 19%) through social safety net programs compared to 8% for the United States. On average, 85% of this spending is associated with social insurance programs: pensions for old-age, disability or dependents, and contingency for temporary loss of work due to unemployment, illness or maternity (Tesliuc 2006). Article 34 "Social Security and Social Assistance" of the EU Charter of Fundamental Rights states that […] the Union recognises and respects the right to social […] assistance so as to ensure a decent existence for all those who lack sufficient resources […] (EU Charter of Fundamental Rights). But there is no "European model" welfare state: social protection systems vary widely across the Europe in size, institutional set-up and re-distributional nature (Esping-Andersen 1990).

In this chapter, I focus on the impact of negative health shocks on labor supply in Western Europe and draw inferences on the extent of reverse causation and consequences for the gradient for this population. Specifically, I (1) investigate the impact of negative health shocks on the likelihood to remain employed across education levels in this group of countries (2) assess how well European countries provide financial support to individuals who suffered a negative health shock, and (3) identify across countries what options in terms of labor force status are offer to health impaired individuals.

4. Underlying Theoretical Model

My theoretical model is a static two-period model of labor supply, extending Cutler et al. (2011). It integrates both a standard health capital model (Grossman 1972) and an optimal labor supply model (Bound and Burkhauser 1999).

According to the first framework (Grossman 1972), people work as long as their health is above a threshold related to their productivity in the labor market. From this perspective, the response to a potential health shock will depend on the severity of the shock, the stock of health before the shock, and the health requirement for work (i.e. physical and mental effort). All else equal, people who have more severe health shocks or who were in worse health before the health shock will be more likely to exit the labor force than will others. Similarly, people with more physically or mentally demanding jobs will be more likely to leave the labor force after a health shock.

According to the second framework (Bound and Burkhauser 1999), the choice between disability insurance, retirement, and labor force participation is made in light of income and substitution effects, and tastes for leisure. In this model, the behavioral differences across people will be explained by the relative disability insurance replacement rate (if the worker is entitled to disability benefits), the retirement pension amount (if retiring is an option), the amount of other earnings in the household, and the extent to which the person dislikes work relative to leisure. I add the option of unemployment, which has been shown to be a common health response of workers in Europe (García-Gómez 2011).

In every country, (1) civil servants enjoy more job security than people employed in the private sector, (2) public pensions have statutory minimum retirement age requirements (possibly based on year of birth, gender, and employment history), (3) eligibility for disability benefits is conditioned on coverage, health, and job requirements, and (4) eligibility for unemployment benefits depends on coverage and tenure in the previous job. Hence the choices offered to a worker depend in particular (but not exhaustively) on their country of residence, age, gender, health stock, full employment history, current company agreements, and number of children. As a result, based on this current and past situation, and depending on the generosity of the public transfer policies in his/her country of residence, the individual may be able to choose whether to work (W), retire (R), receive unemployment benefits (U) or enroll in disability (D). These choices may not be exclusive.

The individual is assumed to be employed in the first period. They do not receive any additional benefits. Between the first and the second period, the worker may experience a health shock. Let Ω be the restricted set of available options given to the worker: $\Omega \subseteq \{W, R, D, U\}$. Because some of the information necessary to establish which choices are accessible to a worker are not available to the researcher (e.g. full employment history, company agreement, etc.), the choice set Ω for each individual in the second period is a priori unknown.

Utility is represented by a function u, which is a function of consumption, health, and a possible disutility factor, and which exhibits positive diminishing marginal returns with respect to its objects. For workers, consumption is equal to earned (y_e) plus unearned income (y_n). Health affects utility as $\alpha_W H$ for workers and $\alpha_L H$ for others (who are at *leisure*). Applying for unemployment or disability benefits provides disutility (specifically c_U and c_D). Thus, utility for workers, retirees, and people receiving unemployment benefits and disability insurance are, respectively,

$$U_W = u(y_e + y_n;\ \alpha_W H\ ;\ 0)\ if\ W \in \Omega\ ;$$

$$U_R = u(y_R + y_n;\ \alpha_L H\ ;\ 0)\ if\ R \in \Omega\ ;$$

$$U_U = u(y_U + y_n;\ \alpha_L H\ ;\ c_U)\ if\ U \in \Omega\ ;$$

$$U_D = u(y_D + y_n;\ \alpha_L H\ ;\ c_D)\ if\ D \in \Omega\ ;$$

The worker chooses in the second period whether to continue working, retire, go on disability or go on unemployment by maximizing utility over his possible choices in Ω. From this unified framework, we can infer that:

(1) In a given country, a worker will be more likely to keep on working in period 2 if (a) he/she enjoyed better health in period 1; or (b) he/she did not experience a health shock; (c) he/she is younger; (d) he/she is a civil servant; (e) he/she does not qualify for full retirement benefits; (f) the physical/psychological requirements for the job are lower; and/or (g) if he/she can work and receive benefits at the same time.

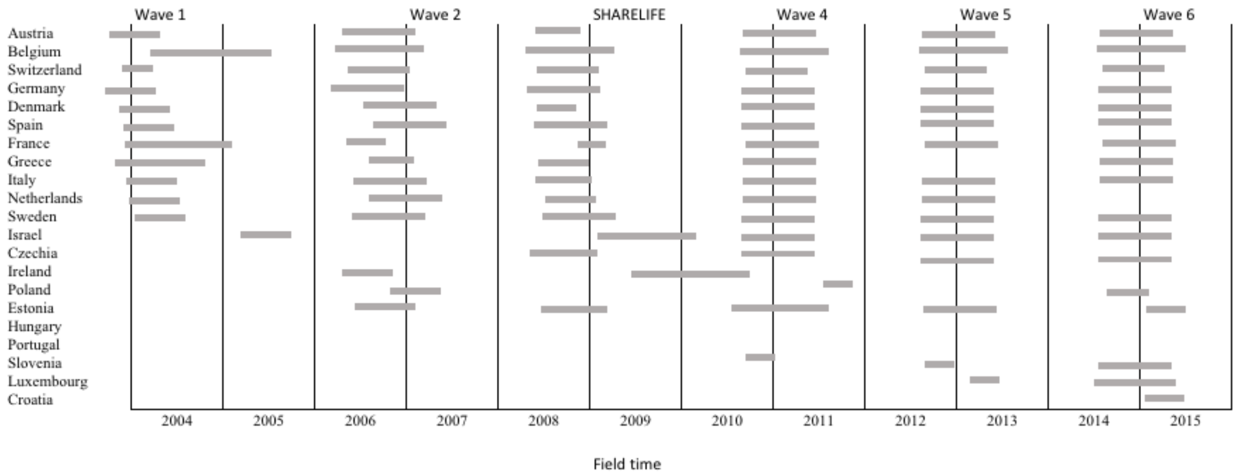
(2) Across countries, all else equal, a worker will be more likely to keep on working if (a) companies are more flexible in accommodating health-impaired employees; (b) the requirements to receive any benefits are more stringent; (c) the replacement rates for these benefits are lower and/or (d) employment protection legislation is more stringent.

5. Data

5.1 Data harmonization - Comparability across datasets

To complete my study, I use the Survey of Health, Ageing and Retirement in Europe (SHARE[18]), which was presented in Chapter I. Figure 5 identifies the countries surveyed for the 6 waves of SHARE.

18 www.share-project.org.



From: http://www.share-project.org/data-documentation/waves-overview.html

Figure 5: Country Wave Field Time Overview, Wave 1 to Wave 6

The Gateway to Global Aging Data[19] is a platform for population survey data on aging around the world, including HRS and SHARE. Using the RAND HRS as a model, they provide Stata code to construct the Harmonized Survey of Health, Ageing, and Retirement in Europe (Harmonized SHARE) as easy-to-use versions of data from the first four similar waves of SHARE – waves 1 to 5 except SHARELIFE, wave 3 – with a set of harmonized variables suitable for cross-country analysis. I enriched the code provided to expand the set of available variables, and integrated the information available from Wave 6.

5.2 Weights

Sample design and weighting strategies for SHARE are described in detail in De Luca et al (2015). The following reviews the key principles.

For each wave, the target population includes persons aged 50 or more, and persons who are a spouse/partner of a person aged 50 or more, who speak (one of) the official language(s) of the country (regardless of nationality and citizenship) and who do not live either abroad or in

19 https://g2aging.org

institutions such as prisons and hospitals during the entire fieldwork period. People who were residents in nursing homes and other institutions for elderly were considered to be part of the target population investigated by SHARE, but this population group may not be well represented in all countries due to the lack of suitable sampling frames.

In order to facilitate inference to the population of interest, the survey is based upon probability samples with full population coverage. This is the key principle of the SHARE sampling design, as it is for all advanced population-based survey programs. The availability of a probability sample ensures that every unit in the target population has a chance greater than zero of being selected into the sample. Sampling design weights are defined as the inverse of the probability of being included in the sample of any specific wave. These weights compensate for unequal selection probabilities of the sample units. They allow obtaining unbiased estimators of the population parameters only under the ideal situation of complete response. Unfortunately, the SHARE data are affected by problems of unit non-response (i.e., eligible sample units fail to participate in the survey because of either noncontact or explicit refusal to cooperate) and sample attrition (i.e., responding units in a given wave of the panel drop out in a subsequent wave). Therefore, estimators constructed using sample design weights alone, and ignoring unit non-response and attrition, may be biased (Lessler and Kalsbeek 1992).

The strategy used by SHARE to cope with the potential selection bias generated by unit non-response and panel attrition relies on the ex-post calibration procedure of Deville and Särndal (1992). This statistical re-weighting procedure gives calibrated weights which are as close as possible, according to a given distance measure, to the original design weights while also respecting a set of known population totals (the calibration margins). Under certain assumptions about the missing data process, calibrated weights may help reduce the potential selectivity bias generated by unit non-response and panel attrition. The key assumption is that, after conditioning on a set of variables (the calibration variables), there is no relation between the response probability and the other key survey variables excluded from the conditioning set.

Since the basic units of analysis can be either individuals or households, calibrated cross-sectional and longitudinal weights can be computed at the individual level for inference to the target population of individuals and at the household level for inference to the target population of households. Calibrated cross-sectional weights are defined for the sample of respondents 50 years of age and older (either individuals or households) for the wave considered. At the individual level, each respondent receives a calibrated weight that depends on the household design weight and the respondent's set of calibration variables. At the household level, each interviewed household member receives a common calibrated weight that depends on the household design weight and the calibration variables of all respondents 50 years of age and older in the same household.

Calibrated longitudinal weights differ from calibrated cross-sectional weights in two important respects. First, these weights are only defined for the balanced subsample of eligible units who participated in two or more waves of the panel. Second, since mortality is a source of attrition which affects both the sample and the population, calibrated longitudinal weights take into account mortality of the original target population across waves. Hence, the target population for longitudinal analyses is the original population at the beginning of the time reference period that survives up to the end of period.

For each wave, the data include calibrated cross-sectional weights to be used in the context of cross-sectional analyses and calibrated longitudinal weights to be used for longitudinal analyses. Because I restrict my study to respondents that are observed in two consecutive waves, I used the longitudinal weights for waves 1 to 2, 3 to 4, 4 to 5, and 5 to 6. To simplify the structure of the data, SHARE does not provide calibrated longitudinal weights for all possible wave combinations. To construct the longitudinal weights between waves 2 and 4 – which were not made readily available – I followed the procedure described in the SHARE generating calibrated weights user guide (2013).

6. Criteria for Inclusion in the Study

To both maximize the number of observations available and ensure methodological comparability, I first restrict my study to the countries surveyed in the 5 comparable waves (waves 1, 2, 4, 5, and 6): Austria, Germany, Sweden, Spain, Italy, France, Denmark, Switzerland, and Belgium. In the rest of the document, I will refer to this group of countries as "Europe". Because I am interested in analyzing the impact of a health shock on income, I restrict my sample to the respondents who are observed in two consecutive waves (skipping wave 3). In the rest of the document the following pairs of waves are considered consecutive: 1 and 2, 2 and 4, 4 and 5, and 5 and 6. Attrition between waves is dealt with through the use of longitudinal weights[20].

The SHARE questionnaire asks the respondents to classify themselves into one of six mutually exclusive labor force states: "worker", "retired", "unemployed", "disabled", "homemaker", or "other". SHARE also asks respondents to detail their earnings (from employment or self-employment) and other income (from old age pension benefits, early retirement pension benefits, unemployment benefits, sickness benefits, disability insurance

[20] Appendix 13.1 shows the mean characteristics (% female, % partnered, number of years of education, and age at interview) for both the individuals in the cross-sectional SHARE dataset (weighted with cross-sectional weights) and the individuals in the first period of the two-period model dataset (weighted with longitudinal weights). There is no statistical significant difference between the two populations.

benefits, social assistance, or public long-term care insurance) during the last year. When disclosed, this income is reported before tax in wave 1, and after tax in subsequent waves.

Self-reported activity status reflects individual perceptions about work status and institutional features of the country of residence (Börsch-Supan et al.2009). In some countries individuals may be allowed to work while collecting other benefits and classify themselves as working even if a substantial share of their income is not currently earned. Hence I normalize the definition of working by creating the sub-category “only working for pay” and further restrict my study to respondents who are receiving labor income from employment only in the first period. The method used to assign a respondent’s labor force status is presented in Appendix B.2. Table 8 presents the descriptive statistics for the remaining sample by country and wave in period 1.

7. Negative Health Shocks

To disentangle the causal relationship from health to wealth and to distinguish the effects of health from other environmental factors, the standard approach is to concentrate on *health shocks*, as sudden health changes can be considered exogenous. Health shocks are defined as a sudden deterioration in a person's health that might be brought about by an accident or an unanticipated disease (See Section 1). Several definitions of health shocks have been used in previous literature. Hurd and Kapteyn (2003) used the change in self-reported health status, whereas others have examined the impacts of chronic conditions such a heart or lung, disease, cancer, or stroke (Adams et al 2003, Lee and Kim 2003, Smith 1999, 2005, Wu 2003). García-Gómez (2011) used both measures. Among studies using chronic conditions, Smith (1999, 2005) and Wu (2003) focused on the new onset of chronic conditions, whereas Adams et al (2003) focused on the prevalence of existing conditions. Lee and Kim (2003) further investigated and found that new events and existing chronic conditions have different impacts on wealth change. Focusing on specific types of health problems, Smith (1999, 2005) examined both severe and mild chronic conditions, whereas Wu (2003) addressed only severe conditions.

In Chapter 1, I constructed two population health metrics for survey-based data suitable for analysis across time and populations. The first variable, *Health Stock*, is an objective comprehensive health metric, and the second variable - referred to a *Functioning Stock* – is restricted to the objective measure of an individual's level of function. Figure 6 and 7 show the weighted distribution of the change in functioning stock respectively by level of education and by tercile of income between two consecutive periods for all respondents ages 50-65 living in Europe. On the x-axis is the change in functioning stock. It is negative if the respondent experienced a decrease in functioning, or positive if he/she reported an improvement.

As is visible on these two figures, the share of respondents whose functioning stock remained constant across two consecutive waves is increasing with their level of education and their tercile of income.

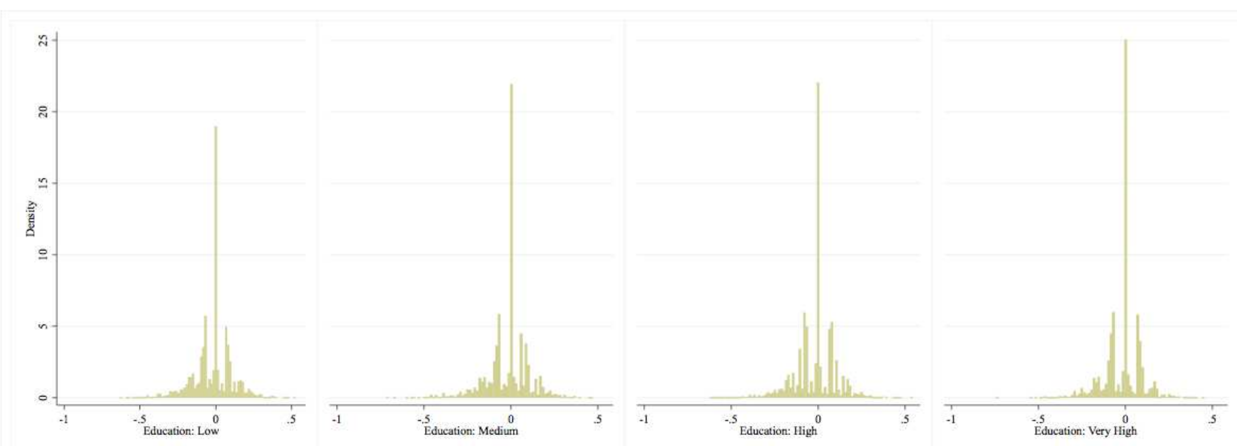


Figure 6: Distribution of the Change in Functioning Stock between two Consecutive Waves by Education Level (All repondents ages 50-65)

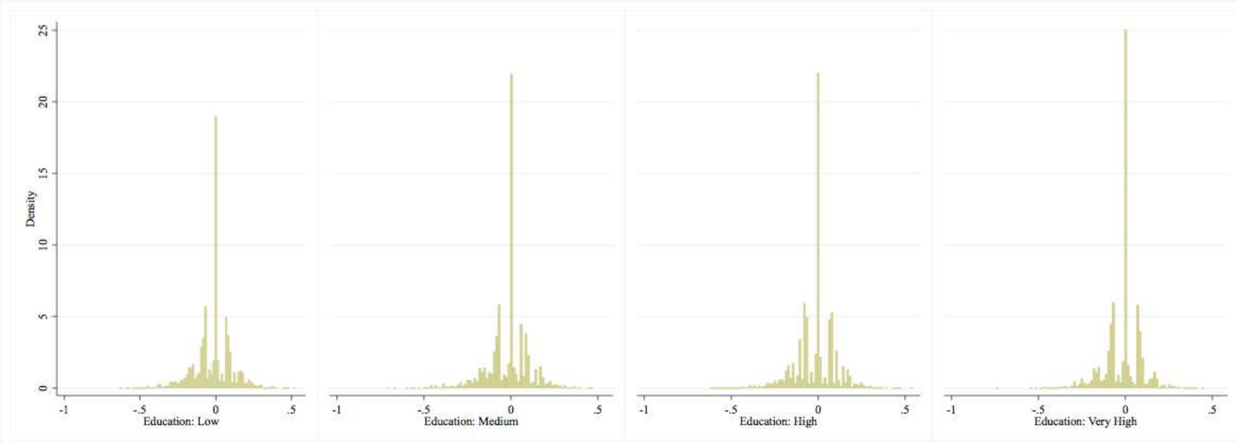


Figure 7: Distribution of the Change in Functioning Stock between two Consecutive Waves by Income Tercile (All repondents ages 50-65)

In a similar way, figure 8 shows the weighted distribution of the change in functioning stock by country between two consecutive period for all respondents ages 50-65. The countries with the highest shares of respondents experiencing no change in functioning stock across two consecutive period – Switzerland, Sweden, and Denmark - appear to be the ones enjoying the highest mean health stock (See Chapter 1).

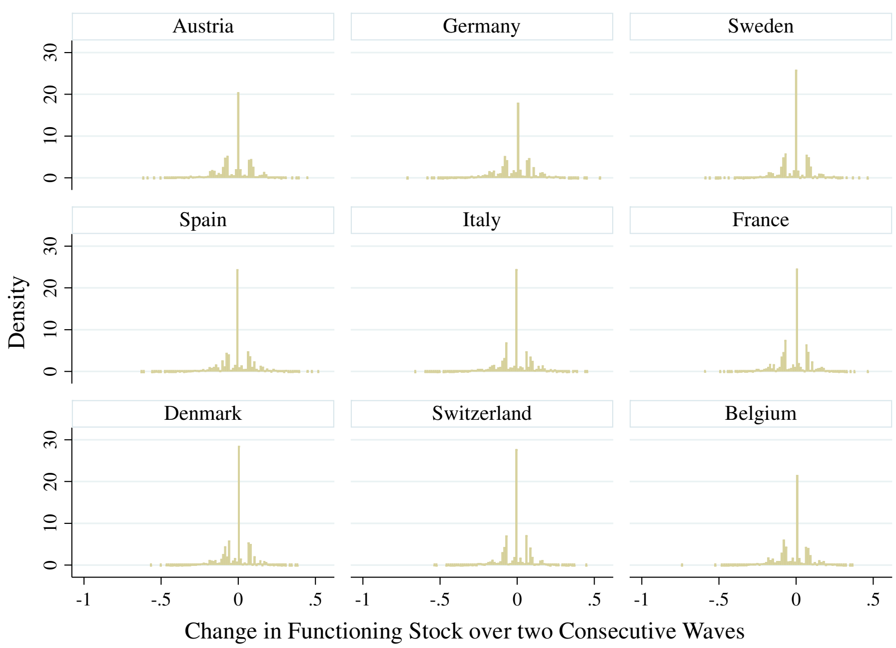


Figure 8: Distribution of the Change in Functioning Stock between two Consecutive Waves by Country (All repondents ages 50-65)

7.1 Definition of Health Shocks

I define a negative health shock[21] as a dummy variable equal to one if and only if (1) the respondent experienced[22] a decrease between two consecutive periods in the functioning stock, (2) the magnitude of the decrease exceeds a given threshold (in percent). To allow me to analyze a gradation of shocks, I set these thresholds to 5%, 10%, 15%, and 20% corresponding respectively to the dummy variables Shock5p, Shock10p, Shock15p, and Shock20p. This definition is at once more restrictive than some of the definitions previously used in the literature as I do not consider conditions that are altering the likelihood of transitioning to other health stock levels at future times or that are the result of a slow deterioration of health capital (diabetes, high blood pressure, cholesterol, grip strength, BMI, smoking, physical activity, genetic disposition), and at the same time more exhaustive as I potentially exploit (a) all new acute conditions affecting functioning in the short run (not only the new onset of chronic diseases such as cancer, lung or heart disease, stroke, hip fracture, arthritis, or other condition), (b) a hospital visit within the last year when none was reported during the previous wave, (c) the onset of a difficulty in an ADL or IADL, and (d) the new onset of a depression. Above all, it will enable studying the possible gradation in the impact of a health shock with respect to the intensity of that shock: a more substantial change in functioning stock should have more severe consequences than a more limited change.

Table 6 below shows the weighted frequency of health shocks between two consecutive waves among the respondents only working for pay in the first period (all waves). I define the

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[21] In the rest of the chapter, I will omit the term "negative" when referring to health shocks. In Chapter III, I will consider the impact of positive health shocks, this time considering only the impact of positive changes in functioning stocks across two consecutive waves.

[22] For a limited subset of conditions (heart problem, stroke, cancer, and hip fracture), respondents are asked if that condition was diagnosed since the previous interview. I use that information to adjust the change in functioning stock.

dummy variable Shock0 as equal to one if and only of the respondent's functioning stock increased or stayed constant beween two consecutive periods. Respondents in that category will serve as control group for my estimations. As a whole, about one third of the respondents experienced a decrease of at least 5% of their functioning stock between two consecutive periods. The likelihood of experiencing any type of shock health decreases with the tercile of household income corrected for household size[23] and with the education level[24] of the respondent. For example, on average across Europe, 10% of respondents ages 50-65 in the first income tercile reported a 20% decrease in their functioning stock between two consecutive waves, while only 7% of the respondents in the highest income tercile did so. Germans are on average more likely to report any kind of negative health shock, which was to be expected given their average level of health (see Chapter I)[25].

7.2 Occurrence of Health Shocks

To identify the factors that affect the likelihood that near-elderly individuals experience health problems, I modelled the occurrence of having a health shock on potential risk factors (see Yilmazer and Sharf 2014) using a weighted probit regression model with country fixed effects and longitudinal weights.

[23] The Statistical Office of the European Union (EUROSTAT) adopted in the late 1990s the so-called "OECD-modified equivalence scale". This scale assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child. $\varphi OCDE = 1 + 0.5(NAD - 1) + 0.3NCH$, with NAD being the number of adults and NCH the number of children in the household.

[24] I use the ISCED-97 classification (OECD, 1999) of the highest degree as measure of education available in SHARE. The seven original education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up).

[25] For an individual with a Functioning Stock of 1 in period 1 (the maximum value), the decrease in functioning caused by the onset of each condition in the "functioning" category can be calculated by multiplying the facfor loading in Appendix A.3 by 0.232. For example, the onset of a gross motor ADL will cause a 12% decrease in the functioinng stock.

Table 6: Frequency of Respondents in each Health Shock Category Between Two Consecutive Waves by Household Income tercile, Education Level, and Country - Population ages 50-65

	Shock0	Shock5p	Shock10p	Shock15p	Shock20p
Europe	60%	35%	21%	13%	8%
HH Income Tercile =1	58%	37%	24%	16%	10%
HH Income Tercile =2	60%	35%	21%	13%	8%
HH Income Tercile =3	62%	33%	19%	11%	7%
Education: Low	59%	37%	24%	16%	10%
Education: Medium	60%	35%	22%	14%	9%
Education: High	59%	35%	21%	13%	8%
Education: Very High	63%	33%	18%	11%	6%
Austria	59%	37%	22%	16%	9%
Germany	57%	37%	23%	15%	10%
Sweden	64%	31%	17%	10%	5%
Spain	65%	31%	19%	12%	7%
Italy	62%	34%	21%	13%	8%
France	60%	36%	20%	12%	7%
Denmark	63%	33%	17%	10%	6%
Switzerland	64%	30%	16%	9%	5%
Belgium	59%	36%	21%	13%	7%

Notes: For each country, the percent in each column represents the weighted frequency of respondents with respectively: Shock0: a *functioning stock* constant or increasing between 2 consecutive periods ; Shock5p, Shock10p, Shock15p, Shock20p: a *functioning stock* decreasing by respectively at least 5, 10, 15, or 20 percentage points between 2 consecutive periods

The equation modelling the probability for individual i of experiencing a health shock between periods 1 and 2 is:

$$Shock_{i12} = 1 \ if \ \beta_0 HS_{i1} + \beta_1 Gender_{it} + \beta_2 \ Part_{it} + \beta_3 \ Age_{it} + \beta_4 \ Overweight_{it} + \beta_5 Smoke_{it} + \beta_6, Educ_{i1} + \beta_7 \ TerInc_{it} + \beta_8 \ Country_j + \beta_9 \ Wave_{t1} + \varepsilon_{ijt} \geq 0$$

$$= 0 \ otherwise$$

where, for individual i, $Shock_{i12}$ is a categorical variable equal to 1 if the respondent experienced a health shock between periods 1 and 2, HS_{i1} is the individual's health stock in period 1, $Gender_i$ is a dummy variable equal to 1 if the respondent is female, $Part_{it}$,is a dummy variable equal to one if the respondent is partnered, $Age_{it}$is the repondent's age at the date of the interview in period 1, $Overweight_{it}$ is a dummy variable equal to 1 if the repondent's BMI was over 25 at period 1, $Smoke_{it}$ is a dummy variable equal to 1 if the respondent declared smoking in period 1, $Educ_i$ is a categorical variable ranging from 0 to 3, $TerInc_{it}$ is a factor variable equal to the tercile of the household income corrected for household size in period 1, $Country_j$ is a dummy for the respondent's country of residence, $Wave_{t1}$ is a dummy for the wave of respondent participation in period 1, and ε_{ijt} is an error term with a standard normal distribution.

Table 7: Marginal Effects of Probit Regression of Occurrence of Health Shock between Two Waves (All respondents aAes 50-65)

VARIABLES	Pr(Shock5p)	Pr(Shock10p)	Pr(Shock15p)	Pr(Shock20p)
Health Stock	0.359***	0.003	-0.087**	-0.166***
	(0.041)	(0.039)	(0.035)	(0.029)
Reference (Male)				
Female	0.061***	0.049***	0.035***	0.023***
	(0.009)	(0.009)	(0.008)	(0.007)
Reference (Not Partenered)				
Partnered	-0.008	-0.013	-0.015	-0.007
	(0.011)	(0.011)	(0.010)	(0.009)
Age at interview	0.004***	0.006***	0.005***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Reference (Low/Normal weight)				
Overweight/Obese	0.068***	0.063***	0.050***	0.032***
	(0.009)	(0.009)	(0.008)	(0.007)
Reference (Does Not Currently Smoke)				
Currently Smokes	0.049***	0.048***	0.032***	0.021**
	(0.011)	(0.011)	(0.010)	(0.009)
Reference (Education: Low)				
Education: Medium	-0.019	-0.022	-0.015	-0.010
	(0.015)	(0.014)	(0.013)	(0.012)
Education: High	-0.035***	-0.039***	-0.041***	-0.030***
	(0.013)	(0.012)	(0.011)	(0.010)
Education: Very High	-0.064***	-0.071***	-0.058***	-0.044***
	(0.014)	(0.014)	(0.013)	(0.012)

VARIABLES	Pr(Shock5p)	Pr(Shock10p)	Pr(Shock15p)	Pr(Shock20p)
Reference (HH Income Tercile = 1)				
HH Income Tercile = 2	-0.024**	-0.025**	-0.024**	-0.021**
	(0.011)	(0.011)	(0.010)	(0.008)
HH Income Tercile = 3	-0.033***	-0.029***	-0.031***	-0.026***
	(0.011)	(0.011)	(0.010)	(0.009)
Reference (Austria)				
Germany	0.020	0.026*	0.009	0.023*
	(0.015)	(0.015)	(0.014)	(0.013)
Sweden	-0.057***	-0.062***	-0.064***	-0.044***
	(0.015)	(0.015)	(0.014)	(0.012)
Spain	-0.072***	-0.066***	-0.065***	-0.041***
	(0.016)	(0.016)	(0.014)	(0.011)
Italy	-0.035**	-0.036**	-0.043***	-0.024**
	(0.015)	(0.015)	(0.014)	(0.011)
France	0.004	-0.012	-0.033**	-0.017
	(0.014)	(0.013)	(0.013)	(0.011)
Denmark	-0.028**	-0.042***	-0.052***	-0.025**
	(0.013)	(0.013)	(0.012)	(0.011)
Switzerland	-0.069***	-0.073***	-0.075***	-0.046***
	(0.014)	(0.014)	(0.013)	(0.011)
Belgium	0.009	-0.002	-0.018	-0.020**
	(0.013)	(0.013)	(0.013)	(0.010)
Reference (wave = 1)				
wave = 2	0.137***	0.147***	0.122***	0.097***
	(0.012)	(0.013)	(0.012)	(0.011)
wave = 4	0.040***	0.034***	0.028**	0.018*
	(0.013)	(0.013)	(0.011)	(0.010)
wave = 5	0.015	0.008	0.007	0.000
	(0.010)	(0.009)	(0.008)	(0.007)
Observations	40,874	34,801	31,645	29,408

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; All predictors at their mean value; Health Stock represents the Health Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Age at Interview is a discrete variable equal to the age f the respondent at the date of interview ; Overweight is a dummy variable equal to 1 if the respondent’s BMI is greater or equal to 25 ; Currently Smokes is a dummy variable equal to 1 if the respondent currently smokes ; HH Income Tercile is a discrete variable equal to the respondent’s income (corrected for household size) tercile in the first period. The country and wave dummies correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves.

Table 7 presents the marginal effects for the probit regression results. As expected, respondents who are partnered, more educated, or whose household income (corrected for household size) belongs to a higher tercile in the first period are less likely to experience a health shock in the following period. Conversely, smoking, being older, female, or overweight increases the probability of experiencing a health shock in the next period. A lower health stock increases the probability of experiencing a severe health shock but the likelihood of experiencing a mild shock increases when the health stock is higher. The elapsed time between wave 2 and the consecutive wave is 4 years, and only 2 years for the other baseline waves. This explains why the coefficient on wave 2 is always positive and statistically significant.

Interestingly, three countries stand out by their ability to mitigate the onset of health shocks: in Switzerland, Spain, and Sweden, residents are less likely to experience any type of negative health shock, even after controlling for age, gender, education, household tercile, and wave.

8. Descriptive Statistics in Period 1

The following table presents weighted descriptive statistics for the population studied in the first period by country and wave. Recall that I restrict my analysis to respondents who are receiving labor income from employment only in the first period. The "HS" and "Func" columns give the mean health and functioning stocks in period 1; "Female", "Part", and "Civil" show respectively the percentages of respondents that are female, are married or partnered, or civil servants; "Age" the average age at interview in period 1; "Education" is the workers' average education level.

Table 8: Descriptive Statistics of Employed Population Working for Pay Only in Period 1 by Country and Wave

Country	Period 1	HS	Func	Female	Partnered	Education	Age	Civil
Europe	1	0.83	0.90	0.44	0.79	1.90	54.67	0.23
		(0.00)	(0.00)	(0.01)	(0.01)	(0.03)	(0.10)	(0.01)
	2	0.84	0.92	0.43	0.82	1.98	54.59	0.18
		(0.00)	(0.00)	(0.02)	(0.01)	(0.03)	(0.12)	(0.01)

Country	Period 1	HS	Func	Female	Partnered	Education	Age	Civil
	4	0.83	0.90	0.48	0.76	2.00	55.30	0.15
		(0.00)	(0.00)	(0.02)	(0.02)	(0.03)	(0.10)	(0.01)
	5	0.82	0.90	0.49	0.76	1.99	55.31	0.36
		(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.07)	(0.01)
Austria	1	0.83	0.90	0.32	0.84	2.06	54.03	0.18
		(0.01)	(0.01)	(0.04)	(0.03)	(0.08)	(0.24)	(0.03)
	2	0.82	0.89	0.28	0.83	2.10	55.50	0.22
		(0.01)	(0.02)	(0.05)	(0.05)	(0.11)	(0.30)	(0.06)
	4	0.85	0.92	0.47	0.70	2.17	54.32	0.16
		(0.00)	(0.01)	(0.03)	(0.02)	(0.04)	(0.15)	(0.02)
	5	0.84	0.91	0.51	0.70	2.13	55.24	0.15
		(0.01)	(0.01)	(0.03)	(0.03)	(0.05)	(0.17)	(0.02)
Germany	1	0.84	0.90	0.44	0.79	2.34	54.90	0.13
		(0.01)	(0.01)	(0.03)	(0.03)	(0.03)	(0.21)	(0.02)
	2	0.85	0.92	0.47	0.81	2.36	55.26	0.19
		(0.01)	(0.01)	(0.03)	(0.03)	(0.04)	(0.23)	(0.03)
	4	0.81	0.87	0.52	0.73	2.39	57.24	0.13
		(0.01)	(0.01)	(0.04)	(0.04)	(0.05)	(0.22)	(0.03)
	5	0.80	0.88	0.48	0.77	2.30	55.54	0.34
		(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.11)	(0.02)
Sweden	1	0.86	0.93	0.47	0.75	1.86	56.01	0.00
		(0.00)	(0.00)	(0.02)	(0.02)	(0.05)	(0.18)	-
	2	0.87	0.94	0.49	0.77	2.08	56.07	0.00
		(0.00)	(0.01)	(0.03)	(0.03)	(0.05)	(0.29)	-
	4	0.86	0.93	0.52	0.76	2.13	58.60	0.00
		(0.01)	(0.01)	(0.04)	(0.04)	(0.06)	(0.26)	-
	5	0.84	0.92	0.50	0.68	2.24	56.74	0.50
		(0.00)	(0.00)	(0.02)	(0.02)	(0.04)	(0.18)	(0.02)
Spain	1	0.83	0.91	0.35	0.74	1.24	55.18	0.17
		(0.01)	(0.01)	(0.04)	(0.04)	(0.11)	(0.35)	(0.03)
	2	0.84	0.92	0.36	0.78	1.37	55.35	0.17
		(0.01)	(0.01)	(0.05)	(0.04)	(0.11)	(0.31)	(0.03)
	4	0.86	0.93	0.44	0.84	1.40	53.84	0.17
		(0.01)	(0.01)	(0.05)	(0.03)	(0.11)	(0.29)	(0.03)
	5	0.84	0.92	0.46	0.83	1.50	55.45	0.37
		(0.01)	(0.01)	(0.05)	(0.04)	(0.11)	(0.28)	(0.05)
Italy	1	0.81	0.89	0.39	0.81	1.49	54.03	0.43
		(0.01)	(0.01)	(0.04)	(0.04)	(0.08)	(0.25)	(0.04)

Country	Period 1	HS	Func	Female	Partnered	Education	Age	Civil
	2	0.83	0.91	0.35	0.90	1.53	53.14	0.00
		(0.01)	(0.01)	(0.04)	(0.02)	(0.07)	(0.25)	-
	4	0.84	0.91	0.42	0.85	1.61	54.07	0.00
		(0.01)	(0.01)	(0.05)	(0.03)	(0.08)	(0.24)	-
	5	0.82	0.91	0.52	0.75	1.39	54.30	0.46
		(0.01)	(0.01)	(0.03)	(0.03)	(0.07)	(0.19)	(0.03)
France	1	0.82	0.89	0.50	0.78	1.78	54.24	0.33
		(0.01)	(0.01)	(0.03)	(0.02)	(0.06)	(0.16)	(0.03)
	2	0.84	0.91	0.48	0.82	1.95	53.75	0.30
		(0.01)	(0.01)	(0.04)	(0.02)	(0.06)	(0.25)	(0.04)
	4	0.82	0.89	0.48	0.72	1.94	54.02	0.29
		(0.00)	(0.00)	(0.02)	(0.02)	(0.04)	(0.13)	(0.02)
	5	0.81	0.89	0.50	0.75	2.04	55.35	0.30
		(0.01)	(0.01)	(0.03)	(0.02)	(0.05)	(0.14)	(0.02)
Denmark	1	0.85	0.92	0.47	0.84	2.33	55.03	0.19
		(0.00)	(0.01)	(0.03)	(0.02)	(0.04)	(0.20)	(0.02)
	2	0.86	0.93	0.50	0.82	2.40	55.65	0.15
		(0.00)	(0.00)	(0.02)	(0.02)	(0.03)	(0.16)	(0.02)
	4	0.85	0.92	0.52	0.79	2.49	55.87	0.13
		(0.00)	(0.00)	(0.02)	(0.02)	(0.03)	(0.17)	(0.01)
	5	0.83	0.91	0.49	0.79	2.44	56.19	0.49
		(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.12)	(0.02)
Switzerland	1	0.87	0.94	0.43	0.82	1.63	55.08	0.08
		(0.01)	(0.01)	(0.04)	(0.03)	(0.07)	(0.28)	(0.02)
	2	0.87	0.93	0.41	0.81	1.89	55.23	0.10
		(0.01)	(0.01)	(0.03)	(0.03)	(0.04)	(0.24)	(0.02)
	4	0.86	0.92	0.47	0.75	2.08	55.64	0.08
		(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.15)	(0.01)
	5	0.84	0.91	0.47	0.76	2.10	56.29	0.40
		(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.14)	(0.02)
Belgium	1	0.83	0.91	0.40	0.86	1.95	54.36	0.34
		(0.00)	(0.00)	(0.02)	(0.02)	(0.05)	(0.16)	(0.02)
	2	0.84	0.92	0.41	0.83	2.03	54.57	0.35
		(0.00)	(0.01)	(0.03)	(0.02)	(0.06)	(0.18)	(0.03)
	4	0.84	0.90	0.44	0.71	2.18	53.47	0.33
		(0.01)	(0.01)	(0.03)	(0.03)	(0.06)	(0.18)	(0.03)
	5	0.82	0.91	0.45	0.76	2.22	54.47	0.36
		(0.00)	(0.01)	(0.03)	(0.02)	(0.05)	(0.15)	(0.03)

Note: For each country and wave, the first line shows the weighted mean and the second shows the standard deviation in parenthesis. The columns depict the following: HS represents the Health Stock in the first period, as a continuous variable ranging from 0 to 1; Func represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; Educ4. is a 4-level categorical variable; Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview.

We do not observe a striking variation in the average health and functioning stocks nor age of the working population across countries by wave. But the share of women or civil servants in the workforce and their level of education are not uniform across countries and waves. The workforce education level in Southern countries (Italy and Spain) appears for example to be lower than in all other countries (See OECD 2017).

9. The Impact of Health Shocks on the Probability of Working

Corroborating the existence of a pathway going from SES to health, I have so far shown that on average in Europe, respondents with a higher education level or belonging to a higher household income tercile are less likely to experience a health shock. I will now investigate the impact of a health shock on the probability of continuing to work for pay only in the second period, focusing on possible differences in outcomes (a) across levels of education and (b) across countries of residence. Assuming the loss of earned income is not fully compensated by benefits, if the impact of a health shock on the probability of working is lower for low levels of education, "reverse causation" could be partially attenuating the effect of the causal pathway going from SES to health. Conversely, if the impact of a health shock on the probability of working is more important for less educated workers, "reverse causation" could have a magnifying effect, steepening the slope of the SES-Wealth gradient.

9.1 Labor Force Status in Wave 2

Table 9 presents the share of the respondents belonging to the category “Work Only” by health shock status (Shock0, Shock5p, Shock10p, Shock15p, and Shock20p). Table 9 can be read as following: in Austria, 71% of respondents whose functioning stock increased or remained constant between two consecutive waves continued having work as only source of personal income, while only 49% of respondents who experienced a functioning stock reduction of at least 20% continued having work as only source of personal income.

The first salient feature is that overall, experiencing a health shock between two consecutive waves appears to reduce the probability of having earned income as sole source of personal revenue. The impact of the health shock appears to be “dose responsive”, i.e. increasing with the intensity of the shock.

Table 9: Share of the working population belonging to the category “Work Only” (weighted) in Period 2 by Country and Health Shock Status

Category	Shock0	Shock5p	Shock10p	Shock15p	Shock20p
Europe	0.76	0.69	0.65	0.60	0.58
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Education: Low	0.67	0.58	0.52	0.51	0.49
	(0.02)	(0.03)	(0.04)	(0.06)	(0.07)
Education: Medium	0.73	0.66	0.63	0.54	0.53
	(0.03)	(0.04)	(0.05)	(0.07)	(0.10)
Education: High	0.77	0.68	0.62	0.55	0.49
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Education: Very High	0.78	0.75	0.76	0.75	0.77
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Austria	0.71	0.70	0.64	0.59	0.48
	(0.02)	(0.03)	(0.05)	(0.07)	(0.09)
Germany	0.75	0.71	0.67	0.62	0.59
	(0.02)	(0.02)	(0.03)	(0.04)	(0.06)
Sweden	0.78	0.65	0.57	0.52	0.50
	(0.01)	(0.03)	(0.04)	(0.06)	(0.11)
Spain	0.74	0.64	0.58	0.54	0.53
	(0.02)	(0.04)	(0.06)	(0.07)	(0.09)

Italy	0.78	0.68	0.68	0.62	0.57
	(0.02)	(0.04)	(0.05)	(0.07)	(0.08)
France	0.74	0.67	0.64	0.60	0.59
	(0.01)	(0.02)	(0.03)	(0.05)	(0.07)
Denmark	0.79	0.72	0.68	0.60	0.57
	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Switzerland	0.80	0.76	0.74	0.69	0.67
	(0.01)	(0.02)	(0.03)	(0.04)	(0.06)
Belgium	0.76	0.68	0.58	0.55	0.42
	(0.01)	(0.02)	(0.03)	(0.05)	(0.06)

For each country, the first line shows the weighted mean and the second shows the standard deviation in parenthesis. The first column gives the share of respondents who belong to the category “Work Only” in the second period among the respondents whose functioning stock increased or remained constant ; the following columns give the share of the respondents belonging to the category “Work Only” in the second period among those who experienced a health shock of type “Shock5p”, “Shock10p”, Shock15p”, and “Shock20p”.

The second interesting element is that among workers who do not experience a health shock (column Shock0), the share of people exiting the work force varies across level of education. Only 67% of workers with primary education (low level of education) keep having work as their only source of revenue (“Work Only”) despite experiencing no negative health shock. This percentage increases to 78% for college-educated workers (very high level of education). Moreover, these college-educated workers appear insulated from the health shocks effects. The share of respondents who remain “working only” remains around 76% independent of the magnitude of the change in functioning stock.

The third notable element is the heterogeneity between the rates of exit from work across countries. For example, a health shock appears to have little impact on the probability of having earned income as single source of personal revenue in Switzerland, but it has a more sizeable effect on that same probability in Sweden, and this for any level of decrease in the functioning stock.

I will now formally estimate to what extent a health shock between two periods impacts the probability of working for respondents whose only source of personal revenue in the first period is employment.

9.2 Econometric Methods

The task of assessing a treatment effect (the impact of a health shock on labor force status in our case) is problematic outside the realm of a controlled experiment because the onset of a health shock is likely to be endogenous. In other words, variables may exist that are correlated with both the probability of working in the second period and the probability of having a health shock. Such confounders can be either observable (e.g. health stock, education) or unobservable (e.g. self-esteem, social capital, risk-aversion).

This case belongs to the broader class of "endogenous switching" (ES) and "sample selection" (SS) problems, which are prevalent in economics. ES is a concern whenever the dependent variable of a model is a function of a binary regime switch (as in this study), whereas SS arises whenever the response variable is observed only if a selection condition is met. In either case, problems arise because standard regression techniques result in biased and inconsistent estimators if unobserved factors affecting the response are correlated with unobserved factors affecting the switch/selection process (Heckman 1978, 1979).

Two econometric tools have been developed to mitigate these biases—the propensity score matching (PSM) method to mitigate selection bias due to observables, and the Heckman inverse-Mills-ratio (IMR) method to address selection bias due to both observables and unobservables (Tucker 2011). PSM is a method for selecting units from a large reservoir of potential controls to produce a control group that is similar to the treated group with respect to the distribution of observed covariates, but it does not alleviate selection bias due to unobservables (Rosenbaum & Rubin 1985). Heckman proposed a two-stage approach to evaluating programs for which the treatment choices are binary and the program outcomes depend on a linear combination of observable and unobservable factors. His approach is to estimate the choice model in the first stage and add a bias correction term in the second-stage regression. After further restricting unobservables to multivariate normal distributions, he derives the bias correction variable in the form of inverse Mills ratio (IMR). This method is relatively straightforward but it is limited to situations in which the choices are binary, the outcomes of choices are modeled in a linear regression, and the unobservables in the choice and outcome models follow multivariate normal distribution.

For non-continuous responses, however, accounting for SS or ES is more complicated. Then two-stage procedures analogous to IMR are only approximate and no appropriate distribution results for the estimators are available. The model can be estimated by full information maximum likelihood (FIML) estimation of a recursive, simultaneous binary choice model (Greene 1998), formulated as a system of equations for two latent (i.e. unobserved) responses. The switching dummy (health shock between periods 1 and 2) is assumed to be generated as:

$$S_i^* = z_i'\gamma + v_i$$

$$S_i = \begin{cases} 1 \; if \; S_i^* > 0 \\ 0 \; otherwise \end{cases}$$

where S_i^* represents a continuous latent variable, γ an $L \times 1$ vector of parameters, and v_i a residual term.

A similar latent response model is specified for the response dummy (e.g. working for pay in the second period):

$$w_i^* = x_i'b + tS_i + u_i$$

$$w_i = \begin{cases} 1 \; if \; w_i^* > 0 \\ 0 \; otherwise \end{cases}$$

where b represents a $K \times 1$ vector of parameters, $t \in R$ is the coefficient to be estimated associated with the endogenous dummy, and u_i is a residual term. Typically, a bivariate normal distribution is assumed for u_i and v_i (see Miranda & Rabe-Hesketh 2006), which is what I will presume for the rest of the chapter.

9.3 Results

9.3.1. Health Shocks and Education

As a reminder, the seven 1997-ISCED education levels have been recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up). I run a set of bivariate probit equations (weighted with longitudinal weights) to assess the impact of experiencing a health shock between two consecutive periods on the probability of having work as the only source of personal income in the second period (“Work Only). The independent variables for the outcome equations are functioning stock, being female, whether the respondent is partnered, if they are civil servants, their education level (4 levels), age (quadratic[26]), wave and country dummy variables as well as these variables interacted, and one of the four types of categorical health shocks (with education level interaction terms) – Shock5p, Shock10p, Shock15p, and Shock20p. The switching equations (health shock occurrence) are the equations presented in section 7.2. These equations will be used as the treatment equations

[26] To capture the anticipated non-linearities in the effect of age.

throughout the rest of the study. The control group consists of the respondents whose functioning stock increased or remained constant (Shock0).

Table 17 in Appendix B.3 presents the results for this first set of bivariate probit models. Rho, the correlation coefficient between the residuals of each of the two probits - outcome and treatment equations - is never statistically significantly different from zero[27]. Hence the bivariate probit models can be run as two independent univariate probits models (Greene 2012 p. 742). The marginal effects of the Probit equations on the probability of "working only" in the second period are showed in Table 10.

Table 10: Marginal effects of the Probit equations on the probability of working for pay only in the second period, by Health Shock Intensity[28]

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.301***	0.326***	0.311***	0.303***
	(0.054)	(0.058)	(0.060)	(0.061)
Reference (Male)				
Female	0.004	-0.003	0.002	0.004
	(0.012)	(0.014)	(0.014)	(0.014)
Reference (Not Partnered)				
Partnered	0.037**	0.031*	0.025	0.026
	(0.016)	(0.017)	(0.018)	(0.018)
Reference (Education: Low)				
Education: Medium	-0.006	0.006	-0.010	-0.009
	(0.029)	(0.031)	(0.033)	(0.034)
Education: High	0.044**	0.049**	0.047*	0.047*
	(0.022)	(0.025)	(0.026)	(0.026)
Education: Very High	0.093***	0.109***	0.106***	0.105***
	(0.023)	(0.025)	(0.027)	(0.027)
Age at interview	-0.037***	-0.038***	-0.039***	-0.038***
	(0.002)	(0.002)	(0.003)	(0.003)
Reference (Not Civil Servant)				
Civil servant	0.042***	0.040***	0.035**	0.029*
	(0.014)	(0.015)	(0.016)	(0.017)
Reference (No Shock)				

[27] The absolute value of the test statistics for the null hypothesis of zero correlation (ρ=0) are always less than 1.96.

[28] Stratified results by gender shown in Appendix 13.3

Shock5p = 1	-0.066***			
	(0.014)			
Shock10p = 1		-0.081***		
		(0.018)		
Shock15p = 1			-0.123***	
			(0.026)	
Shock20p = 1				-0.145***
				(0.035)
Country-Wave Fixed Effect	Yes	Yes	Yes	Yes
Observations	15,721	13,176	12,069	11,331

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; All predictors at their mean value; Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

As could be expected, workers enjoying a higher functioning stock or a more advanced education level in the first period are more likely to continue "working only" in the second period. So are civil servants. The quadratic impact of age is highly significant[29].

Being partnered increases the likelihood to continue working but the marginal impact is statistically significant only in two of the regressions. Gender is never significant. Finally, as expected, the marginal impact of a health shock increases with its intensity: a 20% decrease in the functioning stock is more consequential then a 5% decrease.

[29] The chi-squared values (for one degree of freedom) generated by the Wald tests for a null hypothesis of the coefficient on age squared equal to zero are respectively 46.80, 36.27, 29.12, and 28.00 (for Shock5p, Shock10p, Shock15p, and Shock20p), which all all associated with a p-value less than 1%.

[27] Stratified results by gender shown in Appendix 13.3

Table 11 shows the marginal impact of health shocks by increasing intensity respectively on the probability of working only, by education level.

Table 11: Average Marginal Effects of Health Shocks on the Probability of Working Only, by Education Level[27]

VARIABLES	Shock5p	Shock10p	Shock15p	Shock20p
Education: Low	-0.078*	-0.134**	-0.144**	-0.159**
	(0.043)	(0.056)	(0.067)	(0.078)
Education: Medium	-0.086*	-0.082	-0.195***	-0.233**
	(0.049)	(0.054)	(0.074)	(0.100)
Education: High	-0.083***	-0.132***	-0.193***	-0.264***
	(0.022)	(0.031)	(0.044)	(0.064)
Education: Very High	-0.033*	-0.009	-0.014	0.009
	(0.020)	(0.024)	(0.032)	(0.036)
Observations	15,721	13,176	12,069	11,331

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. All predictors at their mean value

Ceteris paribus, on average across Europe, college-educated workers are protected from the effect of health shocks: for this education level, there is no statistically significant impact of health shocks on the probability of working only compared to college-educated workers whose functioning shock did not decline. Conversely, workers with a medium or high level of education (above primary school but no college) suffer the strongest impact of negative health shocks on their probability of working only. Interestingly, workers with the lowest level of education (primary school or less) are partially shielded from health shocks. Figure 9 represents the share of workers working only in the second period (on the y-axis), grouped by education level. Within each education level, the blue dot represents the share of workers who are still employed among those who did not experience a shock, and the red, green, and yellow dots represent the share of workers who are still employed among those who experienced respectively a 5%, 10%, 15%, and 20% reduction in functioning stock. The gradient is retained for workers who did not experience a shock or suffered a light decrease in functioning. But as the intensity of the shock increases, the gradient is flattened for non-college educated workers. As a consequence, the magnitude of the shock impact is more important for workers with intermediary levels of education.

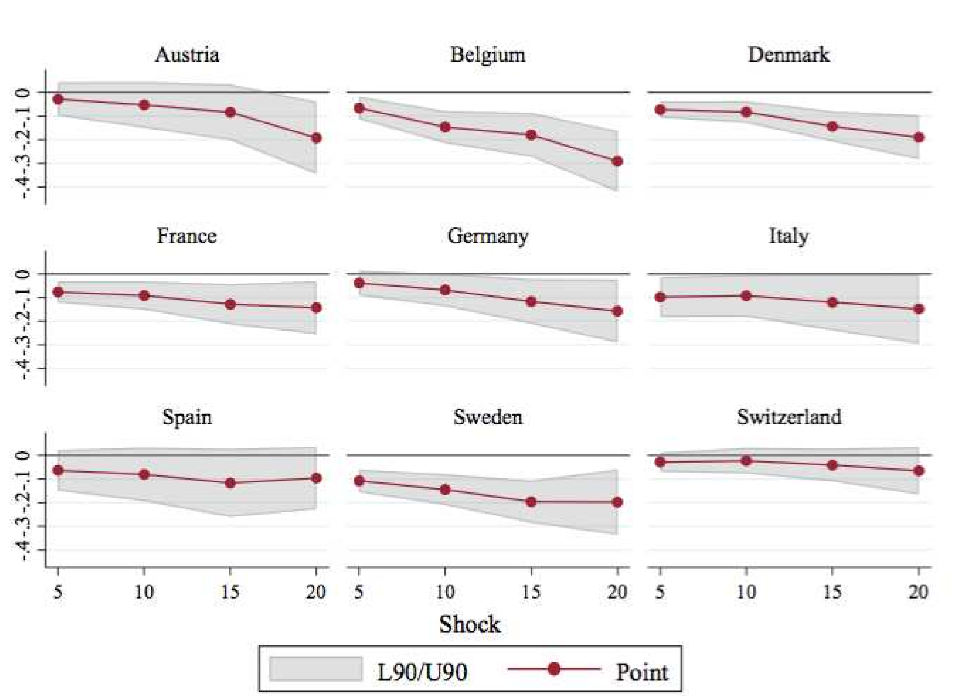

Figure 9: Share of Workers Working Only in the Second Period, by Education Level and Shock Intensity

So far, we have established that on average in Europe, the impact of health shock is "U-shaped" across levels of education: (1) Very highly educated workers (college) are the least likely to experience a health shock. Because they are less likely to pursue a physically-demanding job and enjoy on average more favorable employment contract terms, healh shocks do not have a statistically significant impact on their probability of working only; (2) Workers with a medium or high level of education (secondary school) are the most affected by health shocks. The difference in the probability of working between workers who experienced a health shock and the ones who did not is the highest. (3) Low-skilled workers (primary school or less), despite being the most at risk of suffering a health issue, do not see their probability of working decrease dramatically after a shock because they are also more likely to exit the workforce before the shock occurs: as can be seen in Figure 9, only 68% low-skilled workers who were "working only" in the first period and who didn't experience any health problem (our control group), continue working only in the second[30].

Because the impact of a negative health shock on the probability of working for workers with a medium/high range of education (secondary school) workers is important, "reverse causation" could have a magnifying effect, steepening the slope of the SES-Wealth gradient for "medium range" levels of SES (large $\alpha_3 N$). But because the impact of a health shock on the probability of working is limited for low (primary school) and very high (college) levels of SES, "reverse causation" appears to leave the slope of the SES-Wealth gradient unchanged at these levels of SES (small $\alpha_3 N$).

9.3.2. Health Shocks and Country of Residence

I now now investigate if country differences in the impact of a health shock on the probability of working only in the second period can be indentified. I run a second set of bivariate probit equations (weighted with longitudinal weights). In this case, the independent variables for the outcome equations are unchanged except that the four types of categorical health shocks are now interacted with country dummy variables (and not with education levels). The switching equations (health shock occurrence) and the control group remain unchanged. I do not run separate regressions by country to enable comparisons at the overall mean of the covariates.

Table 18 in Appendix B.3 presents the results for this second set of bivariate probit models. Rho, the correlation coefficient between the residuals of each of the two probits -

[30] Respectively 74%, 80%, and 82% of the control group for medium, high, and very high levels of education continue working in the second period.

outcome and treatment equations - is never statistically significantly different from zero[31]. Hence once again, the bivariate probit models can be run as two independent univariate probits models. The marginal effects of the Probit equations on the probability of "working only" in the second period are showed in Table 12.

Table 12: Marginal effects of the Probit equations on the probability of working for pay only in the second period[27]

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.289***	0.308***	0.291***	0.284***
	(0.052)	(0.055)	(0.057)	(0.058)
Reference (Male)				
Female	0.004	-0.002	0.002	0.004
	(0.012)	(0.013)	(0.014)	(0.014)
Reference (Not Partnered)				
Partnered	0.036**	0.031*	0.025	0.024
	(0.015)	(0.017)	(0.017)	(0.018)
Reference (Education: Low)				
Education: Medium	-0.005	0.007	-0.009	-0.007
	(0.027)	(0.029)	(0.030)	(0.031)
Education: High	0.041**	0.046**	0.044*	0.044*
	(0.021)	(0.023)	(0.024)	(0.024)
Education: Very High	0.091***	0.107***	0.104***	0.103***
	(0.022)	(0.024)	(0.025)	(0.025)
Age at interview	-0.039***	-0.040***	-0.040***	-0.040***
	(0.002)	(0.002)	(0.002)	(0.002)
Reference (Not Civil Servant)				
Civil servant	0.041***	0.039***	0.033**	0.029*
	(0.014)	(0.015)	(0.016)	(0.017)
Reference (No Shock)				
Shock5p = 1	-0.065***			
	(0.014)			
Shock10p = 1		-0.083***		
		(0.017)		
Shock15p = 1			-0.123***	
			(0.023)	
Shock20p = 1				-0.150***
				(0.030)

[31] The absolute value of the test statistics for the null hypothesis of zero correlation (ρ=0) are always less than 1.96.

[27] Stratified results by gender shown in Appendix 13.3

Country-Wave Fixed Effect	Yes	Yes	Yes	Yes
Observations	15,721	13,176	12,069	11,331

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
NOTE: All predictors at their mean value

Note: Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

Table 13: Marginal Effect of Health Shocks on the Probability of Working Only, by Country[27]

VARIABLES	Shock5p	Shock10p	Shock15p	Shock20p
Austria	-0.028	-0.053	-0.084	-0.192**
	(0.036)	(0.050)	(0.060)	(0.078)
Germany	-0.039	-0.068*	-0.117**	-0.157**
	(0.027)	(0.036)	(0.048)	(0.068)
Sweden	-0.108***	-0.145***	-0.196***	-0.198***
	(0.025)	(0.034)	(0.046)	(0.071)
Spain	-0.064	-0.081	-0.117	-0.096
	(0.044)	(0.058)	(0.074)	(0.068)
Italy	-0.098**	-0.092**	-0.120**	-0.148**
	(0.043)	(0.045)	(0.061)	(0.075)
France	-0.077***	-0.091***	-0.128***	-0.143**
	(0.023)	(0.031)	(0.044)	(0.057)
Denmark	-0.072***	-0.083***	-0.143***	-0.190***
	(0.018)	(0.024)	(0.033)	(0.048)
Switzerland	-0.028	-0.023	-0.041	-0.066
	(0.021)	(0.028)	(0.035)	(0.051)
Belgium	-0.066***	-0.146***	-0.179***	-0.291***
	(0.025)	(0.035)	(0.048)	(0.066)
Observations	15,721	13,176	12,069	11,331

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
NOTE: All predictors at their mean value

[27] Stratified results by gender shown in Appendix 13.3

These results can be best represented graphically as in Figure 10, with the percent decrease in functioning stock on the x-axis and impact on the probability of working for pay only on the y-axis.

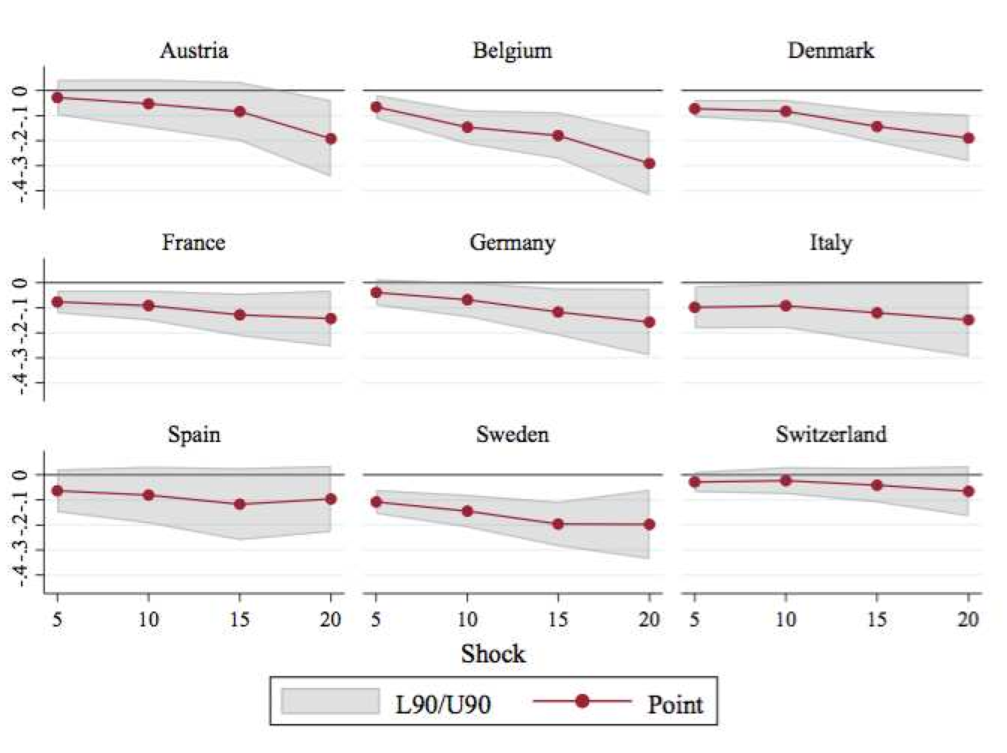

Figure 10: Impact of Decrease in Functioning Stock on the Probability to "Work Only", by Country

The countries showing the smallest impact on the probability of working for pay only are Switzerland (-6.6%) and Spain (-9.6%), where the effects are not statistically significant at the 90% level even for a 20% decrease in the functioning stock. At the other end of the spectrum, are Belgium (-29.1%), followed by Austria (-19.2%) and the Nordic countries Sweden (-19.8%) and Denmark (-10%).

So far, I have constructed a new type of negative health shock variable accounting for the magnitude of the reduction in an individual's functioning stock. I have focused on one particular type of labor outcome and investigated the impact of health shock intensity on the probability to "work only" across education levels and country of residence. I have shown that on average in the European countries under review:

(1) Labor responses are dose-responsive with the intensity of the health shock;

(2) The impact of health shock is "U-shaped" across levels of education: compared to workers with a medium or high level of education, the probability of "working only" for low-skilled workers and for college-educated workers is less affected by the occurrence of a health shock. Assuming the loss of earned income is not fully compensated by benefits, we could infer that in the short term, "reverse causation" for negative health shocks could be steepening the slope of the SES-Wealth gradient for workers with a middle-range level of education and leaving it unaffected it for low and high-levels of SES.

(3) All else equal, there is a sizeable variation across countries in the magnitude of the impact of a health shock on the probability to continue working only.

In the next section, I will investigate these country differences and analyze what becomes of the workers who stop having earned income as their unique source of personal revenue after a health shock. I will restrict my analysis to one type of shock, Shock15p, which offers a trade-off between number of observations and severity of the shock- and investigate the impact of a such a shock on a broader set of possible labor outcomes to draw additional inferences about the extent of "reverse causation" in Europe and across countries.

10. Discrete Choice Models

10.1 Labor Force Status in Wave 2

To better comprehend the mechanisms underlying the cross-country differences depicted in the previous section, I expand and refine the choices available to the worker in the second period. The labor force status in the second period is divided into five comprehensive and mutually exclusive categories[32]:

- Same Job: a worker is considered working in the same job if they work and did not change type of employment, employer, or contract length since period 1, and do not receive benefits;
- New Job: a worker is considered working in a new job if they work, changed jobs since the last interview, and do not receive benefits ;
- Job and Benefits: a worker is considered in this category if they work and receive benefits;
- Benefits only: a respondent is considered receiving "benefits only" if they receive benefits and do not work ;
- No Personal Income: a respondent is considered having no personal income (through work or benefits) if they do not belong to any of the previous categories. These people could be receiving alimony, survivor pension from their spouse or partner, or rental income.

I did not distinguish between different types of benefits because unemployment and disability benefits are often used as early exit paths from the labor market by those aged over 55. Around 10% of people aged 55-59 were on unemployment benefits in Belgium and France in 2006. In most European Union member states, there are special, more favorable rules for older unemployed workers. This tends to transform unemployment benefits for older people into early retirement pensions[33]. In the same way, disability benefits, due to their specific nature or to lack of control over access to the schemes, have become one of the main early exit paths in some countries. Around or more than 20% of people aged 55-59 were on disability benefits in Sweden and over 10% in Denmark in 2006 (European Commission).

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[32] See Appendix 13.2 for detail on the method used to assign each respondent with a labor force category in the second period

[33] Benefits may be higher or may be received over longer periods than for younger workers. In some cases, specific benefits are paid after the expiration of standard unemployment benefits. Conditions regarding availability for work and job-seeking are often relaxed for the unemployed over the age of 55 (European Commission).

10.2 Descriptive Statistics in Wave 2

Table 14 presents the weighted distribution of the labor force status of the respondents in the second period for the repsondents whose functioning stock increased or remained constant (Shock0) and the respondents who experienced a 15% reduction in their functioning stock (Shock15p).

The proportion of respondents who do not receive any personal income (i.e. income through work or personal benefits) is close to zero, notably among the respondents having experienced a 15% reduction in their functioning stock. In Europe, social safety nets appear to be effective for the fraction of the population studied. Based on this result, I will not consider the possibility for a respondent to be left with no personal income in the second period in the rest of the study.

10.3 The Econometric Models

10.3.1 Multinomial Probit with endogenous treatment

I employ a discrete-choice model where a respondent has four choices: stay in the same job, change jobs, receive benefits and work, or receive benefits only. The utility from each choice j is described by the latent utility equation U_j^* and is first estimated using a Multinomial Probit (MNP) model. For each of the health shock categories, the potentionally endogenous treatment equations (health shock occurrence) are the probit equations presented in section 7.2. I estimate the following set of equations simultaneously:

$$U_{ji}^* = X_i\beta_j + Y_i\gamma_j + S_i t + \varepsilon_{ji}$$

$$S_i^* = X_i\beta + Z_i\delta + \nu_i$$

$$S_i = \begin{cases} 1 \ if \ S_i^* > 0 \\ 0 \ otherwise \end{cases}$$

Table 14: Labor Force Status in Period 2 of Workers without Health Shocks and with a Shock15p Health Shock

	Same Job		New Job		Work and Benefits		Benefits Only		No Personal Income	
	Shock0	Shock15p	Shock0	Shock15p	Shock0	Shock15p	Shock0	Shock15p	Shock0	Shock15p
Austria	0.679	0.538	0.029	0.054	0.076	0.113	0.212	0.294	0.004	0.000
	(0.023)	(0.066)	(0.007)	(0.034)	(0.014)	(0.045)	(0.021)	(0.062)	(0.002)	-
Germany	0.676	0.576	0.078	0.045	0.076	0.094	0.159	0.266	0.011	0.019
	(0.018)	(0.045)	(0.012)	(0.017)	(0.010)	(0.022)	(0.013)	(0.043)	(0.003)	(0.010)
Sweden	0.675	0.416	0.109	0.108	0.131	0.269	0.086	0.207	0.000	0.000
	(0.017)	(0.065)	(0.013)	(0.028)	(0.011)	(0.047)	(0.008)	(0.039)	-	-
Spain	0.692	0.503	0.052	0.039	0.065	0.230	0.155	0.207	0.036	0.021
	(0.026)	(0.072)	(0.011)	(0.024)	(0.014)	(0.071)	(0.019)	(0.048)	(0.013)	(0.013)
Italy	0.705	0.582	0.074	0.037	0.075	0.094	0.115	0.255	0.032	0.032
	(0.025)	(0.068)	(0.016)	-	(0.015)	(0.028)	(0.016)	(0.059)	(0.009)	(0.021)
France	0.690	0.573	0.054	0.028	0.090	0.151	0.157	0.242	0.009	0.005
	(0.016)	(0.050)	(0.008)	(0.013)	(0.009)	(0.030)	(0.011)	(0.039)	(0.003)	(0.005)
Denmark	0.671	0.460	0.115	0.141	0.076	0.130	0.135	0.000	0.002	0.008
	(0.013)	(0.037)	(0.009)	(0.027)	(0.007)	(0.027)	(0.009)	(0.033)	(0.001)	(0.006)
Switzerland	0.719	0.553	0.086	0.141	0.092	0.131	0.094	0.164	0.009	0.010
	(0.015)	(0.049)	0.000	(0.039)	(0.010)	(0.032)	(0.010)	(0.034)	(0.003)	(0.010)
Belgium	0.696	0.455	0.062	0.097	0.102	0.226	0.138	0.213	0.002	0.009
	(0.015)	(0.046)	(0.007)	(0.027)	(0.010)	(0.040)	(0.010)	(0.034)	(0.001)	(0.007)

Notes: All respondents are working for pay only in the first period. For each Labor Force Status (Same Job, New Job, Work and Benefits, Benefits Only, and No Personal Income), the first column displays the share of respondents whose functioning stock increased or remained constant who belong to that category in the second period, and the second column displays the share of respondents whose functioning stock decreased by at least 15% who belong to that category in the second period. For each country, the first line displays the mean and the second line the standard error.

ε_{ji} *and* $\nu_i \sim MVN\ (0,\Sigma)$

where, for each individual i, X_i is a vector of explanatory variables that are common to the labor outcomes and health shock equations (female, partenered, education, age, country, wave), Y_i and Z_i are vectors of explanatory variables that only affect respectively the labor outcome equation (functioning stock, civil servant, city, age squared) and the health shock equation (health stock, smoking, overweight), and S_i is the switching dummy (health shock between periods 1 and 2) determined by the latent continuous variable S_i^*. The error terms of the equation are distributed as multivariate normal with mean zero and variance-covariance matrix Σ. This system of equation is estimated simultaneously using Geweke–Hajivassiliou–Keane (GHK) simulated maximum likelihood (See Roodman (2017)).

10.3.2 Multinomial Logit

This time assuming that health shocks are exogenous and that the disturbances ε_{ji} are independent and exhibit an extreme-value distribution, the probability of transitioning from a job to labor force status j, conditional on X_i, Y_i and S_i, is the multinomial logit probability,

$$\mathrm{P}\ (U_{ji}^* > U_{j'i}^*, j' \neq j) = \frac{\exp(X_i\beta_j + Y_i\gamma_j + S_i + \varepsilon_{ji})}{\sum_{j' \in J}\exp(X_i\beta_{j'} + Y_i\gamma_{j'} + S_i + \varepsilon_{j'i})}$$

MNL models are unable to estimate equation parameters for all transitions, therefore for identification purposes, I assume that the parameters for staying in the same job are equal to zero so that parameters estimated will provide insight into the impact of the regressors on actual transitions to a new job, a job and benefits or benefits only.

10.4 Results

Table 15 presents the average marginal effects of each for the regressors[34] on the probability of transitioning into each of the four labor force categories.

Table 15: Marginal impact of Explanatory Variables on the Probability to Transition to Different labor Force Outcomes in Period 2

Labor Force In Period 2	Pr(Same Job)	Pr(New Job)	Pr(Benef + Work)	Pr(Benef Only)
Functioning Stock	0.350***	-0.076*	-0.082**	-0.192***
	(0.069)	(0.046)	(0.038)	(0.045)
Reference (Male)				
Female	0.016	0.009	0.009	-0.034***
	(0.015)	(0.010)	(0.009)	(0.011)
Reference (Not Civil Servant)				
Civil Servant	0.071***	-0.039***	-0.023**	-0.009
	(0.018)	(0.011)	(0.011)	(0.014)
Reference (Not Partnered)				

Labor Force In Period 2	Pr(Same Job)	Pr(New Job)	Pr(Benef + Work)	Pr(Benef Only)
Partnered	0.022	0.004	-0.009	-0.017
	(0.019)	(0.011)	(0.011)	(0.014)
Reference (Education:Low)				
Education: Medium	-0.013	0.004	0.025	-0.016
	(0.035)	(0.025)	(0.019)	(0.026)
Education: High	0.046	-0.011	0.014	-0.049**
	(0.030)	(0.022)	(0.015)	(0.021)
Education: Very High	0.098***	-0.004	-0.004	-0.090***
	(0.031)	(0.023)	(0.015)	(0.022)
Age	-0.034***	-0.006***	0.009***	0.032***
	(0.002)	(0.002)	(0.001)	(0.001)
Reference (No Shock)				
Shock15p	-0.105***	-0.019*	0.050***	0.074***
	(0.024)	(0.010)	(0.014)	(0.021)
Reference (Austria)				
Germany	0.033	0.049***	-0.011	-0.071***

[34] As a compromise between the number of shock observations and the intensity of the shock, only the results of the multinomial logit measuring the impact of a 15% decrease in the functional stock (Shock15p) are reported.

	(0.026)	(0.016)	(0.016)	(0.021)
Sweden	0.041	0.099***	0.032*	-0.172***
	(0.027)	(0.018)	(0.017)	(0.018)
Spain	0.058*	0.020	0.009	-0.087***
	(0.033)	(0.014)	(0.021)	(0.027)
Italy	0.039	0.030**	0.006	-0.075***
	(0.029)	(0.014)	(0.020)	(0.024)
France	-0.001	0.018*	0.025	-0.043**
	(0.024)	(0.011)	(0.016)	(0.020)
Denmark	0.010	0.101***	-0.007	-0.104***
	(0.023)	(0.013)	(0.015)	(0.019)
Switzerland	0.078***	0.073***	0.001	-0.153***
	(0.024)	(0.014)	(0.016)	(0.019)
Belgium	-0.029	0.034***	0.053***	-0.058***
	(0.024)	(0.011)	(0.018)	(0.021)
Reference (Wave 1)				
Wave 2	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000
Wave 4	-0.110***	0.002	0.018	0.089***
	(0.023)	(0.010)	(0.016)	(0.021)
Wave 5	0.068***	0.033**	-0.021	-0.079***
	(0.024)	(0.016)	(0.014)	(0.017)
Observations	11,915	11,915	11,915	11,915

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. All predictors at their mean value. Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The country and wave dummies correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock15p is a dummy variable equal to one if the respondent experienced a decline in Functioning Stock of at least 15% between two consecutive periods.This dummy variable is interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

Again, the results are intuitive. A higher functioning stock in the first period increases the probability of remaining in the same job and decreases the probability of switching to any of the other labor force categories. Compared to private sector employees, civil servants are more likely to remain in the same job, and less likely to transition to “intermediary” labor force statuses (new job or work and receive benefits). Respondents with a college degree are more likely to remain in the same job and less likely to exit the work force entirely. Very interestingly, on average across countries, a 15% shock decreases the likelihood of remaining in the same job by 10.5%, while increasing the probability of exiting the workforce entirely by 7.5% and of working with benefits by 5%. It also has an impact on job mobility: a 15% shock decreases the probability of changing jobs by 1.9%. This result was anticipated given that, even in countries with higher job mobility and lower job protection legislation like Switzerland or Denmark (Eichhorst & Konle-Seidl 2006), sick workers are protected from dismissal[35]. Gender and partnership do not generally have a statistically significant impact on the probably to transition to any of the categories.

Let's now compare the results across countries. Because of low counts for certain countries, I collapse the two first labor force categories into the category defined in section A.1: "Work Only". The other two categories ("Benefits and Work" and "Benefits Only") remain unchanged and I apply the econometric methods described in section 11.3. Like for the four-choice model, the correlation between the error terms ε_{ji} and ν_i are not statistically different from zero (See Appendix B.5). Hence I estimate the labor outcome and the shock equations separately. Table 16 presents the marginal impact of a 15% reduction in functioning stock across the labor force categories in the three-choice model. A simple assumption would be to expect that each each country, the probability to stop having work as only source of revenue would be symmetrically compensated by the probability to have benefits as only source of income. Yet we see across countries a strinking variation in the pathways offered to health impaired employees.

[35] http://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=7970

Table 16: Marginal Impact of a 15% Reduction in Functioning Stock on the probability to Work Only, Work and Receive Benefits, or Receive Benefits Only in Period 2

	Work Only	Benef + Work	Benef Only
Austria	-0.078	0.031	0.047
	(0.061)	(0.044)	(0.058)
Germany	-0.111**	0.018	0.093**
	(0.047)	(0.024)	(0.046)
Sweden	-0.199***	0.118***	0.081**
	(0.047)	(0.043)	(0.032)
Spain	-0.135*	0.146**	-0.011
	(0.082)	(0.074)	(0.035)
Italy	-0.126**	0.018	0.108*
	(0.063)	(0.032)	(0.061)
France	-0.129***	0.058**	0.070*
	(0.043)	(0.029)	(0.037)
Denmark	-0.144***	0.047*	0.097***
	(0.033)	(0.027)	(0.029)
Switzerland	-0.045	0.018	0.027
	(0.035)	(0.028)	(0.028)
Belgium	-0.178***	0.112***	0.065**
	(0.047)	(0.041)	(0.033)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
NOTE: All predictors at their mean value

(1) Work Only

The impact of health shocks on the probability of having work as sole source of revenue is negative, and statistically significant for all the countries considered but Switzerland and Austria. Austria reported the lowest effective retirement age among the countries studied, hinting that workers are more likely to retire before they suffer from a health shock[17]. Switzerland is the only country where sick pay (after three months of absence due to health problems) is paid by private insurance whose cost is born by the employer and the employee. Such insurance covers at least 80% of the employee's salary during a period of time of 720 days[36]. Consequently employees who are temporarily unable to work because of a medical condition can remain on their employer's payroll.

[36] http://www.legalexpatgeneva.com/remuneration-during-sick-leave/

(2) Benefits Only

In every country except Austria, Switzerland, and Spain[37], a health shock increases the probability of receiving benefits only. In Germany and Italy, exiting the workforce while severing all ties with work appears to be the primary pathway for respondents who experienced a health shock.

(3) Benefits and Work

In Spain, Sweden, Belgium, France, and Denmark, the marginal impact of a Shock15p health shock on the probability of receiving benefits while working is positive and statistically significant. Encouraged by the European Councils of Amsterdam, Lisbon, Stockholm and Barcelona (Salais 2004), most European countries implemented policies aimed at increasing the employment rate of older workers by smoothing the transition from work to retirement, through, for instance, the adjustment of the working time at the end of a professional career.

The current system in Sweden entitles workers older than 61 to reduce working hours by as much as 50%, and to draw 100%, 75%, 50% or 25% of the full pension (Belloni et al., 2006). In Belgium every employee entering the labor market is legally entitled to a maximum one-year time credit. The main beneficiaries (50 percent) of the scheme are employees over 50 (Huiskamp & Vos 2011). They use the scheme for partial or early retirement, for instance by reducing the number of working hours by 20 percent over a period of five years with additional unemployment benefits aimed at compensating the loss of income.

[37] Spain's case reported the lowest level of social protection expenditure, which could explain the higher probability of working while receiving benefits. http://ec.europa.eu/eurostat/web/social-protection/data/database

11. Conclusion

In this chapter, I investigated the short term impacts of negative health shocks on the labor outcomes of working-age individuals (who have been shown to be the most economically vulnerable to a sudden decline in health) across levels of education and country of residence in Western Europe, and their possible implications on the extent of "reverse causation", the causal pathway going from health to the financial components of SES[38].

The first step was to address concerns of reporting heterogeneity between countries identified in previously attempted cross-country comparisons. To that end, I used an ex-ante harmonized cross-national comparative social survey (SHARE) now available with five comparable waves. Furthermore, I proposed in Section 7 a new definition of negative health shock as the onset of a decrease between two consecutive periods in the functioning stock, whose magnitude exceeded a given threshold (in percentage terms). This approach has the merit of being based on an objective measure of an individual's level of function (See Chapter 1), and also allowing the study of the impact of a health shock with respect to the intensity of that shock. To substantiate the validity of the construction of these health shocks, I showed in particular that respondents with a higher education level or belonging to a higher household income tercile were less likely to experience a health shock, corroborating the existence of a pathway going from SES to health. I also identified three countries (Switzerland, Sweeden, and Spain) that are the best at mitigating the occurrence of negative health shocks, even after controlling for age, gender, education, household tercile, and wave. Lastly, to address country-specific perceptions of self-reported activity status, I normalized the definition of labor force categories (in Appendix

[38] My study ignores the effects of spousal response in the labor supply decision, which may be important (Siegel 2006). Furthermore, the relatively small number of observations for each country currently prevents a more targeted analysis by type of health shock, occupation, or gender, all of which could give us insights into the mechanisms underlying these high level results.

B.2), and further restricted my study to respondents are receiving labor income from employment only in the first period (defined as “working only”).

In Section 9, I have focused on one particular type of labor outcome and investigated the impact of health shock intensity on the probability to continue “working only” across education levels and country of residence. I showed that on average in the European countries under review, labor responses are dose-responsive with the intensity of the health shock, and that the impact of a health shock is “U-shaped” across levels of education. Assuming the loss of earned income is not fully compensated by benefits, we could infer that in the short term, “reverse causation” from negative health shocks could be steepening the slope of the SES-Wealth gradient for workers with the middle range level of education and leaving it unchanged for low and high-levels of SES. I also showed that all else equal, there is a sizeable disparity across countries in the magnitude of the impact of a health shock on the probability to continue “working only”.

In Section10, I have investigated this cross-country variation and analyzed what becomes of the workers who stop having earned income as their unique source of personal revenue after a health shock, based on their country of residence. My first takeaway is that overall in the countries exmained, the social safety net appears to be effective. The rates of people left without labor income or benefits are extremely low in every country considered.

Without delving into the complexities of the country-specific social insurance systems and the associated variation in benefit generosity, it is impossible to conclude on the relative magnitude of reverse causation across countries. However, two groups of countries stand out by the way they maintain a connection with work for employees experiencing a decline in health. In Switzerland, sick pay is paid by private insurance whose cost is born by the employer and the employee. Hence health impaired employees can remain on their employer's payroll for up to 720 days even if they are unable to work because of a medical condition. Assuming the loss of earned income is not fully compensated by benefits, we could infer that in the short term, the impact of "reverse causation" from negative health shocks should the smallest in Switzerland. On the other hand, a hybrid labor force status is prevalent in Sweden, Spain, Belgium, and to a lesser extent in France and Denmark, where a substantial fraction of health impaired workers start receiving benefits but do not sever all work ties. This difference could be crucial to assess the longer-term impact of health shocks: because of the two-period nature of the model, this chapter overlooked the possible dynamic differences across the pathways offered to respondents who suffered a negative health shock. Depending on the labor force status they transitioned to (working only, benefits only, or work and benefits), workers recovering after a health shock may be more likely to reenter the workforce after an episode of disability. This question will be the focus of Chapter III.

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Appendix

B.1 Difference in Population Characteristics

Variable	Country	SHARE Cross-Sectional	Two-Period Model	Difference
Female	Austria	0.522	0.520	0.002
		(0.009)	(0.021)	(0.023)
	Germany	0.517	0.522	(0.005)
		(0.008)	(0.020)	(0.022)
	Sweden	0.520	0.517	0.003
		(0.009)	(0.023)	(0.024)
	Spain	0.534	0.539	(0.004)
		(0.010)	(0.025)	(0.027)
	Italy	0.554	0.556	(0.002)
		(0.008)	(0.021)	(0.022)
	France	0.525	0.524	0.001
		(0.007)	(0.017)	(0.019)
	Denmark	0.524	0.526	(0.002)
		(0.007)	(0.016)	(0.018)
	Switzerland	0.519	0.519	(0.000)
		(0.009)	(0.021)	(0.023)
	Belgium	0.516	0.516	(0.001)
		(0.006)	(0.016)	(0.017)
Partnered	Austria	0.709	0.717	(0.008)
		(0.008)	(0.019)	(0.020)
	Germany	0.739	0.750	(0.011)
		(0.008)	(0.019)	(0.021)
	Sweden	0.678	0.677	0.001
		(0.009)	(0.023)	(0.025)
	Spain	0.751	0.770	(0.019)
		(0.009)	(0.023)	(0.024)
	Italy	0.794	0.814	(0.020)
		(0.007)	(0.017)	(0.019)
	France	0.753	0.748	0.005
		(0.006)	(0.014)	(0.015)
	Denmark	0.757	0.760	(0.003)
		(0.007)	(0.015)	(0.016)

Variable	Country	SHARE cross-sectional	Two-Period Model	Difference
	Switzerland	0.750	0.748	0.002
		(0.008)	(0.019)	(0.020)
	Belgium	0.758	0.763	(0.005)
		(0.006)	(0.014)	(0.015)
Education	Austria	10.198	10.222	-0.023
		(0.066)	(0.166)	(0.179)
	Germany	13.437	13.625	-0.188
		(0.049)	(0.121)	(0.130)
	Sweden	11.873	12.019	-0.147
		(0.052)	(0.121)	(0.131)
	Spain	9.060	8.887	0.172
		(0.082)	(0.214)	(0.229)
	Italy	9.122	8.987	0.135
		(0.066)	(0.162)	(0.175)
	France	10.778	11.031	-0.254
		(0.062)	(0.150)	(0.163)
	Denmark	13.454	13.578	-0.123
		(0.046)	(0.103)	(0.113)
	Switzerland	10.241	10.305	-0.064
		(0.084)	(0.192)	(0.210)
	Belgium	11.590	11.753	-0.163
		(0.047)	(0.114)	(0.123)
Age Interview	Austria	57.691	57.701	-0.010
		(0.070)	(0.171)	(0.185)
	Germany	57.743	57.770	-0.027
		(0.067)	(0.164)	(0.177)
	Sweden	57.901	57.855	0.046
		(0.078)	(0.189)	(0.204)
	Spain	57.239	56.980	0.259
		(0.086)	(0.219)	(0.235)
	Italy	57.649	57.273	0.376
		(0.073)	(0.207)	(0.220)
	France	57.178	57.153	0.024
		(0.064)	(0.163)	(0.175)
	Denmark	57.517	57.411	0.106
		(0.065)	(0.148)	(0.162)
	Switzerland	57.253	57.228	0.025
		(0.081)	(0.189)	(0.205)
	Belgium	57.210	57.026	0.184

	(0.058)	(0.143)	(0.154)

B.2 Labor Force Categories

The respondents are asked at each wave which of the following mutually exclusive categories best describes their current employment situation: (1) Retired (retired from own work, including semi-retired, partially retired, early retired, pre-retired) ; (2) Employed or self-employed (paid work, including also working for family business but unpaid including workers who are still employees of a firm though currently not paid); (3) Unemployed (laid off or out of work, including short term unemployed) ; (4) Permanently sick or disabled (including partially disabled or partially invalid) ; (5) Homemaker (including looking after home or family, looking after grandchildren) ; and (6) Other (Rentier, Living off own property, Student, Doing voluntary work).

Additionally, respondents are asked if they did any paid work since the last interview, either as an employee or self-employed, even if this was only for a few hours. If so, respondents are asked if, during that time, they have been working continuously, and if so, if they experienced any of non-mutually exclusive following changes (1) a change in type of employment (for instance from dependent employment to self-employment) ; (2) a change in employer ; (3) a promotion ; (4) a change in job location ; and (5) a change in contract length (from long term to short term or viceversa). Respondents who answered that they have worked since the last interview are also asked questions regarding their current job (number of hours work, the current tenure in the job, if their job is physically demanding or stressful among others. I define a person as "working" if they are employed or self-employed or if they answered to at least one question regarding their current job.

Finally, respondents are asked if they received income from any of non-mutually exclusive following sources in the previous year: (1) Public old age pension; (2) Public old age supplementary pension or public old age second pension; (3) Public early retirement or pre-retirement pension; (4) Main public disability insurance pension, or sickness benefits; (5) Secondary public disability insurance pension, or sickness benefits; (6) Public unemployment benefit or insurance; (7) Main public survivor pension from your spouse or partner; (8) Secondary public survivor pension from your spouse or partner; (9) Public war pension; and (10) Public long-term care insurance. I will consider that the respondent received "some benefits" if they acknowledged receiving income from any of these sources except (7) or (8).

To deal with missing data in responses, I used answers to the survey questions identified above to assign a labor force status to each respondent in the second period. The decision tree is depicted in figure 11.

- Same Job: a worker is considered working in the same job in the second period if they define themselves as employed or self-employed or if they describe their current labor force status as "other" while working and if their tenure in the job increased between two consecutive waves, and if and didn't mention they changed type of employment, employer, or contract length (A promotion or change in job location by themselves are not considered changing jobs);
- New Job: a worker is considered working in a new job if they define themselves as employed or self-employed in the second period or if they describe their current labor force status as "other" and if they declared not having worked continuously since the last period, or if their tenure in the job in the second period is less or equal to the time span between the first and second period or if they mentioned they changed type of employment, employer, or contract length;

- Job and Benefits: a worker is assigned to that category either if they are employed or self-employed and receive benefits or if they are retired, disabled, or unemployed and work.
- Benefits only: a respondent is considered receiving "benefits only" if they are retired, unemployed, or disabled and did not work, or if they describe their current labor force status as "other" while not working and receiving benefits.
- No Personal Income: a respondent is considered having no personal income (through work or benefits) if they do not belong to any of the previous categories. These people could be receiving alimony, survivor pension from their spouse or partner, or rental income.

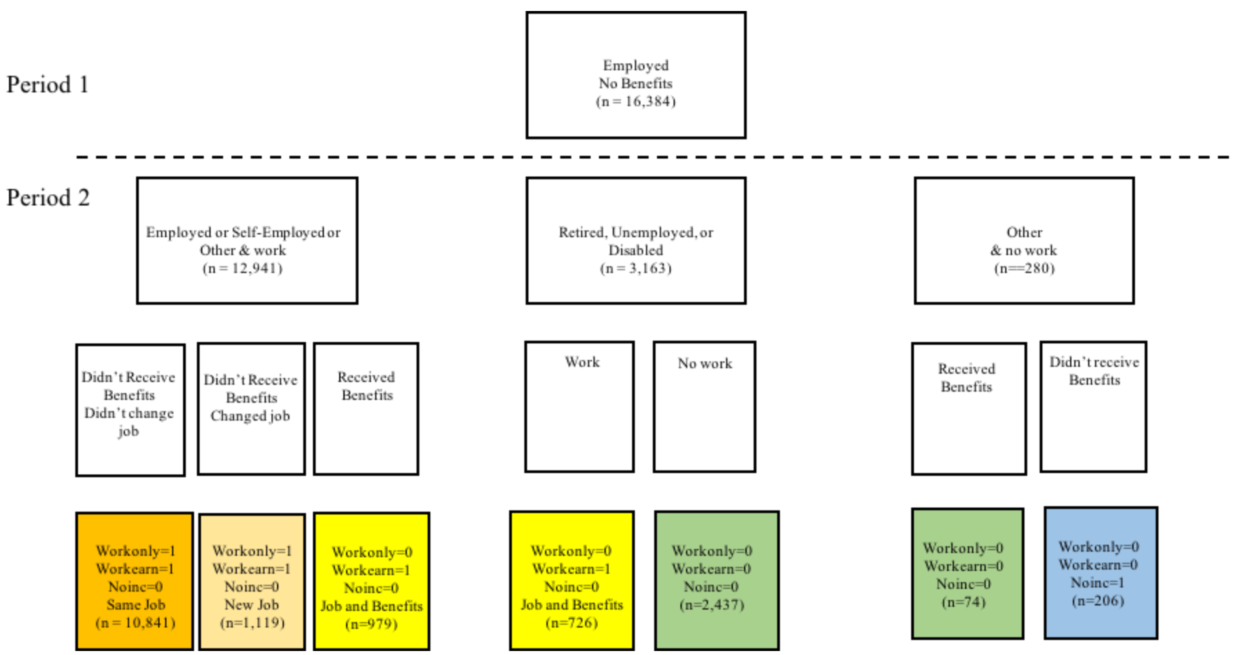

Figure 11: Labor Force Status in Period 2

B.3 Biprobits results

B.3.1 Work Only (Education)

Table 17: Marginal Impact of Biprobit of Health Shocks on the Probability to Work Only in Period 2

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Functioning Stock	0.964*		1.159***		1.076***		1.058***	
	(0.517)		(0.212)		(0.226)		(0.239)	
Reference (Male)								
Female	-0.008	0.198***	0.003	0.194***	0.016	0.166***	0.019	0.119
	(0.098)	(0.043)	(0.054)	(0.053)	(0.053)	(0.063)	(0.053)	(0.078)
Reference (Not Partnered)								
Partnered	0.131**	-0.033	0.100	-0.092	0.082	-0.089	0.086	-0.095
	(0.054)	(0.052)	(0.063)	(0.062)	(0.064)	(0.071)	(0.066)	(0.087)
Reference (Education: Low)								
Education: Medium	-0.006	0.044	-0.009	0.024	-0.005	0.049	-0.012	-0.076
	(0.113)	(0.080)	(0.113)	(0.093)	(0.112)	(0.109)	(0.112)	(0.131)
Education: High	0.175**	-0.008	0.166*	-0.019	0.176**	-0.016	0.180**	-0.106
	(0.088)	(0.069)	(0.090)	(0.076)	(0.090)	(0.089)	(0.091)	(0.103)
Education: Very High	0.317***	-0.089	0.295***	-0.120	0.317***	-0.068	0.329***	-0.128
	(0.102)	(0.080)	(0.099)	(0.086)	(0.097)	(0.100)	(0.098)	(0.118)
Age at interview	1.004***	0.002	0.984***	0.009	0.920***	0.008	0.940***	0.000
	(0.186)	(0.006)	(0.189)	(0.007)	(0.197)	(0.008)	(0.204)	(0.010)
Age Squared	-1.033***		-1.017***		-0.960***		-0.980***	
	(0.172)		(0.168)		(0.175)		(0.181)	
Reference (Not Cvil Servant)								
Civil servant	0.156***		0.148**		0.129**		0.109*	
	(0.054)		(0.058)		(0.062)		(0.065)	
Shock5p = 1	0.143							
	(1.339)							
Shock5p#Education: Medium	-0.044							
	(0.188)							
VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Shock5p# Education: High	-0.070							
	(0.137)							
Shock5p# Education: Very High	0.088							
	(0.144)							
Germany	0.138	0.150**	0.168	0.221***	0.159	0.128	0.220	0.272**
	(0.168)	(0.069)	(0.162)	(0.084)	(0.171)	(0.097)	(0.176)	(0.120)
Sweden	0.613***	-0.140*	0.607***	-0.137	0.611***	-0.187*	0.713***	-0.129
	(0.143)	(0.073)	(0.163)	(0.090)	(0.171)	(0.108)	(0.173)	(0.146)
Spain	0.345*	-0.204**	0.331*	-0.133	0.234	-0.173	0.350*	-0.105
	(0.192)	(0.088)	(0.197)	(0.106)	(0.202)	(0.122)	(0.206)	(0.144)
Italy	-0.057	-0.111	-0.125	-0.091	-0.060	-0.219**	0.044	0.016
	(0.179)	(0.084)	(0.181)	(0.099)	(0.195)	(0.110)	(0.198)	(0.128)
France	0.178	0.066	0.221	0.079	0.223	-0.036	0.299*	0.131
	(0.147)	(0.069)	(0.160)	(0.083)	(0.170)	(0.100)	(0.172)	(0.123)
Denmark	0.323**	-0.054	0.356**	-0.088	0.335*	-0.186**	0.405**	-0.139
	(0.145)	(0.066)	(0.162)	(0.078)	(0.172)	(0.091)	(0.175)	(0.113)
Switzerland	0.435**	-0.123*	0.459**	-0.162**	0.456**	-0.269***	0.514**	-0.203*
	(0.172)	(0.067)	(0.193)	(0.083)	(0.205)	(0.096)	(0.207)	(0.119)
Belgium	0.188	0.008	0.168	-0.003	0.253	-0.093	0.343**	-0.134
	(0.140)	(0.069)	(0.154)	(0.083)	(0.165)	(0.097)	(0.168)	(0.119)
Reference (wave = 1)								
wave = 2	-0.595**	0.383***	-0.469**	0.472***	-0.424*	0.543***	-0.479*	0.562***
	(0.243)	(0.058)	(0.236)	(0.071)	(0.239)	(0.086)	(0.245)	(0.105)
wave = 4	0.268	0.150**	0.251	0.152**	0.230	0.208**	0.281	0.266**
	(0.180)	(0.063)	(0.157)	(0.077)	(0.167)	(0.091)	(0.171)	(0.113)
wave = 5	0.464***	0.064	0.499***	0.060	0.526***	0.171**	0.627***	0.152*
	(0.168)	(0.049)	(0.164)	(0.059)	(0.172)	(0.072)	(0.178)	(0.085)
Reference (Austria)								
Germany#wave = 2	0.203		0.213		0.144		0.211	
	(0.235)		(0.257)		(0.269)		(0.282)	
Germany#wave = 4	0.317		0.397*		0.384		0.340	
	(0.212)		(0.233)		(0.244)		(0.250)	
Germany#wave = 5	-0.007		-0.024		-0.030		-0.135	
	(0.177)		(0.195)		(0.205)		(0.213)	
Sweden#wave = 2	0.048		0.047		0.016		0.063	
	(0.234)		(0.258)		(0.269)		(0.283)	

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Sweden#wave = 4	0.058		0.079		0.115		0.102	
	(0.188)		(0.206)		(0.216)		(0.222)	
Sweden#wave = 5	-0.341*		-0.369*		-0.353*		-0.475**	
	(0.183)		(0.201)		(0.211)		(0.219)	
Spain#wave = 2	0.282		0.184		0.356		0.371	
	(0.281)		(0.308)		(0.317)		(0.323)	
Spain #wave = 4	-0.399*		-0.282		-0.193		-0.317	
	(0.240)		(0.263)		(0.271)		(0.280)	
Spain #wave = 5	-0.499*		-0.574**		-0.473*		-0.584**	
	(0.257)		(0.274)		(0.281)		(0.291)	
Italy#wave = 2	0.447		0.459		0.302		0.329	
	(0.275)		(0.305)		(0.319)		(0.331)	
Italy #wave = 4	0.124		0.424*		0.401		0.331	
	(0.235)		(0.244)		(0.263)		(0.270)	
Italy #wave = 5	0.081		0.109		0.063		-0.068	
	(0.218)		(0.237)		(0.251)		(0.258)	
France #wave = 2	0.012		-0.037		-0.062		-0.008	
	(0.229)		(0.254)		(0.265)		(0.277)	
France #wave = 4	-0.079		-0.029		-0.040		-0.067	
	(0.176)		(0.193)		(0.204)		(0.210)	
France#wave = 5	-0.503***		-0.533***		-0.562***		-0.668***	
	(0.188)		(0.201)		(0.211)		(0.217)	
Denmark#wave = 2	0.206		0.164		0.126		0.199	
	(0.224)		(0.249)		(0.259)		(0.269)	
Denmark#wave = 4	0.021		0.037		0.080		0.037	
	(0.177)		(0.195)		(0.206)		(0.212)	
Denmark#wave = 5	0.081		0.026		0.024		-0.071	
	(0.177)		(0.196)		(0.206)		(0.213)	
Switzerland#wave = 2	0.475*		0.404		0.329		0.421	
	(0.255)		(0.278)		(0.291)		(0.302)	
Switzerland#wave = 4	0.084		0.095		0.120		0.046	
	(0.197)		(0.217)		(0.230)		(0.236)	
Switzerland#wave = 5	-0.134		-0.204		-0.208		-0.305	
	(0.201)		(0.223)		(0.236)		(0.243)	
Belgium#wave = 2	-0.114		-0.225		-0.379		-0.377	
	(0.228)		(0.250)		(0.262)		(0.273)	
Belgium#wave = 4	-0.131		-0.080		-0.114		-0.162	
	(0.185)		(0.203)		(0.215)		(0.221)	

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Belgium#wave = 5	-0.412**		-0.441**		-0.523**		-0.666***	
	(0.189)		(0.198)		(0.209)		(0.217)	
Shock10p = 1			-0.706					
			(0.476)					
Shock10p#Education: Medium			0.116					
			(0.218)					
Shock10p#Education: High			-0.057					
			(0.172)					
Shock10p#Education: Very High			0.320*					
			(0.181)					
Shock15p = 1					-0.778*			
					(0.428)			
Shock15p#Education: Medium					-0.158			
					(0.260)			
Shock15p#Education: High					-0.196			
					(0.208)			
Shock15p#Education: Very High					0.325			
					(0.219)			
Shock20p = 1							-0.808*	
							(0.471)	
Shock20p#Education: Medium							-0.225	
							(0.325)	
Shock20p#Education: High							-0.349	
							(0.253)	
Shock20p#Education: Very High							0.451*	
							(0.265)	
Health Stock		1.209***		0.101		-0.390		-0.806**
		(0.234)		(0.269)		(0.312)		(0.378)
Currently Smokes = 1, 1.Yes		0.147**		0.190***		0.177**		0.180*
		(0.060)		(0.062)		(0.077)		(0.098)
Overweight = 1		0.203***		0.203***		0.204***		0.201**
		(0.043)		(0.055)		(0.068)		(0.087)
Reference (HH Income Tercile = 1)								
HH Income Tercile = 2		0.012		-0.064		-0.087		-0.120
		(0.081)		(0.074)		(0.091)		(0.110)
HH Income Tercile = 3		-0.055		-0.097		-0.148		-0.173
		(0.109)		(0.078)		(0.091)		(0.110)

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Constant	-24.643***	-1.834***	-24.000***	-1.625***	-22.121***	-1.441**	-22.714***	-0.959
	(5.083)	(0.410)	(5.322)	(0.477)	(5.562)	(0.580)	(5.749)	(0.700)
Rho	-0.222		-0.198		0.212		0.199	
	(0.804)		(0.271)		(0.218)		(0.224)	
Observations	15,721	15,721	13,176	13,176	12,069	12,069	11,331	11,331

Notes: Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared; Health Stock represents the Health Stock in the first period, as a continuous variable ranging from 0 to 1; Overweight is a dummy variable equal to 1 if the respondent's BMI is greater or equal to 25 ; Currently Smokes is a dummy variable equal to 1 if the respondent currently smokes ; HH Income Tercile is a discrete variable equal to the respondent's income (corrected for household size) tercile in the first period. The country and wave dummies (interacted) correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves.

B.3.2 Work Only (Country)

Table 18: Marginal Impact of Biprobit of Health Shocks on the Probability to Work Only in Period 2

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Functioning Stock	1.102***		1.088***		1.008***		0.979***	
	(0.307)		(0.206)		(0.221)		(0.238)	
Reference (Male)								
Female	0.023	0.203***	0.022	0.200***	0.022	0.169***	0.020	0.122
	(0.084)	(0.043)	(0.050)	(0.053)	(0.052)	(0.062)	(0.053)	(0.076)
Reference (Not Partnered)								
Partnered	0.131**	-0.034	0.092	-0.090	0.081	-0.090	0.082	-0.101
	(0.057)	(0.051)	(0.061)	(0.062)	(0.064)	(0.071)	(0.067)	(0.085)
Reference (Education: Low)								
Education: Medium	-0.017	0.044	0.025	0.031	-0.025	0.067	-0.034	-0.061
	(0.092)	(0.080)	(0.094)	(0.092)	(0.101)	(0.107)	(0.105)	(0.127)
Education: High	0.143*	-0.012	0.139*	-0.009	0.142*	0.002	0.136	-0.083
	(0.077)	(0.069)	(0.076)	(0.077)	(0.082)	(0.091)	(0.086)	(0.108)
Education: Very High	0.333***	-0.082	0.340***	-0.113	0.361***	-0.057	0.362***	-0.123
	(0.100)	(0.074)	(0.088)	(0.085)	(0.091)	(0.098)	(0.096)	(0.116)
Age at interview	1.018***	0.002	0.939***	0.009	0.892***	0.008	0.912***	0.000
	(0.176)	(0.006)	(0.186)	(0.007)	(0.198)	(0.008)	(0.206)	(0.011)
Age Squared	-1.047***		-0.970***		-0.933***		-0.954***	
	(0.157)		(0.167)		(0.176)		(0.183)	
Reference (Not Civil Servant)								
Civil servant	0.157***		0.143**		0.126**		0.111*	
	(0.053)		(0.056)		(0.061)		(0.064)	
Reference (Austria)								
Germany	0.173	-0.062	0.128	-0.089	0.153	-0.126	0.174	-0.145
	(0.161)	(0.144)	(0.167)	(0.168)	(0.173)	(0.195)	(0.176)	(0.228)
Sweden	0.695***	-0.209	0.600***	-0.373**	0.638***	-0.368*	0.689***	-0.284
	(0.192)	(0.138)	(0.172)	(0.163)	(0.174)	(0.191)	(0.176)	(0.227)

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Spain	0.364*	-0.145	0.333	-0.191	0.250	-0.284	0.319	-0.207
	(0.204)	(0.173)	(0.206)	(0.203)	(0.204)	(0.238)	(0.207)	(0.280)
Italy	-0.000	-0.233	-0.127	-0.264	-0.047	-0.460*	0.011	-0.386
	(0.204)	(0.165)	(0.184)	(0.192)	(0.195)	(0.240)	(0.198)	(0.289)
France	0.232	-0.199	0.169	-0.345**	0.210	-0.443**	0.237	-0.469**
	(0.187)	(0.139)	(0.169)	(0.165)	(0.173)	(0.196)	(0.175)	(0.236)
Denmark	0.381**	-0.127	0.320*	-0.319*	0.343**	-0.348*	0.361**	-0.420*
	(0.168)	(0.142)	(0.168)	(0.169)	(0.173)	(0.199)	(0.175)	(0.246)
Switzerland	0.433**	-0.234	0.407**	-0.237	0.448**	-0.376	0.473**	-0.342
	(0.212)	(0.162)	(0.196)	(0.191)	(0.205)	(0.230)	(0.207)	(0.273)
Belgium	0.232	-0.222	0.160	-0.330**	0.253	-0.490**	0.321*	-0.502**
	(0.181)	(0.139)	(0.161)	(0.162)	(0.169)	(0.195)	(0.171)	(0.230)
Shock5p#Austria	-0.214							
	(1.102)							
Shock5p#Germany	-0.047							
	(0.159)							
Shock5p#Sweden	-0.327**							
	(0.156)							
Shock5p#Spain	-0.135							
	(0.200)							
Shock5p#Italy	-0.253							
	(0.192)							
Shock5p#France	-0.164							
	(0.148)							
Shock5p#Denmark	-0.198							
	(0.143)							
Shock5p#Switzerland	-0.027							
	(0.153)							
Shock5p#Belgium	-0.143							
	(0.153)							
Austria.wave = 2	-0.547**	0.123	-0.475**	0.114	-0.417*	0.273	-0.511**	0.076
	(0.214)	(0.203)	(0.224)	(0.233)	(0.235)	(0.259)	(0.238)	(0.314)
Austria.wave = 4	0.292*	-0.157	0.180	-0.294*	0.193	-0.295	0.231	-0.415*
	(0.160)	(0.140)	(0.160)	(0.163)	(0.166)	(0.189)	(0.171)	(0.226)
Austria.wave = 5	0.469***	-0.023	0.428***	-0.179	0.493***	-0.052	0.587***	-0.215
	(0.152)	(0.149)	(0.165)	(0.175)	(0.171)	(0.201)	(0.178)	(0.237)
Germany #wave = 2	0.208	0.488**	0.339	0.597**	0.202	0.400	0.303	0.662*
	(0.316)	(0.232)	(0.262)	(0.268)	(0.272)	(0.301)	(0.286)	(0.360)

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Germany #wave = 4	0.317	0.225	0.436*	0.380	0.412*	0.426	0.390	0.659**
	(0.219)	(0.200)	(0.230)	(0.233)	(0.239)	(0.270)	(0.245)	(0.325)
Germany #wave = 5	0.003	0.137	0.036	0.238	-0.001	0.172	-0.101	0.341
	(0.189)	(0.173)	(0.194)	(0.204)	(0.204)	(0.235)	(0.212)	(0.276)
Sweden#wave = 2	0.062	0.017	0.096	0.181	0.041	0.077	0.085	0.017
	(0.237)	(0.227)	(0.258)	(0.261)	(0.271)	(0.292)	(0.281)	(0.357)
Sweden#wave = 4	0.078	0.271	0.179	0.551**	0.179	0.609**	0.148	0.667*
	(0.219)	(0.192)	(0.205)	(0.235)	(0.215)	(0.284)	(0.223)	(0.371)
Sweden#wave = 5	-0.333*	-0.004	-0.307	0.175	-0.340	-0.014	-0.464**	-0.122
	(0.184)	(0.172)	(0.201)	(0.206)	(0.210)	(0.240)	(0.218)	(0.290)
Spain#wave = 2	0.284	0.006	0.201	0.131	0.366	0.093	0.380	0.097
	(0.281)	(0.270)	(0.301)	(0.317)	(0.311)	(0.359)	(0.318)	(0.414)
Spain#wave = 4	-0.403*	0.110	-0.221	0.253	-0.140	0.413	-0.270	0.410
	(0.245)	(0.221)	(0.265)	(0.268)	(0.271)	(0.304)	(0.279)	(0.371)
Spain#wave = 5	-0.515*	-0.322	-0.569**	-0.152	-0.462*	-0.048	-0.564*	-0.028
	(0.270)	(0.235)	(0.271)	(0.278)	(0.278)	(0.325)	(0.291)	(0.349)
Italy#wave = 2	0.457	0.028	0.435	-0.108	0.278	-0.062	0.348	0.213
	(0.278)	(0.263)	(0.306)	(0.303)	(0.319)	(0.344)	(0.329)	(0.414)
Italy#wave = 4	0.150	0.469**	0.509**	0.493*	0.441*	0.572*	0.391	0.827**
	(0.300)	(0.220)	(0.245)	(0.267)	(0.262)	(0.313)	(0.272)	(0.366)
Italy#wave = 5	0.084	-0.049	0.157	0.192	0.095	0.322	-0.038	0.463
	(0.222)	(0.203)	(0.231)	(0.241)	(0.248)	(0.294)	(0.255)	(0.348)
France#wave = 2	0.034	0.332	0.083	0.514*	0.010	0.481	0.104	0.785**
	(0.263)	(0.236)	(0.257)	(0.277)	(0.268)	(0.323)	(0.278)	(0.397)
France#wave = 4	-0.064	0.437***	0.083	0.648***	0.016	0.666***	-0.007	0.868***
	(0.249)	(0.166)	(0.198)	(0.197)	(0.206)	(0.234)	(0.212)	(0.283)
France#wave = 5	-0.491**	0.252	-0.423**	0.443**	-0.512**	0.377	-0.609***	0.626**
	(0.219)	(0.177)	(0.205)	(0.210)	(0.211)	(0.246)	(0.219)	(0.293)
Denmark#wave = 2	0.217	-0.025	0.189	0.110	0.137	-0.004	0.264	0.227
	(0.228)	(0.223)	(0.247)	(0.260)	(0.259)	(0.293)	(0.266)	(0.363)
Denmark#wave = 4	0.026	0.225	0.118	0.463**	0.123	0.443*	0.097	0.595**
	(0.198)	(0.167)	(0.196)	(0.199)	(0.206)	(0.235)	(0.212)	(0.291)
Denmark#wave = 5	0.094	0.111	0.108	0.340*	0.072	0.221	-0.024	0.355
	(0.182)	(0.171)	(0.195)	(0.205)	(0.204)	(0.240)	(0.212)	(0.294)
Switzerland#wave = 2	0.476*	0.145	0.396	0.016	0.301	-0.013	0.437	0.064
	(0.256)	(0.245)	(0.275)	(0.286)	(0.289)	(0.327)	(0.298)	(0.398)
Switzerland#wave = 4	0.080	0.188	0.121	0.172	0.129	0.337	0.078	0.431
	(0.213)	(0.184)	(0.215)	(0.217)	(0.228)	(0.261)	(0.234)	(0.315)

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Switzerland#wave = 5	-0.128	0.106	-0.153	0.105	-0.188	0.108	-0.274	0.126
	(0.209)	(0.193)	(0.220)	(0.228)	(0.233)	(0.271)	(0.241)	(0.325)
Belgium#wave = 2	-0.103	0.282	-0.107	0.358	-0.337	0.212	-0.358	0.119
	(0.256)	(0.231)	(0.252)	(0.267)	(0.263)	(0.303)	(0.270)	(0.366)
Belgium#wave = 4	-0.133	0.177	-0.014	0.320	-0.051	0.581**	-0.122	0.444
	(0.201)	(0.176)	(0.203)	(0.207)	(0.216)	(0.247)	(0.222)	(0.284)
Belgium#wave = 5	-0.396	0.392**	-0.276	0.525**	-0.397*	0.605**	-0.548**	0.705**
	(0.245)	(0.178)	(0.200)	(0.209)	(0.209)	(0.244)	(0.216)	(0.294)
Shock10p#Austria			-0.917***					
			(0.334)					
Shock10p#Germany			-0.042					
			(0.192)					
Shock10p#Sweden			-0.384**					
			(0.190)					
Shock10p#Spain			-0.135					
			(0.244)					
Shock10p#Italy			-0.173					
			(0.214)					
Shock10p#France			-0.116					
			(0.181)					
Shock10p#Denmark			-0.158					
			(0.175)					
Shock10p#Switzerland			0.043					
			(0.190)					
Shock10p#Belgium			-0.326*					
			(0.187)					
Shock15p#Austria					-0.904**			
					(0.372)			
Shock15p#Germany					-0.112			
					(0.237)			
Shock15p#Sweden					-0.471**			
					(0.236)			
Shock15p#Spain					-0.170			
					(0.296)			
Shock15p#Italy					-0.187			
					(0.265)			
Shock15p#France					-0.153			
					(0.226)			

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
Shock15p#Denmark					-0.289			
					(0.215)			
Shock15p#Switzerland					0.049			
					(0.233)			
Shock15p#Belgium					-0.359			
					(0.236)			
Shock20p#Austria							-1.278***	
							(0.470)	
Shock20p#Germany							0.120	
							(0.298)	
Shock20p#Sweden							-0.163	
							(0.324)	
Shock20p#Spain							0.241	
							(0.319)	
Shock20p#Italy							0.099	
							(0.322)	
Shock20p#France							0.163	
							(0.284)	
Shock20p#Denmark							-0.112	
							(0.274)	
Shock20p#Switzerland							0.283	
							(0.303)	
Shock20p#Belgium							-0.377	
							(0.297)	
Health Stock		1.151***		0.067		-0.395		-0.805**
		(0.235)		(0.271)		(0.322)		(0.401)
Reference (Does Not Currently Smoke)								
Currently Smokes		0.158***		0.195***		0.186**		0.194**
		(0.053)		(0.061)		(0.076)		(0.095)
Reference (Not Overweight)								
Overweight		0.202***		0.198***		0.202***		0.206**
		(0.050)		(0.053)		(0.066)		(0.084)
Reference (HH Income Tercile = 1)								

VARIABLES	WorkOnly	Shock5p	WorkOnly	Shock10p	WorkOnly	Shock15p	WorkOnly	Shock20p
HH Income Tercile = 2		-0.008		-0.086		-0.110		-0.143
		(0.079)		(0.071)		(0.088)		(0.110)
HH Income Tercile = 3		-0.080		-0.128*		-0.182**		-0.208*
		(0.091)		(0.070)		(0.086)		(0.108)
Constant	-25.000***	-1.630***	-22.794***	-1.309***	-21.342***	-1.189**	-21.821***	-0.581
	(4.973)	(0.429)	(5.240)	(0.493)	(5.564)	(0.601)	(5.794)	(0.723)
Rho	-.119		.352		.304		.301	
	(.778)		(.211)		(.200)		(.223)	
Observations	15,721	15,721	13,176	13,176	12,069	12,069	11,331	11,331

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. All predictors at their mean value. Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared; Health Stock represents the Health Stock in the first period, as a continuous variable ranging from 0 to 1; Overweight is a dummy variable equal to 1 if the respondent's BMI is greater or equal to 25 ; Currently Smokes is a dummy variable equal to 1 if the respondent currently smokes ; HH Income Tercile is a discrete variable equal to the respondent's income (corrected for household size) tercile in the first period. The country and wave dummies (interacted) correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves.

B.4 Probit Results Stratified by Gender

Table 19: Marginal effects of the Probit equations on the probability of working for pay only in the second period, by Health Shock Intensity (Education Equation)– Males ages 50-65

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.296***	0.328***	0.322***	0.297***
	(0.090)	(0.095)	(0.098)	(0.101)
Reference (Not Partnered)				
Partnered	0.027	0.010	0.018	0.027
	(0.023)	(0.025)	(0.026)	(0.027)
Reference (Education: Low)				
Education: Medium	-0.013	0.001	-0.010	-0.020
	(0.038)	(0.040)	(0.043)	(0.044)
Education: High	0.003	-0.001	0.007	0.002
	(0.032)	(0.035)	(0.037)	(0.037)
Education: Very High	0.089***	0.101***	0.110***	0.105***
	(0.033)	(0.037)	(0.039)	(0.039)
Age at interview	-0.041***	-0.043***	-0.044***	-0.043***
	(0.004)	(0.005)	(0.005)	(0.005)
Reference (Not Civil Servant)				
Civil Servant	0.037	0.030	0.023	0.018
	(0.024)	(0.026)	(0.028)	(0.028)
Reference (Austria)				
Germany	0.065	0.056	0.052	0.063
	(0.095)	(0.117)	(0.126)	(0.143)
Sweden	0.126	0.128	0.141	0.161
	(0.096)	(0.111)	(0.122)	(0.141)
Spain	-0.003	-0.001	-0.000	0.012
	(0.093)	(0.110)	(0.117)	(0.132)
Italy	-0.017	0.007	0.015	0.023
	(0.096)	(0.122)	(0.130)	(0.149)
France	-0.044	-0.039	-0.035	-0.018
	(0.096)	(0.114)	(0.123)	(0.138)
Denmark	0.104	0.113	0.114	0.128
	(0.092)	(0.110)	(0.118)	(0.136)
Switzerland	0.124	0.127	0.128	0.132
	(0.094)	(0.109)	(0.117)	(0.132)
Belgium	-0.032	-0.044	-0.027	-0.012
	(0.093)	(0.113)	(0.121)	(0.139)
Reference (Wave = 1)				
Wave = 2	-0.102***	-0.108***	-0.102***	-0.092***
	(0.022)	(0.026)	(0.028)	(0.029)
Wave = 4	0.095***	0.100***	0.089***	0.093***
	(0.029)	(0.030)	(0.033)	(0.032)
Wave = 5	0.103***	0.106***	0.115***	0.114***
	(0.023)	(0.025)	(0.027)	(0.027)
Reference (No Shock)				
VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)

Shock5p	-0.065***			
	(0.021)			
Shock10p		-0.061**		
		(0.026)		
Shock15p			-0.106***	
			(0.035)	
Shock20p				-0.131***
				(0.046)
Country-Wave fixed effects	Yes	Yes	Yes	Yes
Observations	7,651	6,475	5,967	5,636

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; All predictors at their mean value; Males ages 50-65" working only" in the first period ; Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

Table 20: Marginal effects of the Probit equations on the probability of working for pay only in the second period, by Health Shock Intensity (Education Equation)– Females ages 50-65

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.309***	0.322***	0.296***	0.304***
	(0.077)	(0.081)	(0.085)	(0.086)
Reference (Not Partnered)				
Partnered	0.034*	0.035	0.017	0.011
	(0.020)	(0.022)	(0.024)	(0.025)
Reference (Education: Low)				
Education: Medium	0.019	0.031	0.010	0.019
	(0.039)	(0.043)	(0.047)	(0.049)
Education: High	0.090***	0.104***	0.089***	0.094***
	(0.030)	(0.033)	(0.033)	(0.034)
Education: Very High	0.100***	0.123***	0.104***	0.108***
	(0.031)	(0.035)	(0.037)	(0.038)
Age at interview	-0.034***	-0.034***	-0.034***	-0.033***
	(0.004)	(0.004)	(0.004)	(0.004)
Reference (Not Civil Servant)				
Civil Servant	0.054**	0.059**	0.056**	0.048*
	(0.022)	(0.024)	(0.025)	(0.026)
Reference (Austria)				
Germany	0.109	0.122	0.109	0.103
	(0.084)	(0.087)	(0.087)	(0.093)
Sweden	0.178**	0.187**	0.177**	0.177**
	(0.075)	(0.077)	(0.078)	(0.084)
Spain	0.086	0.107	0.096	0.096
	(0.091)	(0.087)	(0.088)	(0.094)
Italy	0.097	0.103	0.097	0.100
	(0.089)	(0.089)	(0.087)	(0.090)
France	0.065	0.080	0.066	0.063
	(0.085)	(0.085)	(0.084)	(0.090)
Denmark	0.137	0.147	0.135	0.130
	(0.088)	(0.089)	(0.086)	(0.091)
Switzerland	0.170*	0.184**	0.171*	0.162*
	(0.087)	(0.090)	(0.090)	(0.095)
Belgium	0.043	0.037	0.029	0.026
	(0.089)	(0.090)	(0.090)	(0.095)
Reference (Wave = 1)				
Wave = 2	-0.091***	-0.075**	-0.089***	-0.093***
	(0.028)	(0.031)	(0.032)	(0.033)
Wave = 4	0.114***	0.134***	0.127***	0.120***
	(0.023)	(0.025)	(0.027)	(0.029)
Wave = 5	0.058**	0.056**	0.047	0.041
	(0.024)	(0.027)	(0.030)	(0.030)
Reference (No Shock)				
Shock5p	-0.065***			
	(0.017)			

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Shock10p		-0.088***		
		(0.020)		
Shock15p			-0.106***	
			(0.025)	
Shock20p				-0.115***
				(0.030)
Country-Wave fixed effects	Yes	Yes	Yes	Yes
Observations	8,070	6,701	6,102	5,695

Standard errors in parentheses

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

NOTE: All predictors at their mean value

Note: Females ages 50-65" working only" in the first period ; Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

Table 21: Average Marginal Effects of Health Shocks on the Probability of Working Only, by Education Level – Males ages 50-65

VARIABLES	Shock5p	Shock10p	Shock15p	Shock20p
Education: Low	-0.135**	-0.175**	-0.322***	-0.365***
	(0.061)	(0.079)	(0.099)	(0.107)
Education: Medium	-0.078	0.027	-0.071	-0.143
	(0.072)	(0.061)	(0.085)	(0.122)
Education: High	-0.088**	-0.136***	-0.198***	-0.276***
	(0.035)	(0.049)	(0.073)	(0.104)
Education: Very High	-0.022	0.002	-0.006	0.015
	(0.027)	(0.034)	(0.048)	(0.053)
Observations	7,651	6,475	5,967	5,636

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
NOTE: All predictors at their mean value

Table 22: Average Marginal Effects of Health Shocks on the Probability of Working Only, by Education Level – Females ages 50-65

VARIABLES	Shock5p	Shock10p	Shock15p	Shock20p
Education: Low	-0.029	-0.102	0.013	0.042
	(0.061)	(0.078)	(0.080)	(0.094)
Education: Medium	-0.101*	-0.173**	-0.266***	-0.283**
	(0.060)	(0.074)	(0.095)	(0.133)
Education: High	-0.082***	-0.127***	-0.184***	-0.243***
	(0.024)	(0.032)	(0.044)	(0.056)
Education: Very High	-0.040	-0.020	-0.019	0.002
	(0.027)	(0.030)	(0.038)	(0.045)
Observations	8,070	6,701	6,102	5,695

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
NOTE: All predictors at their mean value

Table 23: Marginal effects of the Probit equations on the probability of working for pay only in the second period, by Health Shock Intensity (Country Equation)– Males ages 50-65

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.282***	0.303***	0.294***	0.269***
	(0.083)	(0.086)	(0.090)	(0.093)
Reference (Not Partnered)				
Partnered	0.026	0.009	0.014	0.022
	(0.022)	(0.024)	(0.025)	(0.025)
Reference (Education: Low)				
Education: Medium	-0.013	-0.004	-0.010	-0.015
	(0.037)	(0.039)	(0.040)	(0.041)
Education: High	0.001	-0.004	0.008	0.006
	(0.030)	(0.033)	(0.033)	(0.034)
Education: Very High	0.087***	0.096***	0.108***	0.104***
	(0.032)	(0.035)	(0.036)	(0.037)
Age at interview	-0.042***	-0.044***	-0.044***	-0.044***
	(0.003)	(0.003)	(0.003)	(0.003)
Reference (Not Civil Servant)				
Civil servant	0.036	0.029	0.021	0.017
	(0.023)	(0.024)	(0.026)	(0.027)
Reference (Austria)				
Germany	0.060	0.051	0.050	0.062
	(0.048)	(0.062)	(0.068)	(0.087)
Sweden	0.121**	0.120**	0.128**	0.151*
	(0.048)	(0.056)	(0.062)	(0.083)
Spain	0.011	0.010	0.017	0.028
	(0.052)	(0.060)	(0.065)	(0.082)
Italy	-0.016	0.009	0.019	0.026
	(0.050)	(0.064)	(0.070)	(0.092)
France	-0.036	-0.032	-0.024	-0.006
	(0.050)	(0.057)	(0.064)	(0.081)
Denmark	0.100**	0.108**	0.108*	0.123
	(0.046)	(0.055)	(0.061)	(0.081)
Switzerland	0.131***	0.134**	0.134**	0.141*
	(0.050)	(0.053)	(0.059)	(0.078)
Belgium	-0.029	-0.041	-0.022	-0.013
	(0.047)	(0.057)	(0.063)	(0.082)
Reference (Wave = 1)				
Wave = 2	-0.099***	-0.100***	-0.091***	-0.085***
	(0.021)	(0.024)	(0.027)	(0.028)
Wave = 4	0.088***	0.092***	0.082**	0.085***
	(0.032)	(0.032)	(0.035)	(0.033)
Wave = 5	0.099***	0.098***	0.105***	0.104***
	(0.021)	(0.023)	(0.024)	(0.024)
Reference (No Shock)				
Shock5p	-0.064***			
	(0.020)			

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Shock10p		-0.064***		
		(0.025)		
Shock15p			-0.106***	
			(0.031)	
Shock20p				-0.136***
				(0.040)
Country-Wave fixed effects	Yes	Yes	Yes	Yes
Observations	7,651	6,475	5,967	5,636

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; All predictors at their mean value; Males ages 50-65" working only" in the first period ; Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

Table 24: Marginal effects of the Probit equations on the probability of working for pay only in the second period, by Health Shock Intensity (Country Equation)– Females ages 50-65

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.297***	0.313***	0.287***	0.296***
	(0.075)	(0.080)	(0.084)	(0.085)
Reference (Not Partnered)				
Partnered	0.033*	0.036*	0.020	0.011
	(0.020)	(0.022)	(0.024)	(0.025)
Reference (Education: Low)				
Education: Medium	0.017	0.030	0.005	0.017
	(0.037)	(0.041)	(0.045)	(0.047)
Education: High	0.085***	0.101***	0.086***	0.090***
	(0.029)	(0.031)	(0.032)	(0.033)
Education: Very High	0.097***	0.123***	0.103***	0.103***
	(0.030)	(0.034)	(0.036)	(0.038)
Age at interview	-0.036***	-0.036***	-0.037***	-0.036***
	(0.003)	(0.003)	(0.003)	(0.003)
Reference (Not Civil Servant)				
Civil servant	0.052**	0.055**	0.054**	0.049*
	(0.021)	(0.023)	(0.024)	(0.025)
Reference (Austria)				
Germany	0.106	0.119	0.102	0.100
	(0.145)	(0.141)	(0.137)	(0.140)
Sweden	0.175	0.185	0.174	0.175
	(0.140)	(0.135)	(0.131)	(0.134)
Spain	0.093	0.115	0.102	0.111
	(0.153)	(0.141)	(0.139)	(0.141)
Italy	0.101	0.107	0.094	0.101
	(0.149)	(0.142)	(0.137)	(0.137)
France	0.069	0.085	0.068	0.065
	(0.147)	(0.140)	(0.136)	(0.138)
Denmark	0.137	0.148	0.132	0.128
	(0.149)	(0.143)	(0.139)	(0.140)
Switzerland	0.174	0.192	0.176	0.169
	(0.148)	(0.144)	(0.144)	(0.145)
Belgium	0.048	0.041	0.029	0.024
	(0.151)	(0.145)	(0.142)	(0.143)
Reference (Wave = 1)				
Wave = 2	-0.093***	-0.080***	-0.090***	-0.093***
	(0.026)	(0.027)	(0.029)	(0.030)
Wave = 4	0.111***	0.129***	0.123***	0.118***
	(0.022)	(0.024)	(0.025)	(0.027)
Wave = 5	0.055**	0.054**	0.047*	0.041
	(0.022)	(0.025)	(0.028)	(0.029)
Reference (No Shock)				
Shock5p	-0.063***			
	(0.017)			

VARIABLES	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Shock10p		-0.091***		
		(0.019)		
Shock15p			-0.112***	
			(0.023)	
Shock20p				-0.121***
				(0.028)
Country-Wave fixed effects	Yes	Yes	Yes	Yes
Observations	8,070	6,701	6,102	5,695

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; All predictors at their mean value; Females ages 50-65" working only" in the first period ; Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock5p, Shock10p, Shock15p, and Shock20p are dummy variables equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 5%, 10%, 15%, and 20% between two consecutive periods.These dummy variables are interacted with the country of residence. In addition to the variables shown, the multivariable model also controlled for the country of residence of the respondent and the wave in the first period.

Table 25: Marginal Effect of Health Shocks on Probability of Working Only for Males, by Country

VARIABLES	Shock5p	Shock10p	Shock15p	Shock20p
Austria	-0.025	-0.039	-0.103	-0.294***
	(0.051)	(0.066)	(0.080)	(0.101)
Germany	-0.031	-0.068	-0.132*	-0.194*
	(0.040)	(0.056)	(0.080)	(0.114)
Sweden	-0.111***	-0.143***	-0.208***	-0.194**
	(0.035)	(0.048)	(0.072)	(0.095)
Spain	-0.051	-0.051	-0.119	-0.160*
	(0.054)	(0.070)	(0.093)	(0.094)
Italy	-0.108*	-0.011	-0.025	-0.063
	(0.063)	(0.056)	(0.069)	(0.088)
France	-0.097***	-0.115**	-0.170**	-0.163**
	(0.036)	(0.051)	(0.070)	(0.082)
Denmark	-0.068***	-0.058	-0.118**	-0.122
	(0.026)	(0.036)	(0.051)	(0.074)
Switzerland	-0.009	0.006	-0.012	-0.052
	(0.027)	(0.034)	(0.047)	(0.073)
Belgium	-0.064*	-0.124***	-0.121**	-0.216*
	(0.034)	(0.046)	(0.059)	(0.111)
Observations	7,651	6,475	5,967	5,636

Standard errors in parentheses

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

NOTE: All predictors at their mean value

Table 26: Marginal Effect of Health Shocks on Probability of Working Only for Females, by Country

VARIABLES	Shock5p	Shock10p	Shock15p	Shock20p
Austria	-0.019	-0.084	-0.055	-0.023
	(0.047)	(0.066)	(0.084)	(0.111)
Germany	-0.046	-0.065*	-0.093**	-0.109*
	(0.033)	(0.039)	(0.047)	(0.057)
Sweden	-0.097***	-0.142***	-0.178***	-0.188*
	(0.034)	(0.047)	(0.059)	(0.108)
Spain	-0.068	-0.089	-0.076	0.027
	(0.066)	(0.083)	(0.101)	(0.084)
Italy	-0.099**	-0.183***	-0.231***	-0.228**
	(0.046)	(0.064)	(0.089)	(0.104)
France	-0.064**	-0.080**	-0.106**	-0.151**
	(0.030)	(0.037)	(0.052)	(0.075)
Denmark	-0.072***	-0.092***	-0.144***	-0.211***
	(0.024)	(0.031)	(0.042)	(0.060)
Switzerland	-0.050*	-0.054	-0.074	-0.098
	(0.030)	(0.043)	(0.054)	(0.074)
Belgium	-0.064*	-0.168***	-0.236***	-0.367***
	(0.037)	(0.052)	(0.071)	(0.077)
Observations	8,070	6,701	6,102	5,695

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
NOTE: All predictors at their mean value

B.5 cmp results

B.5.1 Four-choice-Model

Table 27: Estimates of impact of Covariates on Probability of Same Job/New Job/Benefits and Work/Benefits Only in Period 2, and of Experiencing a Shock15p

Labor Force In Period 2	Reference (Same Job)	New Job	Benef + Work	Benef Only	Shock15p
Functioning Stock		-1.014*	-.538	-.594	
		(0.590)	(0.814)	(0.731)	
Reference (Male)					
Female		.056	.026	-.076	0.116*
		(0.097)	(0.098)	(0.107)	(0.062)
Reference (Not Civil Servant)					
Civil Servant		-.328****	-.320	-.093	
		(0.100)	(0.515)	(0.111)	
Reference (Education:Low)					
Education: Medium		.135	.208	-0.392	0.033
		(0.207)	(0.405)	(0.092)	(0.112)
Education: High		-.010	.071	-0.115	-0.029
		(0.187)	(0.203)	(0.162)	(0.081)
Education: Very High		-.035	-.075	-0.239	-0.079
		(0.202)	(0.165)	(0.324)	(0.092)
Age		.499	-1.170	-0.511	0.009
		(0.483)	(1.765)	(0.663)	(0.008)
Age Squared		-.511	1.157	0.548	
		(0.450)	(1.734)	(0.722)	
Shock15p = 1		0.578	1.067	0.377	
		(2.706)	(2.463)	(0.643)	
Health Stock					-0.790**
					(0.314)
Smokes Now					0.130*
					(0.077)
Overweight					0.150**
					(0.067)
Sigma			1.562	0.579	
			(2.510)	(0750)	
Rho (New-Job)			0.295	0.271	0.006
			(0.421)	(0.388)	(1.010)
Rho (Benef + Work)				0.395	-0.220
				(0.610)	(0.497)
Rho (Benef Only)					-0.178
					(0.376)
Observations	12,069	12,069	12,069	12,069	

Note: Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared; Health Stock represents the Health Stock in the first period, as a continuous variable ranging from 0 to 1; Overweight is a dummy variable equal to 1 if the respondent's BMI is greater or equal to 25 ; Currently Smokes is a dummy variable equal to 1 if the respondent currently smokes ; HH Income Tercile is a discrete variable equal to the respondent's income (corrected for household size) tercile in the first period. The country and wave dummies (interacted) correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock15p is a dummy variable equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 15% between two consecutive periods.These dummy variables are interacted with the country of residence. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves.

B.5.2 Three-choice-Model

Table 28: Estimates of impact of Covariates on Probability of Work Only/Benefits and Work/Benefits Only in Period 2, and of Experiencing a Shock15p

Labor Force In Period 2	Reference (Work Only)	Benef + Work	Benef Only	Shock15p
Functioning Stock		-.429	-.454	
		(0.439)	(0.364)	
Reference (Male)				
Female		.022	-.066	0.117*
		(0.078)	(0.056)	(0.066)
Reference (Not Civil Servant)				
Civil Servant		-.280**	-.065	
		(0.081)	(0.053)	
Reference (Education:Low)				
Education: Medium		.191	-0.039	0.030
		(0.160)	(0.057)	(0.106)
Education: High		.071	-0.096	-0.031
		(0.122)	(0.083)	(0.081)
Education: Very High		-.059	-0.202	-0.078
		(0.132)	(0.158)	(0.092)
Age		-1.039**	-0.439	0.009
		(0.340)	(0.327)	(0.008)
Age Squared		1.027**	0.472	
		(0.313)	(0.346)	
Shock15p = 1		0.986	0.213	
		(2.573)	(0.271)	
Health Stock				-0.788***
				(0.303)
Smokes Now				0.126*
				(0.074)
Overweight				0.149**
				(0.066)
Sigma			0.484	
			(0.353)	
Rho (Benef + Work)			0.384	0.234
			(0.307)	(0.897)
Rho (Benef Only)				-0.092
				(0.222)
Observations	12,069	12,069	12,069	12,069

Note: Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; Female is a dummy variable equal to 1 if the respondent is female ; Part is a dummy variable equal to 1 if the respondent is married or partnered ; The seven 1997-ISCED education levels are recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education;

ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Civil is a dummy variable equal to 1 if the respondent is a civil servant ; Age is the age of the respondent at the interview and Age Squared is the age at the interview squared; Health Stock represents the Health Stock in the first period, as a continuous variable ranging from 0 to 1; Overweight is a dummy variable equal to 1 if the respondent's BMI is greater or equal to 25 ; Currently Smokes is a dummy variable equal to 1 if the respondent currently smokes ; HH Income Tercile is a discrete variable equal to the respondent's income (corrected for household size) tercile in the first period. The country and wave dummies (interacted) correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves. Shock15p is a dummy variable equal to one if the respondent experienced a decline in Functioning Stock of respectively at least 15% between two consecutive periods.These dummy variables are interacted with the country of residence. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves.

Chapter III: Positive Health Shocks in Europe: Ensnared a Benefit Trap?

1. Introduction and background

The evidence in Chapter II indicates that the economic consequences of a deterioration in health have been alleviated in Western Europe by the development of large-scale welfare systems, which include generous social assistance schemes for the least physically able. When comparing outcomes across countries, I further found that there is a striking variation in the pathways offered to health impaired employees: in most Western European countries, a negative health shock increases the probability of exiting the labor force altogether. However, two groups of countries stand out in how they maintain a connection with work for employees experiencing a decline in health. On one hand, in Switzerland health impaired employees can remain on their employer's payroll with sick pay paid by private insurance. On the other hand, a hybrid labor force status is prevalent in Sweden, Belgium, and to a lesser extent in France and Denmark, where a substantial fraction of health impaired workers start receiving benefits but do not sever all work ties. Hence, two similar workers could transition to different work force statuses after a health shock, only because they happen to reside in different countries. My goal in Chapter III is to investigate whether these different alternatives are more or less likely to inhibit workers' transitions back to work. Are institutions in certain countries more likely to ensnare recipients in a "benefits trap" after a negative health shock, and do others create more access to new work opportunities in case of a health recovery or positive shock?

1.1 Benefit Trap and Unused Labor Capacity

Traditional retirement is characterized by a structural break in an individual's late life cycle – from full employment to complete retirement. (Kantarci & Van Soest 2008). This fits with the notion of an institutionalized life course with separate stages of labor force preparation, participation and withdrawal (Kohli & Meyer 1986; Mayer & Schoepflin 1989). Indeed, large fractions of individuals in Europe aged 65 or younger have retired (Angelini et al. 2009). Some of these individuals quit their jobs because of poor health, or were otherwise dismissed, and were not able to find another job. Most of the so-called "young" older people who are currently retired were induced to retire early by substantial financial incentives (see Gruber and Wise, 1999, 2004). Angelini et al. (2009) argue that the presence of financially attractive early retirement schemes in a world of imperfect financial and insurance markets can lead to an *early retirement trap*: people who retire early in life are more likely to be in financial hardship in the long run. More broadly, this phenomenon belongs to vast literature on unused labor capacity, arguing that some workers may be leaving the labor market earlier than would be desirable (given their health conditions, and their socio-demographic characteristics) because they are "pushed" by the generosity of the institutions (Brugiavini et al. 2005, Börsch-Supan et al. 2009).

Post-unemployment earnings losses have been shown to be largely permanent and particularly significant for older workers. This phenomenon is known as "unemployment scarring" (Heckman & Borjas 1980). Indeed, studies on human capital depreciation have established that, after work interruptions, real wages at re-entry are lower than at the point of labor force withdrawal, and that the decline in wages is greater the longer the interruption (Mincer & Ofek 1982, Görlich & De Grip 2008, Kunze 2002). As a consequence, people who are out of the work force have a lower human capital (all else equal) than their counterparts who are still partially working. Thus, the former should have a lower earnings potential and will be more likely to remain inactive.

1.2 Partal retirement – Reintegration: Keeping a Connection with Work

As we have seen, retirement is often described as a direct transition from full employment to full inactivity. However, life expectancy has risen, meaning an increasing proportion of the population is reaching the statutory pension age and spending a longer time in retirement. At the same time, people are having fewer children on average. This presents a challenge for guaranteeing sustainable and adequate pension systems. This challenge is particularly immediate when pensions are funded mainly by current contributions of younger generations (a "pay-as-you-go" system) rather than by accumulated savings, which is the case in almost all occupational and public pension systems in the EU (European Commission 2012). Hence, in most EU Member States, measures have been taken at national and economic sector levels to address the pressure on pension systems.

In particular, the statutory pension age has been raised, early retirement discouraged, pension entitlements reduced and contributions increased. These measures have contributed to the improved sustainability of pension systems. But their effectiveness may be limited and their social acceptability open to question; they may also lead to inadequate pensions and reduced quality of life. As a consequence, many European countries have allowed and sometimes encouraged various forms of partial exits from the labor force, before access to normal retirement (See Eurofound (2016) for detail). The main tools for doing so have been partial retirement schemes, but in many cases pension benefits are not conditioned on being inactive, so that workers can continue working in another (or even the same) job after drawing pension benefits. Hence, exit from the labor force and entry into the pension system are no longer distinct events.

In parallel, there has been a broad shift in focus regarding sickness and disability programs throughout much of the OECD area from passive income maintenance to employment incentives and reintegration policies over the last two decades, with the aim of supporting workers with health impairments, ensuring an adequate labor supply, and reducing spending on social protection programs (Prinz & Tompson 2009, Böheim & Leoni 2018). The reasons are twofold. First, there has been a broader social policy trend away from income protection and towards activation and reintegration of people out of work. Second, this transformation of policy is the result of a failure of sickness and disability benefit programs that seem to have become traps for an increasing share of the workforce. Even in countries where disability benefits are formally granted temporarily, the outflow back into employment is virtually zero (Organization for Economic Co-operation and Development 2003).

From this literature review, it appears that hybrid labor force statuses combining work and benefits, have been gaining favor in Europe over the last decades. The main reasons for that increase is population aging and the corollary solvency issue of pension funds, as well as the observation that people are not likely to re-enter the work force once they have left. My goal in this chapter is to investigate whether incentivizing health impaired individuals to maintain a connection with work while receiving benefits has the added advantage of encouraging workers to transition back to work in case of a health recovery.

2. Research Question

I previously identified three major pathways offered to respondents in Western Europe after a negative health shock: “Work Only”, “Work and Benefits”, and “Benefits Only”, which I will now refer to as *initial workforce status*. Based on this literature review, I want to assess whether the hybrid initial workforce status “Work and Benefits” better enables individuals to leverage an increase in health compared to “Benefits Only”. In order to do so, I will first need to delineate my study sample and define *positive health shocks*. I will then estimate differences in labor status outcomes for respondents experiencing a positive health shock according to their *initial work force status*.

My empirical analysis will involve addressing selection bias and unobserved heterogeneity issues. First, the labor force status of respondents in the first period is not completely random, even if country-specific institutions play a key role in the initial work force status: on average, people who are partially working in the first period are in better health and have a higher education than the people who are out of the workforce (see Table 30). Second, there may be individual specific characteristics that, all else equal, may incentivize workers to choose a particular labor force status in the first or to be more likely to work in the second period.

To control for the possibility of selection bias, my model will control for the individual’s initial work force status by simultaneously estimating reduced form equations for his or her initial work force status, along with the equations for transition decisions. To alleviate the concern over unobserved heterogeneity I will use an empirical strategy that involves the joint estimation of the endogenous multinomial treatment (i.e. initial work force status choice) and an outcome equation (i.e. decision to work or not), following the methodology proposed by Deb &

Trivedi (2006a, 2006b). More precisely, the model has two sets of equations, one for the multinomial initial labor force status ("Work Only", "Work and Benefits", or "Benefits Only") and a second for the binary outcome ("Work" or not). The initial labor force status and outcome equations are linked via observed and unobserved characteristics and they are both non-normal and non-linear.

3. Descriptive Statistics in Period 1

3.1 Data - Criteria for Inclusion in the Study

To complete my study, I use the dataset which was presented in Section 2 of Chapter I. It is a panel dataset of harmonized variables suitable for cross-country analysis for the first five similar waves of the Survey of Health, Ageing and Retirement in Europe (SHARE[39])– waves 1 to 6 except SHARELIFE, wave 3. To ensure methodological comparability, the dataset is restricted to the countries surveyed in these five comparable waves: Austria, Germany, Sweden, Spain, Italy, France, Denmark, Switzerland, and Belgium. I restrict my study to respondents that are observed in two consecutive waves- waves 1 to 2, 2 to 4, 4 to 5, and 5 to 6- and used longitudinal weights to account for attrition between these waves. The method used to assign a respondent's labor force status is presented in Appendix B.2 of Chapter II. In Chapter II, I restricted my study to the respondents who were receiving labor income from employment only in the first period ("Work Only").

Ideally, I would have liked to restrict my sample to individuals who are (1) observed in the survey over three consecutive periods, (2) working only in period 1, and (3) who suffered a negative heath shock between periods 1 and 2. I would then compare the outcomes of individuals

39 www.share-project.org.

who experience a positive health shock between periods 2 and 3, depending on their work force status in period 2. But these inclusion requirements would have considerably lowered my sample size.

Hence I decided to study respondents observed during two consecutive waves (as in Chapter II), but contrary to chapter II, I expanded the range of labor force statuses in the first period to the three categories that have been shown to be the main labor force outcomes in the second period for individuals who were working in the first period: (1) respondents who have work income as only source of personal revenue ("Work Only"), as well as (2) respondents who are receiving labor income along with benefits[40] ("Work and Benefits"), and (3) respondents who receive benefits only ("Benefits Only"). Unfortunately, it is impossible for me to know if the respondents in the last two categories had work as the only source of personal revenue in the recent past and if they experienced a negative health shock, and I was potentially faced with a high heterogeneity of respondents in terms of their willingness to work, particularly among the category "Benefits Only". An obvious source of heterogeneity among respondents, who were above 50 in the 2000s, is gender.

Indeed, it has been shown that, for older individuals who were socialized during a previous era, the meaning of work may be quite different for men and women. Women have historically played a greater role in raising children and grandchildren, providing elder care for parents, and caring for spouses in ill health (Bradley & al. 2002). As such, women may have different incentives to retire than do men. For example, for women, the odds of being retired dramatically increased as the number of dependents increased, while it was not the case for men (Talaga & Beehr, 1995). Gender differences in the decision to retire are also often attributed to

[40] I did not distinguish between different types of benefits because unemployment and disability benefits are often used as early exit paths from the labor market by those aged over 55. See Section 10 of Chapter II

women's generally lower attachment to their jobs (Richardson and Kilty 1991). As a consequence, many analyses of retirement behavior, modelled on a work/non-work dichotomy are more applicable to men (Isaksson and Johansson 2000). Hence, to obtain a more homogeneous group for analysis, I restricted my study to men[41]. This approach has been followed extensively in the labor force literature (See for example Blau & Gilleskie 2001, Quinn 1977, Meghi & Whitehouse 1997, Karpansalo & al. 2005, Herz 1995, Gruber & Madrian 1993, Haveman & Wolfe 1991, Parries & Sommers 1994).

Table 29: Share of Male Respondents in Period 1 (all respondents ages 50 – 65) by Initial Labor Force Status, by country of Residence

	Work Only	Work and Benefits	Benef Only
Austria	0.476	0.042	0.482
	(0.016)	(0.005)	(0.016)
Germany	0.547	0.101	0.352
	(0.015)	(0.009)	(0.014)
Sweden	0.631	0.196	0.174
	(0.016)	(0.014)	(0.010)
Spain	0.545	0.053	0.403
	(0.018)	(0.008)	(0.018)
Italy	0.521	0.079	0.400
	(0.016)	(0.008)	(0.014)
France	0.522	0.069	0.410
	(0.013)	(0.006)	(0.012)
Denmark	0.640	0.120	0.240
	(0.011)	(0.008)	(0.010)
Switzerland	0.729	0.110	0.160
	(0.012)	(0.009)	(0.010)
Belgium	0.489	0.093	0.418
	(0.011)	(0.006)	(0.011)

Note: For each country, the first column gives the share of male respondents whose only source of personal revenue is work, the second column gives the share of respondents who receive some work income as well as some benefits,

[41] Results for a model including both men and women are presented in Appendix C.1.

and the third column give the share of respondents who are completely out of the labor. Standard errors in parenthesis. Waves 1, 2, 4, and 5.

Table 29 presents the descriptive statistics for the remaining sample by country in period 1. Switzerland has the largest share of males “Working Only”, at 72.9%, followed by Denmark at 64.0%, and Sweden, at 63.1%. The countries with the lowest share of male population having work as their sole source of personal income are Austria and Belgium, at 47.6% and 48.9% respectively. These two countries are also the ones with the highest share of male respondents who have completely exited the work force, at 48.2% and 41.8% respectively. Sweden is the country with the highest percentage of its male population in the “Work and Benefits” category (about 20%).

Table 30 presents descriptive statistics for two sets of male respondents based on their initial work status. As in Chapter II, the seven 1997-ISCED education levels have been recoded into four broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up). For each labor force category in period 1, descriptive statistics are presented for all members in the category.

As might be expected, male respondents who are out of the work force in period 1 appear to be on average older, less physically and mentally able, and less educated than their counterparts in the “Work and Benefits” and even more in the “Work Only” categories.

Now that I have characterized my study sample and the three possible initial work statuses, I need to define positive *health shocks*. I will then be able to compare the work outcomes of respondents who experienced a positive health shock and of the ones who did not, based on their initial work status.

Table 30: Descriptive Statistics (Weighted) by Work Force Status in Period 1

	All Males (50-65)		
	Work Only	Work and Benefits	Benefits Only
Functioning Stock	0.919	0.872	0.843
	(0.003)	(0.006)	(0.003)
Age	55.176	58.269	59.809
	(0.079)	(0.194)	(0.090)
Education: Low	0.117	0.141	0.242
	(0.007)	(0.013)	(0.008)
Education: Medium	0.164	0.160	0.175
	(0.010)	(0.015)	(0.008)
Education: High	0.416	0.442	0.423
	(0.012)	(0.022)	(0.010)
Education: Very High	0.303	0.258	0.160
	(0.010)	(0.019)	(0.007)
N =	9,948	1,894	7,321

Note: Mean and Standard Deviation (in parentheses) – Line description: "Functioning Stock" is a continuous variable ranging from 0 (worst) to 1 (best) calculated in Chapter II ; "Age" is the age of the respondent at the interview ; the next 4 categories and dummy variables equal to 1 iff the respondent's level of education belongs to one of the 4 mutually exclusive education categories;. Column description: "Work Only": respondents whose only source of personal revenue is work ; "Work and Benefits": respondents who receive work income and benefits ; " Benefits Only": respondents who receive only benefits. Waves 1, 2, 4, and 5.

4. Positive Health Shocks

4.1 Definition of Health Shocks

As presented in Chapter II, the standard approach to disentangling the causal relationship going from health to wealth and to distinguishing the effects of health from other environmental factors is to concentrate on *health shocks*, as sudden health changes that can be considered exogenous. Several definitions of *negative* health shocks have been used in previous studies but to my knowledge none have been offered for *positive* health shocks. A positive health shock might be defined, for example, as a sudden improvement of a person's health. In Chapter 1, I have constructed two population health metrics for survey-based data suitable for analysis across time and populations. The first variable, *Health Stock*, is an objective comprehensive health metric, and the second variable - referred to a *Functioning Stock* – is restricted to the objective measure of an individual's level of function. In Chapter II, I defined a negative health shock as a dummy variable equal to one if and only if (1) the respondent experienced a decrease between two consecutive periods in the *functioning stock*, and (2) the magnitude of the decrease exceeds a given threshold (in percentage terms). In the same vein, I define a positive health shock as a dummy variable equal to one if and only if (1) the respondent experienced an increase between two consecutive periods in the *functioning stock*[42], and (2) the magnitude of the increase exceeds a given threshold (in percentage terms). Figure 12 shows the weighted distribution of the change in functioning stock by labor force status in period 1 between two consecutive periods for all males ages 50-65 living in Europe and belonging to one of these three categories.

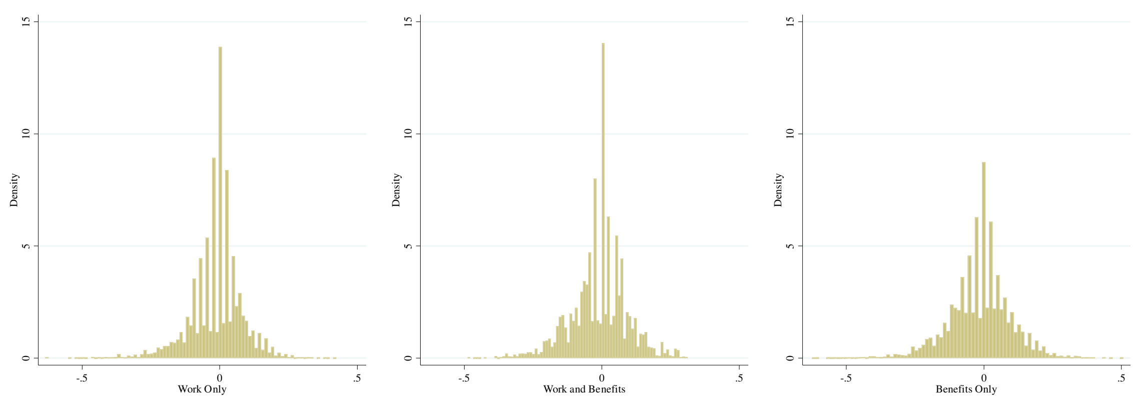

Figure 12: Distribution of the Change in Functioning Stock between two Consecutive Waves by Labor Force Status in Period 1 (All male respondents ages 50-65 belonging to these categories)

[42] When assessing mental health for the construction of the health stock, I used the EuroD indicator. Because I focused on diagnosable conditions, I replaced the mental health indicator with the diagnosis of a depression to define the functioning stock variable in Chapter II. In Chapter III, I revert to the EuroD indicator because I want to be able to assess in my study the consequences of an improvement in mental health.

Table 31 shows the weighted frequency of positive health shocks between two consecutive waves among the respondents belonging to each of the three labor force categories in the first period (all waves).

Table 31: Frequency of Positive Health Shocks between two Consecutive Waves by Labor Force Status in Period 1 (Males ages 50-65)

	Work Only	Work and Benefits	Benefits Only
Control Group	0.622	0.598	0.602
	(0.009)	(0.022)	(0.010)
	6,255	1,132	4,392
Func5p	0.231	0.278	0.274
	(0.008)	(0.021)	(0.009)
	2,154	485	1,979
Func10p	0.108	0.152	0.162
	(0.006)	(0.017)	(0.008)
	955	234	1,140
Func15p	0.058	0.103	0.102
	(0.005)	(0.016)	(0.006)
	465	140	675

For each labor force category in the first period (in column) the percent in each row represents the weighted frequency of respondents with respectively: Control Group: a *functioning stock* constant or decreasing between 2 consecutive periods ; Func5p, Func10p, Func15p: a *functioning stock* increasing by respectively at least 5, 10, or 15 percentage points between 2 consecutive periods. In each block, the first line is the weighted mean, the second is the standard error (in parenthesis), and the third line is the number of observations.

The control group is made of male respondents whose functioning stock *decreased* or stayed constant between two consecutive periods. About 60% of the population belong to that category across all labor force statuses. Func5p, Func10p, and Func15p are dummy variables equal to one if and only if the respondent's functioning stock increased by respectively at least 5, 10, or 15 percentage points between 2 consecutive periods. The respondents who are "Working Only" in the first period are the least likely to experience any kind of increase in their functioning stock compared to the respondents in the "Work and Benefits" and "Benefits Only" categories because they are healthier in the first place (See Table 30). Hence their functioning stock has a smaller margin of improvement.

5. Econometric Model

5.1 Addressing Unobserved Endogeneity Bias

In Chapter II, I have discussed the problem of the broad class of "endogenous switching" and "sample selection" problems, which are prevalent in economics. In the present context, the dependent variable is binary (work or not in the second period) and an explanatory variable (initial work status) is endogenous and multinomial. An overview of contemporary control methods, which extend the Heckman approach to binary, multinomial, ordinal, count and percentile outcomes and to where endogenous variables take various forms can be found in Peel (2014). These contemporary methods aim to improve causal estimates by controlling for hidden bias, though at the price of increased complexity. In particular, Deb & Trivedi (2006a and 2006b) extend the Heckman treatment effect method to the multinomial selection case using a latent factor structure. They propose a specific methodology to combat the effects of an endogenous multinomial treatment on a non-negative integer-valued outcome. One of the main advantages of this methodology lies in the fact that the latent factors can be interpreted as proxies for the unobserved variables. These are introduced into the equation in the same way as are observed variables.

Deb and Trivedi (2006a) originally applied their econometric methodology to the field of medical insurance. It has since then been applied in a wide variety of fields of study, and particularly in those related labor, health, and education economics. Examples include the analysis of how women combine work and family duties (Leoni & Eppel 2013), the impact of migration on socio-economic status of the families Deb & Seck (2009), the relationship between mothers' work pathways and health (Frech & Damaske 2012), the impact of different degrees of activity on the psychological wellbeing of midlife and older adults (Matz-Costa et all 2012)., admission processes in the intensive care units of hospitals (Kim et al. 2014),the relationship between social class and obesity (Bonnefond & Clément 2014), the implications for the academic results of students of them combining work and study (Triventi 2014), the satisfaction and work-related decisions of people with doctorate degrees (Di Paolo 2016), the impact of the choice of educational center on the implication of parents in the education of their children (Buckley 2007), or the determinants of tourist use of public transport at the destination (Gutiérrez & Miravet 2016).

The model is a recursive model with qualitative dependent variables and a latent factor structure: (1) the initial workforce status (in the first period) is multinomial and the outcome equation (work force status in the second period) is binary. (2) The initial workforce status is an input to the outcome equation. (3) Latent factors are incorporated into the initial labor force status and the outcome equations to allow for idiosyncratic influences on the initial labor force status in the first period to affect the work outcome in the second period. These idiosyncratic influences are interpreted as unobserved heterogeneity. Because no closed form solutions for the integrals in the likelihood functions of the model exist, the method applies maximum simulated likelihood (MSL) techniques to estimate the parameters of the model that uses quasi-random draws based on Halton sequences[43].

[43] See Gourieroux and Montfort (1996)

5.2 Initial Labor Force Status

An individual's initial labor force status (in period 1) includes (1) "Work Only" (control group), (2) "Work and Benefits", and (3) "Benefits Only." The indirect utility of individual i associated with the j^{th} work status (EV_{ij}^*) is

$$EV_{ij}^* = z_i'\alpha_j + l_{ij} + \eta_{ij} \qquad j = \{0,1,2\}$$

where z_i denotes exogenous covariates with associated parameters α_j, l_{ij} is a random variable representing unobserved characteristics associated with individual i's labor force status in period 1 and work status in period 2 (such as the interest of the potential job or the individual's financial needs), and η_{ij} is an i.i.d. error term. I assume that the latent factors l_{ij} have a standard normal distribution and the η_{ij} have a logistic distribution. l_{ij} is assumed to be independent of η_{ij}. I let Work Only (j = 0) be the control group and set $EV_{i0}^* = 0$ for identification reasons. Letting d_{ij} be binary variables representing the observed initial labor force choice, the probability individual i makes choice j (conditional on the l_{ij}) is

$$\Pr(d_{ij} | z_i, l_i) = g(z_i, l_i) = \frac{\exp(z_i'\alpha_j + l_{ij})}{1 + \sum_{k=1}^{2} z_i'\alpha_k + l_{ik}} \qquad j = \{0,1,2\} \qquad (1)$$

where $l_i = [l_{i1}, l_{i2}]$ and $EV_{i0}^* = 0$ implies $\alpha_0 = 0$.

5.1 Outcome Equation

The outcome equation must account for the initial employment state of the individual since it may have been determined according to the same decision making process that is used in the outcome equation. Letting y_i equal one if individual i is "working" in the second period and equal zero otherwise, the outcome equation is

$$y_i = \begin{cases} 1, & if\ x_i'\beta + \sum_{j=1}^{2} \gamma_j d_{ij} + \sum_{j=1}^{2} \lambda_j l_{ij} + u_i \geq 0 \\ 0, & if\ x_i'\beta + \sum_{j=1}^{2} \gamma_j d_{ij} + \sum_{j=1}^{2} \lambda_j l_{ij} + u_i < 0 \end{cases}$$

where x_i is a set of exogenous covariates with associated parameter vector β, the γ_j capture the effect of initial work force status on y, the λ_j are load factors on the unobserved variable and u_i is an error term. Hence y_i is a function of each of the latent factors l_{ij} i.e. the outcome is affected by unobserved characteristics that affect selection into the initial work status. If we assume a standard normal error term u_i, we get the probit model, whose density function for y_i is given by

$$f(y_i|x_i, d_i, l_i) = \Phi(x_i'\beta + \textstyle\sum_{j=1}^{2} \gamma_j d_{ij} + \sum_{j=1}^{2} \lambda_j l_{ij}), \qquad (2)$$

where Φ is the cumulative distribution function of the standard normal distribution.

Because of the independence of the error terms of equations (1) and (2) η_{ij} and u_i,

$$\Pr(y_i, d_i|x_i, z_i, l_i) = f\left(x_i'\beta + \textstyle\sum_{j=1}^{2} \gamma_j d_{ij} + \sum_{j=1}^{2} \lambda_j l_{ij}\right) X\ g(z_i'\alpha_1 + l_{i1}, z_i'\alpha_2 + l_{i2})$$

We assumed that the l_{ij} were i.i.d. draws from a standard normal distribution the joint probability must integrate across the l_{ij} ; i.e.,

$$\Pr(y_i, d_i|x_i, z_i) = \int [f(x_i'\beta + d_i'\gamma + l_i'\lambda)\ X\ g(z_i'\alpha_1 + l_{i1}, z_i'\alpha_2 + l_{i2})]\, h(l_i) dl_i,$$

where h is assumed to be a bivariate normaldistribution with elements drawn from i.i.d. unit normal densities.

The multiple integrals associated with this probability present a computational problem which may be overcome using simulation-based estimation (Gourieroux and Montfort 1996). The simulated log likelihood function is given by:

$$lnL(y_i, d_i | x_i, z_i) = \sum_{i=1}^{N} \ln\left(\frac{1}{S}\sum_{s=1}^{S}\left[f\left(x_i'\beta + d_i'\gamma + \tilde{l}_{is}'\lambda\right) X\, g\left(z_i'\alpha_1 + \tilde{l}_{i1s}, z_i'\alpha_2 + \tilde{l}_{i2s}\right)\right]\right),$$

where $\widetilde{l_{is}'}$ is the sth draw (from a total of S draws) of a pseudo-random number from the density h.

In principle, the model can be identified even if the variables that appear in the two equations are identical (i.e. x_i=z_i). In general, however, exclusion restrictions are preferred for identification. Our exclusion restriction is country of residence, which is only included in the initial workforce equation (it is considered an exogenous source of variation for the initial labor force status).

6. Results

I run three different models with the same initial labor force status equations, and assess the impact of positive health shocks of different magnitudes (5%, 10%, and 15%) on the probability to "Work Only" in the second period.

6.1 Initial Labor Force Status

The estimates of the MMNL initial work status equations from each of the 3 models are very similar because they are all estimates for the same choices of initial work status ("Work Only", "Work and Benefits", and "Benefits Only") with the same sets of covariates (Functioning

Stock, age, age squared, country of residence, education level, and wave in period 1). So I present and discuss estimates from only one of these models, that from the joint model of initial work status and probability to Work Only with a 5% increase in the functioning stock. Marginal effects from this model are presented in Table 32.

Table 32: Marginal effects in MMNL Initial Labor Force Status (All male respondents ages 50-65)

Variable	"Work Only"	"Work and Benefits"	"Benefits Only"
Functioning Stock in P1	0.985***	-0.131***	-0.854***
	(0.070)	(0.029)	(0.060)
Age	-0.062***	0.008***	0.054***
	(0.002)	(0.001)	(0.002)
Reference (Education: Low)			
Education: Medium	0.004	0.006	(0.010)
	(0.027)	(0.012)	(0.023)
Education: High	0.103***	(0.005)	-0.098***
	(0.024)	(0.011)	(0.021)
Education: Vey High	0.291***	(0.014)	-0.276***
	(0.026)	(0.012)	(0.023)
Reference (Austria)			
Germany	0.092***	0.060***	-0.151***
	(0.025)	(0.015)	(0.021)
Sweden	0.275***	0.117***	-0.392***
	(0.028)	(0.015)	(0.025)
Spain	0.108***	0.013	-0.121***
	(0.033)	(0.017)	(0.028)
Italy	0.094***	0.044***	-0.138***
	(0.026)	(0.015)	(0.021)
France	0.025	0.037***	-0.062***
	(0.023)	(0.013)	(0.019)
Denmark	0.180***	0.076***	-0.255***
	(0.024)	(0.013)	(0.021)
Switzerland	0.349***	0.068***	-0.416***
	(0.027)	(0.014)	(0.024)

Variable	"Work Only"	"Work and Benefits"	"Benefits Only"
Belgium	(0.021)	0.064***	-0.043**
	(0.023)	(0.013)	(0.019)
Reference (Wave = 1)			
Wave = 2	0.011	0.007	(0.018)
	(0.021)	(0.010)	(0.018)
Wave = 4	0.063***	0.001	-0.063***
	(0.023)	(0.012)	(0.020)
Wave = 5	0.070***	0.008	-0.078***
	(0.019)	(0.009)	(0.018)

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

NOTE: All predictors at their mean value

Note: Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; The seven 1997-ISCED education levels are recoded into three broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Age at Interview is a discrete variable equal to the age f the respondent at the date of interview ; "Working Spouse" is a dummy variable equal to 1 if the respondents spouse is working in the first period. The country and wave dummies correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock increased or stayed constant across the 2 consecutive waves.

Male respondents who are younger, with a higher functioning stock, or more educated, are more likely to be working only. As expected, the statistical significance of these variables in the initial work status choice equations suggests that for this particular population there is favorable selection on the basis of these variables into "Working Only" and a unfavorable selection into "Benefits Only".

The initial work status equation includes country of residence dummy variables, which are excluded from the work equations. Selection into the "Work and Benefits" status is mainly determined by the country of residence. Compared to residents of Austria, all else equal residents in all countries but France and Belgium are more likely to be working only ; residents in all countries but Spain are more likely to be on "Work and Benefits", and residents in all other countries are less likely to be on "Benefits Only". All else equal, the probability to be "Working Only" is the highest for Switzerland. The probability of being on "Work and Benefits" is the highest in Sweden; and the probability of being on "Benefits Only" is the highest in Austria. These results are consistent with my findings from Chapter II.

6.2 Selectivity-corrected Work Only, all Male Respondents ages 50-65

In this set of equations, the outcome equation (equation (2)) estimates the probability of "Working Only" in the second period. The set of exogenous covariates x_i includes the same variables as the ones from the initial work status equation, but without the country of residence. Additionally, the initial work status is interacted with dummy variables equal to one if the respondent experienced a positive health shock of different magnitudes.

Table 33 provides the estimated coefficients on the initial labor force status dummy variables (in the first period) and the factor loadings associated with the latent factors for the probability to work at all in the second period.

Table 33: Initial Work Status and Factor Loading Parameters: Probability of Working Only

	Eq (Func5p)	Eq (Func10p)	Eq (Func15p)
Reference (Work Only)			
Work and Benefits (WB)	-1.903	-2.878	-1.716
	(0.007)	(0.004)	(0.002)
Benefits Only (BO)	-6.939	-6.219	-6.879
	(0.008)	(0.005)	(0.007)
LambdaWB	-1.374	0.054	-2.021
	(0.008)	(0.004)	(0.003)
LambdaBO	1.660	1.665	1.211
	(0.006)	(0.003)	(0.003)

These results confirm that, after controlling for selection on unobservable traits, rmale respondents who are on "Work and Benefits" in the first period are less likely to work at all in the second period compared to respondents who were "Working Only". The associated lambda parameter is negative (in the first and third equations), indicating that the workers who chose the "Work and Benefits" options in the first period were less likely to work than a random individual. Unsurprisingly, the respondents who were on "Benefits Only" in the first period are extremely less likely than the respondents who are working only to have any kind of paid work in the following period. The negative effect of being out of the workforce on the probability of working is even more marked once the endogenous selection is controlled for, since, on average, respondents in this labor force status are ceteris paribus on average more willing to work than a random person (reinforcing the hypothesis of the existence of a "benefits trap")[44].

Table 34: Marginal Effect of the Covariates on the Probability of Working Only (Male Respondents 50-65)

	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Functioning Stock	0.289***	0.274***	0.301***
	(0.001)	(0.000)	(0.000)
Age	-0.045***	-0.063***	-0.041***
	(0.000)	(0.000)	(0.000)
Reference (Education: Low)			
Education: Medium	-0.026***	-0.021***	-0.013***
	(0.000)	(0.000)	(0.000)
Education: High	-0.001***	0.019***	0.027***
	(0.000)	(0.000)	(0.000)
Education: Very High	0.093***	0.067***	0.090***
	(0.000)	(0.000)	(0.000)
Reference (Working Only in P1)			
Work and Benefits in P1	-0.131***	-0.168***	-0.093***
	(0.000)	(0.000)	(0.000)
Benefit Only in P1	-0.695***	-0.662***	-0.631***

[44] Across all three equations, the magnitude of LambdaBO is mall compared to the size of the parameter on "Benefit Only", implying that not correcting for selectivity (with a logit model on the probability to work at all) would yield similar results.

	(0.001)	(0.000)	(0.000)
	Pr(WorkOnly)	Pr(WorkOnly)	Pr(WorkOnly)
Reference (Wave=1)			
Wave=2	-0.078***	-0.071***	-0.063***
	(0.000)	(0.000)	(0.000)
Wave=4	0.057***	0.046***	0.045***
	(0.000)	(0.000)	(0.000)
Wave=5	0.076***	0.046***	0.046***
	(0.000)	(0.000)	(0.000)
Reference (Control Group)			
Functioning Increase 5%	0.077***		
	(0.000)		
Functioning Increase 10%		0.078***	
		(0.000)	
Functioning Increase 15%			0.098***
			(0.000)

Notes: *** p<0.01, ** p<0.05, * p<0.1 All predictors at their mean value. Functioning Stock represents the Functioning Stock in the first period, as a continuous variable ranging from 0 to 1; The seven 1997-ISCED education levels are recoded into three broader categories: "low" (pre-primary and primary education; ISCED 0 to 1), "medium" (lower secondary education; ISCED 2), "high" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "very high" (first and second stage of tertiary education; ISCED 5 and up); Age at Interview is a discrete variable equal to the age f the respondent at the date of the interview. The country and wave dummies correspond respectively to the country of residence of the respondent and the wave in the first period. The control group is composed of respondents whose functioning stock decreased or stayed constant across the 2 consecutive waves.

All coefficients are significant at the 1% level. Younger respondents and respondents with a higher functioning stock or a higher level of education are more likely to “work Only” in the second period. The negative coefficient on “Wave=2” is explained by the longer elapsed time between wave 2 and the following wave (4 years instead of 2 years for the other waves). As presented in the previous table, being on “Work and benefits” and most of all in the “Benefits Only” category in the first period has a very strong negative impact on the probability to work in the second period. On average across all predictors, the probability of working increases with the magnitude of the increase in the functioning stock.

I now focus on the impact of an increase in functioning on the probability to work, as a function of the labor force status in the first period. Table 35 presents the marginal effects of positive health shocks by increasing magnitude, by initial work force status:

Table 35: Average Marginal Effect of Positive Health Shocks, by Initial Work Force Status, on the Probability to Work Only

Initial Workforce Status	Eq (Func5p)	Eq (Func10p)	Eq (Func15p)
Work Only	0.018***	0.026***	0.042***
	(0.000)	(0.000)	(0.000)
Work and Benefits	0.078***	0.131***	0.248***
	(0.000)	(0.001)	(0.001)
Benefits Only	0.007***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)

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

NOTE: All covariates at their mean value for the labor force status considered

As can be seen on this table, a positive health shock will not substantially affect the probability of working for a male individual who was either working only or out of the work force in the first period. However, workers who are in the “Work and Benefits” appear to be largely responsive to an increase in their functioning stock. When on “Work and Benefits” in the first period, the probability of “Working Only” increases by respectively 7.8%, B.1%, and 24.8%, after experiencing a 5%, 10%, or a 15% increase in his functioning stock. These results are presented graphically in Figure 13.

7. Conclusion

Retirement or disability were traditionally described as a one-way transition between a situation of full employment to a situation where the individual is fully inactive, for people who are older or not fully able to work. But over the last decades, hybrid labor force systems, incentivizing work together with the receipt of benefits, have been implemented to improve the

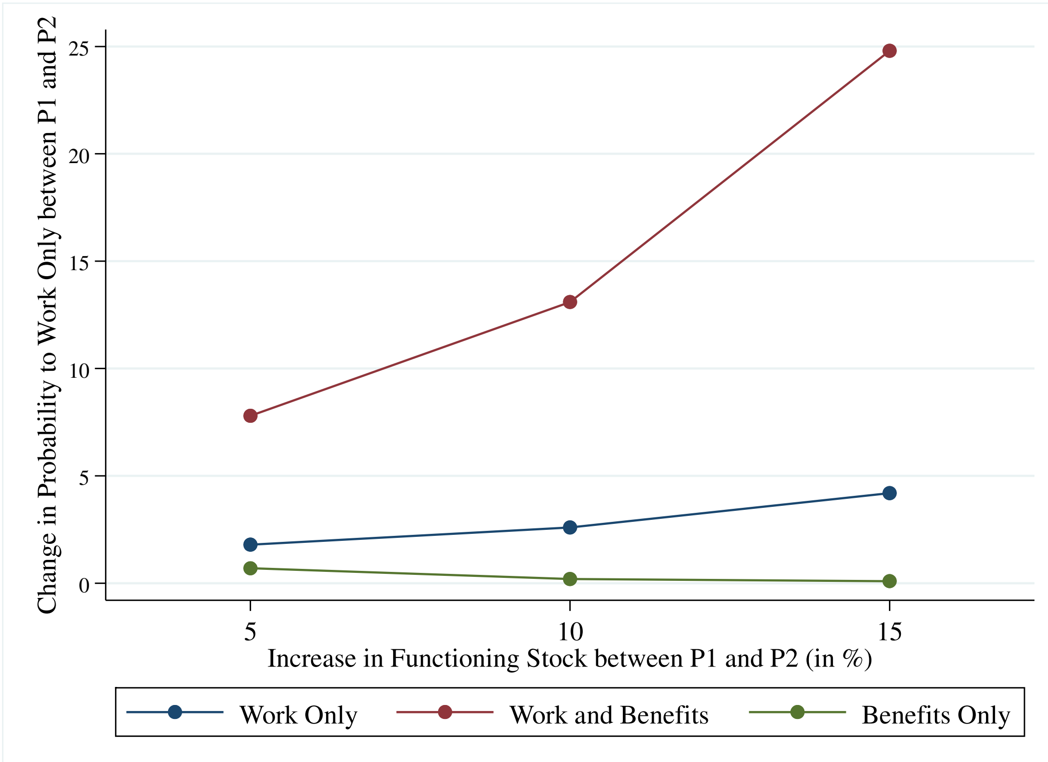

Figure 13: Increase in Probability to Work Only by Positive Health Shock Intensity and Initial Work Force Status

sustainability of pension systems. In this chapter, I investigated the determinants of the probability of working for middle-age male individuals in Western Europe, and identified another advantage of this composite labor force status. I found that male individuals who have completely exited the labor force are dramatically less likely to transition back to work in the future than their counterparts who have maintained at least a partial connection with work. And, most importantly, the impact of the initial work force status is magnified in the case of an improvement in health: male individuals whose mental or physical capacities improve[45] and who were working while receiving benefits are about 25% more likely to have work as only source of income in the following two-year period than comparable individuals whose health did not improve, while these numbers hover around zero for males who had severed all ties with work, suggesting the existence of a "benefit trap". This flexible benefit scheme, enabling work and the receipt of benefits, appears to perform the dual function of "catch and release": it cushions individuals from the impact of a decline in health with the receipt of benefits, while safeguarding the connection with work, thus allowing closer alignment of the individual's work trajectory with their preferences and capacities.

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Appendix

C.1 Results for Model including Men and Women

Table 36: Marginal effects in MMNL Initial Labor Force Status (All respondents ages 50-65)

Variable	"Work Only"	"Work and Benefits"	"Benefits Only"
Functioning Stock in P1	0.941***	-0.095***	-0.846***
	(0.046)	(0.024)	(0.039)
Female	-0.033***	0.030***	0.003
	(0.011)	(0.006)	(0.010)
Age	-0.064***	0.008***	0.056***
	(0.001)	(0.001)	(0.001)
Education: Medium	0.034*	0.012	-0.046***
	(0.020)	(0.011)	(0.017)
Education: High	0.111***	0.000	-0.110***
	(0.017)	(0.009)	(0.014)
Education: Vey High	0.259***	(0.012)	-0.246***
	(0.018)	(0.010)	(0.016)
Germany	0.161***	0.045***	-0.206***
	(0.018)	(0.010)	(0.014)
Sweden	0.294***	0.096***	-0.389***
	(0.019)	(0.010)	(0.017)
Spain	0.145***	(0.010)	-0.135***
	(0.024)	(0.014)	(0.020)
Italy	0.133***	(0.008)	-0.125***
	(0.018)	(0.012)	(0.015)
France	0.110***	0.001	-0.110***
	(0.016)	(0.009)	(0.013)
Denmark	0.221***	0.022**	-0.243***
	(0.016)	(0.009)	(0.014)
Switzerland	0.376***	0.044***	-0.421***
	(0.018)	(0.010)	(0.017)
Belgium	0.010	0.039***	-0.049***
	(0.016)	(0.010)	(0.013)
Wave = 2	0.018	0.004	-0.022*
	(0.015)	(0.009)	(0.013)

Wave = 4	0.074***	0.007	-0.081***
	(0.017)	(0.010)	(0.014)
Wave = 5	0.092***	(0.007)	(0.013)
	(0.014)	0.000	0.000

Table 37: Marginal Effect of the Covariates on the Probability of Working Only (All Respondents 50-65)

	Pr (WorkOnly)	Pr (WorkOnly)	Pr (WorkOnly)
Functioning Stock	0.208	0.264	0.285
	(0.001)	(0.000)	(0.000)
Female	-0.017	-0.014	-0.017
	(0.000)	(0.000)	(0.000)
Age	-0.002	-0.032	-0.022
	(0.000)	(0.001)	(0.000)
Reference (Education: Low)			
Education: Medium	-0.012	-0.021	-0.013
	(0.000)	(0.000)	(0.000)
Education: High	0.012	0.019	0.026
	(0.000)	(0.000)	(0.000)
Education: Very High	0.061	0.067	0.089
	(0.000)	(0.000)	(0.000)
Reference (Working Only in P1)			
Work and Benefits in P1	-0.054	-0.166	-0.089
	(0.000)	(0.000)	(0.000)
Benefit Only in P1	-0.697	-0.661	-0.631
	(0.000)	(0.000)	(0.000)
Reference (Wave=1)			
Wave=2	-0.042	-0.070	-0.061
	(0.000)	(0.000)	(0.000)
Wave=4	0.048	0.046	0.045
	(0.000)	(0.000)	(0.000)
Wave=5	0.042	0.045	0.045
	(0.000)	(0.000)	(0.000)
Reference (Control Group)			
Functioning Increase 5%	0.044		
	(0.000)		
Functioning Increase 10%		0.076	
		(0.000)	
Functioning Increase 15%			0.094

	(0.000)

Table 38: Average Marginal Effect of Positive Health Shocks, by Initial Work Force Status, on the Probability to Work Only (All Respondents Ages 50-65)

Initial Workforce Status	Eq (Func5p)	Eq (Func10p)	Eq (Func15p)
Work Only	0.027***	0.026***	0.041***
	(0.000)	(0.000)	(0.000)
Work and Benefits	0.114***	0.139***	0.259***
	(0.000)	(0.001)	(0.001)
Benefits Only	0.000***	0.002***	0.001***
	0.000	(0.000)	(0.000)

General Conclusion

Returning to the general question of the impact of reverse causation on the Health-Wealth gradient, I presented an extension of Smith (2005)'s set of two equations[46] at the beginning of Chapter II showing current SES for each individual residing in a given country, as reflecting a dynamic history of health, SES, and other relevant forces. . In particular, if we were to represent the gradient graphically with a measure of current SES on the x-axis and a measure of current health on the y-axis, the steepness of the gradient would be accentuated by high levels α_3 for given values of β_3. I proposed that the magnitude of α_3 for negative health shocks ($\alpha_3 N$) could be used to measure a country's or a group of countries' ability to cushion its population from health problems, and that the magnitude of α_3 for positive health shocks ($\alpha_3 P$) would represent the country's or a group of countries' propensity to let its population capitalize on a health recovery. Hence best performing institutions in terms of the Health to Wealth relationship would be those having both $\alpha_3 N$ with a small magnitude and $\alpha_3 P$ with a large magnitude as represented in Figure 14 (b).

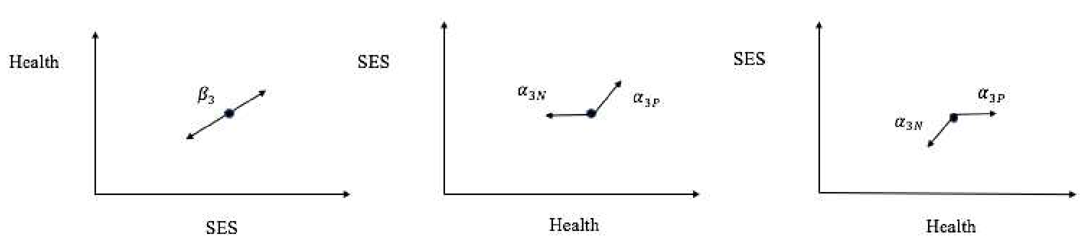
In Chapter II, I have investigated the magnitude $\alpha_3 N$ across levels of education and across countries of residence. I have found that the rates of people left without labor income or benefits are extremely low in every country considered, limiting the magnitude of $\alpha_3 N$ overall in the countries under review. Additionally, assuming the loss of earned income is not fully compensated by benefits, I have inferred that in the short term, "reverse causation" for negative health shocks could be steepening the slope of the SES-Wealth gradient for workers with a

[46] $Y_{it} = \alpha_0 + \alpha_1 H_{it-1} + \alpha_2 Y_{it-1} + \boldsymbol{\alpha_{3N}} \Delta HNeg_{it} + \boldsymbol{\alpha_{3P}} \Delta HPos_{it} + \alpha_4 X_{it-1} + u_{1it},$

$H_{it} = \beta_0 + \beta_1 H_{it-1} + \beta_2 Y_{it-1} + \beta_3 \Delta Y_{it} + \beta_4 X_{it-1} + u_{2it}$

middle range level of education (larger $\alpha_3 N$) and leaving it unaffected for low and high-levels of SES (smaller $\alpha_3 N$). I also concluded that without delving into the complexities of the country-specific social insurance systems and the associated variation in benefit generosity, it was impossible to teach conclusions about the relative magnitude of short term reverse causation across countries. However, two groups of countries stand out in the way they maintain a connection with work for employees experiencing a decline in health. On one hand, health impaired workers in Switzerland are the most likely to remain on their employer's payroll (implying a smaller $\alpha_3 N$). On the other hand, a hybrid labor force status is prevalent in a subset of countries, where a substantial fraction of health impaired workers start receiving benefits but do not sever all work ties. I further hypothesized that this difference in outcome could be crucial to assess the longer-term impact of health shocks.

In Chapter III, I investigated the magnitude of $\alpha_3$for positive health shocks ($\alpha_3 P$), which could represent the country's or a group of countries' propensity to let its population capitalize on a health recovery. I found that among the three possible work force statuses ("Work Only", "Benefits Only", or "Work and Benefits"), only workers on "Work and Benefits" were significantly likely to leverage a recovery and reenter the workforce after an episode of disability. From this result, I can conclude that countries favoring hybrid labor force statuses as a transition out of full activity should present a higher $\alpha_3 P$. This is typically the case of Sweden.



(a) SES to Health
(b) Health to SES Decreasing Slope of Gradient
(c) Health to SES Increasing Slope of Gradient

Figure 14: Conceptual Decompostion of the Slope of the Health-SES gradient

As European populations age and become more frail, results from this dissertation suggest that the impact of reverse causation should steepen the health-wealth gradient, particularly for individuals with secondary school education. To limit this effect, public policies should (1) mitigate the occurrence of health shocks in the first place, (2) support individuals who wish to continue working as long as they are physically and mentally able, and (3) offer hybrid solutions that incentivize work together with the receipt of benefits to health impaired individuals. Other European countries could draw on the experiences of Switzerland and Sweden, who have proven to be the most successful at implementing such policies.