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Abstract

We investigate the long-term effects of macroeconomic crises experienced during prime working age (20 to 50) on health outcomes later in life using data from eleven European countries. Experiencing a severe crisis in which GDP dropped by at least 1% significantly reduces health later in life. Specifically, respondents hit by such a shock rate their subjective health as worse, are more likely to suffer from chronic diseases and mobility limitations, and have lower grip strength. The effects are larger among low-educated respondents. Experiencing a crisis year decreases the probability of being in good health later in life equivalent to being two years older in the overall sample or four years older in the low-educated subsample. Highly educated respondents' health is not affected by economic crises and additionally economic booms have a positive effect on their health. An analysis of critical periods in life reveals that in particular crises experienced later in the career (between age 40 and 50) matter for health. Extensive robustness checks show that our results are not driven by general improvements in health during the post-war years.

Keywords: SHARE; Health; Macroeconomic Conditions; Long-run Effects
JEL: I15; J14; N14

1 Introduction

The recent economic crises and high unemployment rates especially among young Europeans have spiked a debate about the short- and long-term effects of macroeconomic conditions on population well being. In this paper we want to contribute to this debate by reporting evidence of negative long term effects of past economic crises experienced during prime working age on health later in life.

Economic crises are seen as times of severe economic downturn, i.e., times of low economic growth and high unemployment. Generally, they are perceived to put a burden on population health. Shocks to wealth and income, less access to social protection and health care, and an increase in stress due to job loss or job insecurity are detrimental for health.[1] On the other hand, aggregate mortality has been shown to be positively correlated with business cycle fluctuations: in times of economic growth mortality increases and in recessions mortality declines (see, e.g., Ruhm 2000, 2005). The explanations put forward are that during economic downturns opportunity costs of time decrease and individuals may follow healthier lifestyles, i.e. smoke and drink less and spend more time exercising and eating healthy. Additionally, there are fewer costs due to external effects like pollution and congestion that cause detrimental effects on health. The academic debate about the cyclical movements of mortality is still ongoing.[2] Most of the studies so far only consider immediate or very short term effects of economic crises (up to a four year lag, e.g., Ruhm 2000, Gerdtham and Ruhm 2006).

Fewer studies have looked into the long-term effects of economic fluctuations because of important identification issues. In particular, it is very complicated to identify a proper control group, since when a crisis hits a country, it might potentially affect all its citizens. One way to overcome this problem is to consider crises experienced during critical periods in life such as early childhood. Favorable economic conditions at the time of birth have been found to lower mortality and increase cognitive functioning later in life (see, e.g., van den Berg et al. 2006, 2009, Doblhammer et al. 2011). The reasons put forward are related to the quality and quantity of nutrition and access to health care and the hygiene situation in early life. Adverse factors in turn cause a higher exposure to disease and increase the stress levels which have a long-term negative effect on health. The effect is particularly strong for individuals with low education.

[1] See, e.g., Sullivan and von Wachter (2009), Schwandt (2014) for recent evidence on the negative effects of unemployment and stock market fluctuations on individual's health, respectively.

[2] See, e.g., Stevens et al. (2011) or Ruhm (2013) for recent contributions and Ruhm (2012) for a review of the literature. Results, for example, differ by period of study, the selection of countries and their level of social protection (Stuckler et al. 2009), business cycle indicator, cause of mortality and the data used (individual outcomes vs. aggregate mortality).

Another critical period is early adulthood when individuals make the transition from school to work. Unfavorable economic conditions during this period may lead to worse labor market trajectories for those cohorts compared to cohorts graduating during a boom (see, e.g., Kahn 2010, Oreopoulos et al. 2012). This in turn might lead to worse health outcomes later in life (see, e.g., Hessel and Avendano 2013, Cutler et al. 2014).

While it is important to know how macroeconomic conditions at critical periods in childhood and early adulthood influence outcomes later in life, little is known about the (long-term) effect of crises experienced during adulthood on individuals' health. Our objective is to study the effects of severe macroeconomic shocks which occur during the years when a person is most likely to be active on the labor market (age 20 to 50) on various health outcomes later in life. While there is some overlap between our study and studies investigating the effects of crises during early adulthood, we can add a layer of complexity by first looking into the effects of adverse conditions during adulthood in general. In a second step we split this rather large period into smaller age windows to look for critical periods. In particular, we control for crises experienced during different age windows simultaneously to see which periods are the most sensitive for individuals' health later in life. Leist et al. (2013) use a very similar approach to analyze the effect of business cycle fluctuations on cognitive functioning using data from 11 European countries. They find a negative effect of downward fluctuations of the business cycle on cognitive abilities for women experienced in early and mid adulthood and negative effects of recessions experienced after age 45 for men. The proposed mechanisms are that men have a higher probability to experience a lay-off, whereas women have a higher downward occupational mobility and are more likely to work part-time.

Our approach differs from the previous literature in some central respects. First, we look into various different physical and mental health measures to get a broader picture of the effects of macroeconomic conditions on health later in life. Second, in contrast to previous studies, we are not interested in the effects of business cycle fluctuations but want to focus only on severe macroeconomic shocks. We define crises as the 5% worst years in terms of GDP growth experienced in Europe during the period 1954 to 2004. The effect of economic fluctuations is identified by comparing different cohorts across different European countries. As in van den Berg et al. (2009) and Doblhammer et al. (2011) the identification comes from the cohort specific deviation from their (country specific) long term health trend. Third, different from these studies we do not focus on economic crises around birth but on those crises that hit the cohorts of interest during their working life.

We use the first and second wave of the Survey of Health Ageing and Retirement in Europe (SHARE) to shed some light on this relationship. Specifically, we use individ-

ual level data from more than 20,000 individuals aged 50 and older from 11 European countries with different labor market and social policies. We match information about the number of country-specific macroeconomic crises during individuals' working years (age 20 to 50) to the SHARE data. We focus on respondents between age 50 and 70 at the time of the interview. Differing crisis periods between European countries make our study particularly powerful. Furthermore, the SHARE data offers a very rich set of health variables. While our main analysis focuses on self-reported health outcomes, we are also investigating the effects of crises on a larger set of objective health measures, specifically the number of chronic conditions, the number of symptoms, limitations in the instrumental activities of daily living (IADL), mobility limitations, depressive symptoms, grip strength, and recall abilities as a proxy for cognitive functioning.

We find a significant negative effect of the number of crises experienced between age 20 and 50 on self-reported health later in life. Respondents hit by such a shock rate their health as significantly worse compared to respondents who experienced no severe macroeconomic shocks. The effect of experiencing one additional severe crisis is approximately equivalent in size to becoming two years older. Moreover, respondents who experienced a severe macroeconomic downturn suffer from more symptoms, such as fatigue or pain, report more chronic health problems and mobility limitations, have lower grip strength and lower recall abilities. The effects are substantially stronger for respondents with low education. For them, one more crisis year leads to a decrease in self-reported health equivalent to about four more years of age. Moreover, we find a significantly higher number of symptoms and a decrease in grip strength more or less equivalent to 1.5 more years of age.

Only severe crises—such as those measured as the worst 5% of all crisis years in all countries—have an effect on population health. If we relax the crisis definition and instead include the worst 10% of the crisis years, the effects on health become smaller and insignificant. Thus, only severe (enough) crises seem to have a long-term impact on people's health. Splitting the crises period into smaller 5-year intervals shows that in particular crises experienced between age 40 and 50 are negatively related to health later in life. The results are robust to various specifications. For instance, we account for selective mortality and for the effects of World War II. We also perform a sort of placebo test using childhood socio-economic and health conditions as dependent variables. We take this as evidence that general cohort trends in health are not driving our results.

Our paper proceeds as follows. In section 2 we will introduce the SHARE data set, the variables we use, and our measure of macroeconomic crises. Section 3 describes the empirical strategy. In section 4 we will present our results followed by some robustness

checks in section 5 and a conclusion in 6.

2 Data

2.1 SHARE data

We use data from the Survey of Health, Ageing and Retirement in Europe (SHARE), a multidisciplinary and cross-national bi-annual household panel survey coordinated by the Munich Center for the Economics of Aging (MEA) with the technical support of CentERdata at Tilburg University.[3] The survey collects data on health, socio-economic status, and social and family networks for nationally representative samples of older people in the participating countries. The target population consists of individuals aged 50 and older who speak the official language of each country and do not live abroad or in an institution, plus their spouses or partners irrespective of age. Our data are from release 2 of the first two waves (2004 and 2006) of SHARE.

Our sample consists of the respondents of wave 1 (conducted in 2004) and the refreshment sample of wave 2 (conducted in 2006) residing in eleven European countries, namely, Sweden, Denmark, the Netherlands, Austria, Germany, France, Switzerland, Belgium, Greece, Spain, and Italy. We are observing each participant only once. The use of the refreshment sample from wave 2 is not only meant to increase the sample size but to help us to disentangle age effects from cohort effects.[4] We restrict our sample to those who were born in the period 1934-1954, so they are between the age of 20 and 50 in the period between 1954-2004 and they are between 50 and 70 years old at the point of the first wave data collection. We do not include individuals older than 70 in the sample since it could raise the selective mortality problem.[5] Our sample consists of 17,781 respondents from wave 1 and 5,099 respondents from wave 2.

2.2 Macroeconomic crises

While in general the period of 1954-2004 was characterized by post-war economic growth all over Europe, some serious macroeconomic recessions still happened during this period. Among the most serious is the oil crisis 1973-1975, when the members of Organization of Arab Petroleum Exporting Countries proclaimed an oil embargo in response to the U.S.

[3]For information on the data collection and methodology see Börsch-Supan et al. (2005), Börsch-Supan and Jürges (2005) and Börsch-Supan et al. (2013).

[4]Each cohort is two years older in wave 2. For instance the 1954 cohort is 50 years old in 2004 and 52 in 2006.

[5]We comment further on the problem of selective mortality in the section on identification and the robustness checks.

decision to re-supply the Israeli military forces. The price of oil quadrupled, followed by a stock market crash and economic recessions in many European countries. Another prominent crisis is the European Monetary System crisis of 1992-1993. The crisis was catalyzed by the reunification of Germany in 1990, an event unprecedented in history for the amalgamation of a large, rich economy with a smaller economy with a much lower standard of living. This event increased the interest rate in Germany, distorted the currency exchange balance between members of the European Monetary System and caused a severe economic crisis. Additionally, there were a couple of more country specific crises in this period. We construct several measures that account for macroeconomic shocks persons experienced during their working lives. For our main analysis we define crisis years based on real GDP per capita data. In section 4.4 we also employ alternative definitions of crises based on the mean GDP growth and the mean unemployment rate experienced in certain periods.

GDP per capita is a widely used measure of macroeconomic conditions.[6] We take data on GDP per capita in 1990 PPP-adjusted dollars from the Agnus Maddison historical statistics on world population.[7] We use the data for the period 1954-2004 since this is the period when the SHARE respondents in our sample were aged 20 to 50. Relative changes in GDP ($\frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$) are calculated. Table 1 provides some critical values of the distribution of the relative change in GDP over the period from 1954 to 2004 for the countries included in our analysis.[8] Average GDP growth in this period was around 2.6% per year.

Table 1: Distribution of the yearly changes in real PPP-adjusted GDP in the period 1954-2004 in 11 European countries

Percentile of the dist.	1%	5%	10%	50%	90%	95%	99%
% Δ GDP	-2.75%	-0.95%	-0.09%	2.59%	5.71%	6.85%	10.10%

Note: The data are taken from the Agnus Maddison historical statistics on world population on (http://www.ggdc.net/MADDISON/oriindex.htm).The countries included are Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, and Switzerland.

We define several indicators for crises and booms in this period. Our standard measure is the following: we define the worst 5% of the years in terms of GDP dynamics as "crisis years". The worst 5% of the country-years in terms of GDP growth correspond

[6] See, for example, Barro and Ursua (2012).

[7] Data can be downloaded on (http://www.ggdc.net/MADDISON/oriindex.htm).

[8] Germany is treated as one country in this data base even though it was separated into East and West between 1949 and 1990. We ran all our regressions dropping respondents from east Germany and also dropping Germany completely and our results are not changed. Therefore, we decided to keep the macroeconomic data for Germany as it is despite this flaw.

approximately to the years when GDP dropped by at least 0.95% compared to the previous year. Table A1 in the Appendix lists the years of crises by countries. Even though some crises were common for many countries, there is still a sufficient geographical and between-cohort variation in the number of crises. This can also be seen from figure 1. We show the average number of crises per cohort of birth by country. The number of crises experienced between 20 and 50 varies from 0 (in Austria) to 5 (in Switzerland). In order to understand the sensitivity of our results to the crisis definition we change the threshold and redefine crises as worst decile of the country-years of the considered period (1954-2004). In this case years with a GDP drop larger than 0.09% are considered crises years. Moreover, in some specifications we analyze the effects of economic booms experienced between 20 and 50. "Boom years" are defined as the 5% best years in terms of GDP growth. In those years GDP per capita increased by at least 6.85%. The variation in the number of crises and booms by country and cohort is displayed in figure 1.[9]

Finally, we split the period 20 to 50 into 5-year intervals to check if crises that hit individuals in certain critical periods within their working life have different impacts. Thus, we construct indicators of experiencing a crisis at age 20–25, 26–30,..., 46–50 and include them as regressors simultaneously. Additionally, we create alternative period specific measures based on the mean GDP growth and the mean unemployment rate experienced in those periods. The summary statistics for these measures are reported in table A2 in the Appendix.

2.3 Health measures and covariates

Our main dependent variable is a self-rated health measure. Respondents are asked to evaluate their current health on a 5-point scale from "1-excellent" to "5-poor". Our indicator takes value 1 if the self-reported health was "1-excellent" or "2-very good" and 0 otherwise. Self-reported health status is among the most common measures used in public health surveys; it reflects various physical, emotional, social aspects of health and well-being and has been found to predict mortality (see, e.g. Idler and Benyamini 1997, Jylha 2009). About 37% of the respondents in our sample rate their health very good or better (see table A2 in the Appendix).

In addition to that we provide analyses of a variety of other more objective health measures. The variable symptoms reports the number of symptoms that respondents

[9]As mentioned in the introduction, we are not using the country specific worst x% of the years, since then the number of crises for each country in the 50-year period would be identical. There would be variation in the crises strength between countries and in some cases "artificial" crisis years could be created for some cohorts not affected by a recession. Since our purpose is to evaluate the effect of recessions years and not of business cycle fluctuations, the approach described above is the correct one.

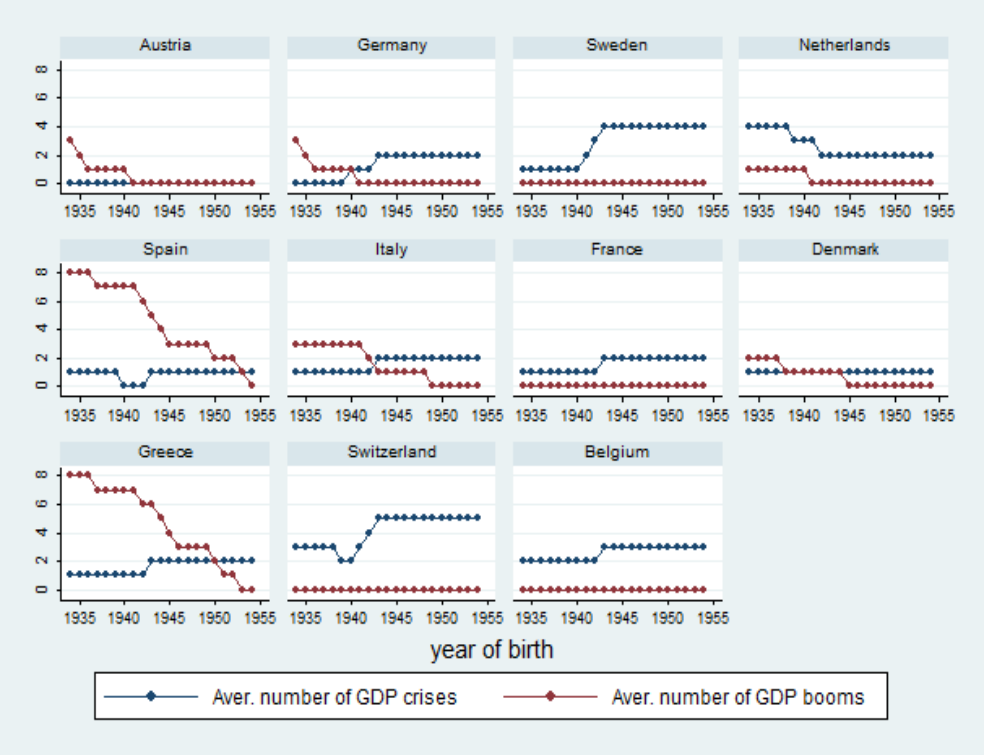

Figure 1: GDP crises and booms over birth cohorts, by countries

experienced in the last six months from a suggested list of 12 symptoms, such as fatigue, pain in the back, heart trouble, sleeping problems, etc. We also have measures of the number of chronic conditions (including high blood pressure, heart attack, diabetes etc.), limitations in the instrumental activities of daily living (IADL), the number of mobility limitations, the number of depressive symptoms, a measure of cognitive functioning (i.e. memory), and grip strength. Grip strength reflects the overall muscle status of the respondent and has been linked to mortality in previous research (see, e.g., Gale et al. 2007). It is our most objective measure of health since the task is performed during the interview. In the table B1 of the Appendix we list the exact definitions of all health variables and table A2 presents the summary statistics.[10]

Covariates. Besides the health and crisis measures we additionally use information on country of residence, gender, year of data collection, and birth year. Educational attainment is differentiated between low education—primary and lower secondary education (ISCED level 0-2), middle education—upper secondary and non-tertiary post secondary education (ISCED level 3-4), and high education—tertiary education (ISCED level 5-6). In a robustness check we use data on childhood health and socio-economic circumstances, namely we have measures of respondents' height, their self-reported health at age 10, and

[10]For an overview of all variables available in SHARE wave 1 and 2 see the questionnaires available on (www.share-project.org.)

their father's occupation. Table A2 reports descriptive statistics for the covariates.

3 Empirical strategy

3.1 Empirical specification

The identification of the effect of interest is based on the deviations of the cohorts affected by a macroeconomic shock from their country specific health trend. This empirical strategy has been already applied in the literature, e.g., when estimating the effects of macroeconomic shocks around birth (Doblhammer et al. 2011). A very similar identification strategy can be also found in Giuliano and Spilimbergo (2014) who investigate how macroeconomic regional shocks during "impressionable years" (18-25 years old) affect individual beliefs about success in life.

More specifically, we estimate the following equation:

$$Y_{isc} = \beta_0 + \beta_1 M_{sc} + \beta_2 X_{isc} + \delta_c + f(s,c) + u_{isc}$$

where Y_{isc} is the health outcome of individual i born in year s in country c; M_{sc} measures the macroeconomic crises (or booms) experienced during ages 20 to 50; in our baseline specification this is a variable counting the number of crises and booms. In the specifications presented in section 4.4 M_{sc} is a vector of dummies indicating if a crises hit in the age intervals from 20–25, 26–30.... and 46–50. The crises measures thus indicate if respondents experienced at least one year with a GDP drop larger than 0.95% in the respective period. In two alternative specifications we also use the average GDP growth and the mean unemployment rate experienced in those age brackets. X_{isc} contains other control variables, such as gender and survey wave. We also control for country fixed effects, δ_c, and country-specific polynomial trends (linear and quadratic) in birth cohort $f(s,c)$. We estimate the model separated by sex and educational level to evaluate the presence of heterogeneity in the effect of interest.

We present marginal effects derived after estimating probit models in all tables except table 4. Here linear models are estimated for the alternative health measures.

3.2 Identification issues

Since the identification of the effect of interest comes from variation between cohorts and countries the main concern is that we are picking up other country and cohort specific trends in health that are correlated with the number of crisis in the years. Looking at

the trends in population health in Europe shows that health improved substantially over time but the patterns were quite different among the countries. At the same time figure 1 shows that the number of crises seems to have increased by cohort while the number of booms decreased for most of the countries considered. Thus, it is essential to control for country-specific trends in health. In this way, we are able to control for a wide variety of unobservable factors that might affect health and avoid spurious correlations with our macroeconomic indicator. As mentioned before, in our main specification we include linear and quadratic country specific trends in health (which is the standard in this literature). In our robustness checks we play around with different trend specifications and show that results are robust to this variation.

Another way to check if we are confounding the effect of the crises with other cohort predetermined characteristics that affect health later in life is by looking at the effects of crises on childhood health. The idea is that macroeconomic crises experienced during working life should be unrelated with childhood health. In this sense our robustness check in section 5 should be interpreted as a sort of placebo test.

Another point of concern is selective mortality since our sample is composed of individuals aged 50 and older. As already discussed in the introduction section, Ruhm (2000) has shown that in the short run mortality shows pro-cyclical fluctuations. This might imply that at the time of observation those cohorts who experience worse macroeconomic condition during their working years are positively selected by mortality. On the other hand, in the same paper Ruhm argues that these unfavorable health effects are partially or fully offset in the medium term if the economic growth is long-lasting. It means that in the presence of selective mortality the direction of the bias is not clear. We try to take this problem into account by including cohort-specific survival rates. Such a strategy should also solve the selection effect due to the Second Word War (WWII). In this second case, the main concern is that our results might be driven by the fact that some of the cohorts involved in this study are born during the years of WWII. Previous research has shown that even today there are measurable effects of experiences during the war on health outcomes of those cohorts (Kesternich et al. 2014). As a robustness check we restrict our analysis on the post-war cohorts only. The results from all the robustness checks are shown in section 5 and they never cast doubt on our identification strategy.

4 Estimation results

4.1 Baseline results

In this section we present empirical evidence in order to reveal whether economic crises during working years have a causal effect on health outcomes later in life. In most tables we display marginal effects after running probit models where the dependent variable is "being in good health". Our baseline specification includes controls for gender, wave, a full set of country dummies and country-specific linear and quadratic trends in age. We calculate robust standard errors clustered at the household level.

Table 2 presents the effect of the number of crises in the overall sample and separately by gender and education levels. Each cell in the table represents results from a separate regression. Marginal effects for the full set of controls are reported in table A3 in the appendix. In the first cell of column (1) we present our baseline results for self-reported health. An increase in the number of severe macroeconomic crises significantly decreases the probability to report good health later in life by about 2.3%. Even though this might seem small, the effect of one additional crisis year on self-reported health is equivalent to becoming almost 2 years older (see table A3).[11]

Separating the effects by education in column (1) reveals that the effect of macroeconomic crises on health is primarily driven by individuals with low levels of education. Among the low educated, experiencing an additional crisis during working life decreases the probability to report good health by 4.2%. That is almost twice the effect in the overall sample and it is equivalent to about 4 more years of age in terms of health among the low educated. The effect is substantially smaller and insignificant among those with higher educational levels.

The influence of macroeconomic shocks on health later in life is somewhat larger for women than for men (see columns 2 and 3). However, analyzing the interaction with education demonstrates that this is driven by differences in the level of education between men and women. Low educated men and women are about equally affected by experiencing crises during their working lives while the effects of crises for men and women with higher levels of education both are zero.

[11]The baseline sample consists of all individuals who have lived in the country of current residence after age 20 and who have worked at least once in the period between 20 and 50. Including those who never worked reduces the effect of crisis on health see column (2) in table A4 in the appendix. This seems plausible since individuals who never worked are less exposed to macroeconomic fluctuations. In our baseline regression we also exclude migrants who entered the country after age 20 because, first, migration can be related to macroeconomic conditions both in the country of origin and the country of migration and, second, we cannot precisely estimate by which crises these persons were affected. Including the migrants (column 3 in table A4 in the appendix) reduces the effect of crises on health further and renders it insignificant.

Table 2: Average marginal effects of crises on the probability to report good health by levels of education and gender

	(1) All	(2) Males	(3) Females
All sample	-0.0225**	-0.0164	-0.0288**
	(0.010)	(0.014)	(0.014)
No. of obs.	22880	11286	11594
Low education	-0.0424***	-0.0386**	-0.0444**
	(0.013)	(0.020)	(0.018)
No. of obs.	9778	4441	5337
Middle education	-0.0149	-0.0040	-0.0235
	(0.019)	(0.026)	(0.026)
No. of obs.	7838	4011	3827
High education	0.0232	0.0394	-0.0099
	(0.025)	(0.034)	(0.039)
No. of obs.	4914	2667	2247

Note: Here and further: average marginal effects are calculated after running probit regression models. Additional control variables are: gender, birth year, squared birth year, wave, country dummies and country-specific linear and quadratic trends in birth year. Standard errors clustered on household level are in parentheses. The number of stars denotes the significance level: * p<0.10, ** p<0.05, *** p<0.01. The variable number of crises is the number of GDP crises experienced between age 20 and 50 where a crisis year is defined as a year in which real GDP in the country dropped by 1% or more with respect to the previous year.

4.2 The effect of crises strength and booms

In this section we investigate whether the intensity of the macroeconomic shocks is an important factor to take into account. We already stressed in the introduction that most of the literature does not distinguish severe macroeconomic shocks from small business cycle fluctuations. One of the reasons why the effects of economic fluctuations on health are not consistent could be that crises are defined in different ways. For this reason we change the criterion to the worst decile of crises years—this corresponds to those years in which GDP dropped by at least 0.09%. Both the results of the regressions with the old and the new crises variable on self-reported health are provided in table 3 for ease of comparison. As before, each cell represents a separate regression result. When we relax the definition of the crisis years and consider also years with smaller drops in GDP, the influence of macroeconomic crunches on health weakens. In the overall sample the effect is about half its original size and insignificant. For individuals with low education the effect is still significant even though it is reduced by almost half. These results suggest that only severe crises significantly harm population health in the long-run.

On the other hand, we would like to understand if booms, that is periods of exceptionally high economic growth, have the reverse effect on health. Booms are defined as the 5% years with the highest growth in GDP in our observation period. According to

Table 3: Average marginal effect of the number of crises of different strength on the probability to report good health

	All	Low educ.	Middle educ.	High educ.
No. of crises (5% worst years)	-0.0225**	-0.0424***	-0.0149	0.0232
	(0.010)	(0.013)	(0.019)	(0.025)
No. of crises (10% worst years)	-0.0107	-0.0230**	-0.0041	0.0135
	(0.009)	(0.012)	(0.015)	(0.020)
No. of booms (5% best years)	0.0318***	0.0300**	0.0286	0.0543*
	(0.011)	(0.014)	(0.022)	(0.029)
Observations	22880	9778	7838	4914

Note: Other controls are as before. A year is considered a crisis year in the 5% (10%)-criterion if in this year real GDP dropped by 1% (0.09%) or more with respect to the previous year; this corresponds to the worst quintile (decile) of crisis years. Booms are defined as the years in which real GDP grew by 6.85% or more with respect to the previous year.

the distribution of the relative changes in GDP, we count a year as boom year if the relative GDP growth was at least 6.85% compared to the previous year (see table 1). The bottom row of table 3 shows the results of a regression of health later in life on economic booms. We find that not only crises but also booms have a long-term impact on subjective health. Experiencing an additional economic boom increases the probability to report being in good health later in life by about 3.2% in the overall population. Effects are significant among the low educated and significant and slightly higher among those with high educational degrees. If we control for booms and busts simultaneously results are consistent.

Overall, our results suggest that people with a high level of education are not severely hit by economic crises and experience positive effects from economic booms. At the same time, those with low levels of education are severely hit by economic crises and moderately profit from economics booms. We do not measure any effects of macroeconomic fluctuations on the health status of persons with medium levels of education.

4.3 Other health outcomes

In addition to self-reported health SHARE provides a rich set of other variables measuring health. In this section we provide evidence of the effects of crises on health outcomes later in life measuring health by the number of symptoms a respondent is suffering from, the number of chronic conditions, grip strength (which is measured during the interview), the number of mobility limitations, limitations in the instrumental activities of daily living (IADL), the number of depressive symptoms, and respondents' recall ability (measured during the interview). The exact variable definitions are provided in the appendix. Linear

models are estimated for all variables.

Overall our results appear to be consistent with previous findings using subjective health as an outcome (see table 4). Respondents who experienced a larger number of crises during their potentially active labor market years report suffering from a larger number of symptoms and more chronic disease compared to those who experienced no or fewer crises. They also show lower grip strength, which is a measure of frailty and has been linked to mortality. They report a larger number of general mobility limitations but no higher probability to suffer from restrictions in the IADL. There are no effects on the probability to report depressive symptoms, but respondents who experienced severe crises have lower recall abilities later in life. As before, the effects are stronger and more frequently significant among those with low levels of educations. Exceptions are a strong negative effect of macroeconomic shocks on the mobility of those with a high level of education and the adverse effect of crises on recall abilities of those with medium levels of education.

Thus, overall we can conclude that the results of crises on health later in life are consistent for a variety of alternative subjective and objective health measures. Those with low education levels are particularly affected by dramatic macroeconomic turbulence experienced over their life-course.

4.4 Timing of crises periods and alternative crises indicators

In this section we would like to understand if crises experienced at different critical periods in the life cycle have different effects on health outcomes later in life. Such critical periods could for example be during childhood and around labor market entry when individuals might be particularly vulnerable to shocks (see, e.g., van den Berg et al. 2006, Cutler et al. 2014 for such analyses).

For this purpose we construct different period specific crisis measures. First we employ a crisis measure similar to the measures used so far. Specifically, we split the period 20 to 50 in six 5-year intervals by creating six dummies that indicate whether the respondent experienced a crisis in a specific age window, from 20–25 to 46–50. We include all dummies simultaneously in the regression. Additionally, we measure the country-specific mean GDP growth rate and the mean unemployment rate in those intervals and use them as alternative measures of macroeconomic conditions during these years.

Results of this exercise are presented in table 5 for the complete sample and separately for the low educated and the middle to high educated. Using the severe crisis indicator shows that especially crises experienced between age 41 and 50 (namely the dummies 41–45 and 46–50) negatively affect health later in life. This effect is once more particularly

Table 4: Average marginal effects of the number of crises on other health outcomes

	(1)	(2)	(3)	(4)
	All	Low educ.	Middle educ.	High educ.
No. of symptoms	0.0523*	0.103**	-0.0404	0.0307
	(0.031)	(0.047)	(0.053)	(0.073)
	22879	9779	7837	4913
No. of chronic diseases	0.0592*	0.0919*	-0.0465	0.115
	(0.032)	(0.048)	(0.056)	(0.073)
	17772	7876	5977	3816
Grip strength	-0.401**	-0.529**	-0.327	-0.351
	(0.173)	(0.256)	(0.300)	(0.392)
	21245	9003	7302	4635
No. of mobility limitations	0.0357***	0.0448***	0.0093	0.0622***
	(0.010)	(0.015)	(0.018)	(0.022)
	22977	9796	7848	4923
IADL	0.0302	0.0594	-0.0160	0.0229
	(0.024)	(0.037)	(0.040)	(0.047)
	22977	9796	7848	4923
No. of depression symptoms	0.0060	0.0874	-0.140**	0.0238
	(0.041)	(0.063)	(0.068)	(0.089)
	22554	9615	7759	4851
Recall	-0.157**	-0.0869	-0.244**	-0.154
	(0.066)	(0.091)	(0.117)	(0.154)
	22638	9679	7778	4855

Standard errors in parentheses; number of observations below standard errors.

strong for the low educated subsample. It is worth noticing that also other age windows show negative and sizeable coefficients (20–25 for the low educated and 36–40 for the high educated) but their standard errors are quite large.

More generally, we would like to establish whether the effect of crises experienced in the age window 41–50 had an impact on old age health because those crises were more recently experienced or because this is a sensitive period. We investigate this issue by splitting the sample into two age groups, namely 50-59 vs. 60–70. The intuition behind this approach is that if the effect in the age window 41–50 is due to the fact that these crises were more recently experienced, we should find a larger effect for the younger cohorts. However, our results (available upon request) seem to reject this hypothesis. If ever, the effect of crises experienced in the age window 41–50 is larger for the older cohorts (people aged 60-70). However, to establish this in a more convincing way one

would need to employ a longer panel.

The importance of the crises experienced during ages 41–50 is confirmed also when using the mean GDP growth as alternative indicator describing the macroeconomic environment but not when using the mean unemployment rate. These alternative measures of the economic conditions are of course correlated with our crises indicator. However, measuring the mean GDP or unemployment rate in a particular age window means analyzing the effect of the average economic condition experienced at that age and does not capture the effect of a severe negative macroeconomic shock. This might explain why these two alternative measures also point out the importance of having favorable economic conditions during early adulthood (20–30). This result is consistent with the literature mentioned before which considers this period as critical because individuals make the transition from school to work (Hessel and Avendano 2013, Cutler et al. 2014) . It is also confirmed by the fact that favorable economic conditions between age 26 and 30 have positive effects only on old age health of the middle to highly educated. Indeed, this age window corresponds approximately with their early labor market experiences.

5 Robustness checks

In this section we address some potential concerns regarding our identification strategy.

Confounding trends. One possible concern with our results is that linear and quadratic trends might not be sufficient to describe the ageing dynamics of health. In this case our results might reflect some residual terms of ageing. For this reason we rerun the regressions first controlling for alternative trends and second we add cohort fixed effects. In the latter case we eliminate all possible within country-variation and capture only between-country variation. We only report results for the low educated subsample in table 6.

Column (1) presents results using country-specific linear trends in birth year; quadratic and cubic trends are added in columns (2) and (3). In column (4) cohort fixed effects and a linear trend are included; and finally in column (5) quadratic trends and fixed effects are taken into account. The bottom line in the table reports the variance inflation factor to show the degree of collinearity in the models.

Overall, our results do not seem overly sensitive to the inclusion of different linear, quadratic or cubic trends. However, the degree of collinearity increases substantially when using cubic trends. Adding cohort fixed effects reduces the size of the coefficients compared to the specifications without fixed effects. This is not surprising since the identifying variation in the crises effect now only stems from variation between countries,

Table 5: Average marginal effect of 1) having at least 1 crisis in 5-years interval 2) mean GDP growth per capita in 5-year intervals 3) mean unemployment rate on the probability to be in good health

	At least 1 GDP crisis			**Mean GDP growth**			**Mean unemployment**		
	All	Low educ.	Middle & high educ.	All	Low educ.	Middle & high educ.	All	Low educ.	Middle & high educ.
20-25	0.0106	-0.0256	0.0412	0.0158*	0.0157	0.0138	-0.0364*	-0.0407	-0.0402
	(0.03)	(0.03)	(0.04)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
26-30	0.0007	-0.0074	0.0115	0.0248**	0.0192	0.0299**	-0.0241*	-0.0043	-0.0295
	(0.02)	(0.03)	(0.03)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)
31-35	-0.0090	-0.0098	-0.0001	0.0200	0.0224	0.0158	-0.0191	-0.0150	-0.0132
	(0.02)	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
36-40	-0.0247	-0.0118	-0.0335	0.0270	0.0370	0.0191	-0.0208	-0.0135	-0.0127
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)
41-45	-0.0370***	-0.0400**	-0.0271	0.0275*	0.0574***	0.0024	-0.0159	-0.0092	-0.0097
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
46-50	-0.0323***	-0.0450***	-0.0165	0.0185*	0.0441***	-0.0057	-0.0027	-0.0045	0.0027
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
N	22880	9778	12752	22880	9778	12752	21132	8747	12069

Table 6: The effect of crises on health: controlling for country and cohort fixed effects

	Linear	Quad.	Cubic	FE+lin	FE+quad
	-0.0308 ***	-0.0424 ***	-0.0291 *	-0.0227	-0.0395 **
	(0.011)	(0.013)	(0.016)	(0.014)	(0.018)
N	9778	9778	9778	9778	9778
VIF	8.63	11.62	17.12	13.15	22.18

standard errors increase, and the degree of collinearity is high.

Childhood outcomes. However, one might still be worried that we are only picking up cohort specific trends in health. Another way to strengthen our causal argument is to use outcomes that are established early in life, and thus should not be affected by crises experienced between age 20 and 50, and that are highly related to health outcomes later in life. Such outcomes are childhood health and socio-economic status (SES). There is a large literature showing that childhood health and SES are highly related to later-life health outcomes (see, e.g., Haas 2008, Mazzonna 2014). We use height, self-reported health at age 10 and fathers' occupation at age 10 as dependent variables (see table 7). Height is measured in the standard SHARE questionnaire, while childhood health and father's occupation are only available for respondents to SHARELIFE. Thus, our samples in these specifications are smaller. Results in table 7 show that there is no relationship between the crises experienced between age 20–50 and health outcomes and SES measured earlier in life. Effects are close to zero and insignificant. We take this result as evidence that we are not picking up general cohort specific trends in health but truly measure the effects of severe macroeconomic shocks on respondents' health.

Table 7: Effect of number of crises on height, self-reported health at age 10 and fathers' occupation at age 10

	(1)	(2)	(3)
	Height	Childhood srh	Fathers' occupation
No. of crises	0.0032	0.0013	0.0112
	(0.137)	(0.002)	(0.007)
Observations	22659	13620	16507

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Note: Results in column (1) are from an OLS regression, results in column (2) and (3) are marginal effects calculated after estimating ordered probit models. Childhood self-reported health and fathers' occupation are known only for respondents who participated in wave 3 of SHARE (SHARELIFE). Childhood health is an ordinary variable taking values from 1 (excellent health) to 5 (poor health). Fathers' occupation at 10 is an ordered variable taking value from 1 most high-skilled to 3 most elementary.

World War II and selective mortality. Finally, two additional concerns with our results are that there could be a confounding influence of WWII, and that selective

mortality could bias our estimation (see discussion in section 3.2).

In column (2) of table 8 we replicate the analysis only using the sub-sample of individuals born after the end of the war (if the country of residence was affected by the war). The date is specific for each country: For Austria, Belgium, Germany, France, Italy, the Netherlands, and Denmark it is 1945; for Spain 1939; for Switzerland, Denmark, and Sweden we include all respondents, since these countries were not significantly affected by the war: Sweden and Switzerland were not under occupation, Denmark was under occupation, but experienced relatively less hardships than the other countries. The coefficient for the postwar subsample is almost identical to the coefficient for our baseline result. However, the effect becomes insignificant due to a substantially smaller sample.

In column (3) we address the issue of selective mortality and replicate our analysis adding the cohort- and country-specific survival rates as control variable. The results suggest that the selective mortality rate does not substantially affect our results. The coefficients in the regressions with or without survival rates are fairly similar to each other. Again significance is slightly smaller due to the smaller sample. We were only able to find detailed information on survival rates for 8 of our 11 countries.

Table 8: Effect of crises on health outcomes for all sample and post-war sub-sample

	All Sample	Postwar Sample	Sample with survival rate
No. of crises	-0.0225**	-0.0221	-0.0208*
	(0.010)	(0.014)	(0.011)
observations	22880	14306	16840

Note: In the post-war sample we include respondents from Austria, Germany, France, Italy, Netherlands, Greece, and Belgium born after 1945, from Spain after 1939, from Sweden, Switzerland, and Denmark - the whole sample. Survival rates for 8 countries (Sweden, Netherlands, Spain, Italy, France, Denmark, Switzerland and Belgium) were derived from the mortality rates. Data source: The Human Mortality Database, University of California, Berkley.

Overall, we are fairly confident that our results of crises experienced between age 20 and 50 are not driven by general cohort trends in health or other severe shocks like the experience of the Second World War.

6 Conclusion

This paper investigates the causal effect of the number of macroeconomic crises experienced during prime working age (20 to 50) on different health outcomes in old age merging macroeconomic data with individual data from SHARE. We exploit the variation between countries and cohorts in the number of macroeconomic crises experienced

during prime working age to identify the effect.

Our results indicate that individuals that experience bad economic times—in which GDP dropped by al least 1%—show a significantly lower probability of being in good health, report a higher number of symptoms, and have lower grip strength. We find some remarkable heterogeneity in the effects. The results are larger in magnitude and more significant for the low-educated sub-sample, while high-educated respondents seem to be mostly positively affected by times of exceptional macroeconomic growth. Respondents who experienced one more crisis during their working live experience a decline in their health after age 50 that is about equivalent to becoming 2 years older. The effect is about twice as large among low educated respondents. The effect size is similar to the effect size measured for cognitive functioning by Leist (2013). The protective effect of education has also been found for crises experienced around graduation by Cutler et al. (2014) and during childhood (Doblhammer et al. 2011).

Further, we find that inside this rather large interval 20-50 we can determine smaller periods in which experiencing a crisis is critical for health. In particular, severe GDP drops at the age periods 41-45 and 46-50 result in significant health declines for respondents with low education. Moreover, there is evidence that high unemployment rates experienced during the early working years (20-25 and 26-30) negatively affect health later in life, while favorable economic conditions in terms of GDP growth at the age interval 26-30 have a positive effect on health of individuals with higher educational level. These findings are in line with previous results in the literature which suggest that economic conditions in the beginning of working life have an effect on health, presumably through affecting the career trajectories (Hessel and Avendano 2013, Cutler et al. 2014).

Our results are not affected by the presence of war-related selective mortality or general trends in health. Finally, we show that the intensity of the crisis matters by showing that only the most severe macroeconomic shocks had long lasting effects on the health of the affected cohort. Such a result is particularly relevant in the light of the previous literature which never distinguished severe macroeconomic crises from business cycle fluctuations.

More generally, our study contributes to the existing literature on the long-term effects of adverse conditions during the life-cycle on health outcomes later in life. To our knowledge, we are the first who considered the influence of adverse economic conditions during adulthood on old-age health. The fact that we find significant effects of macroeconomic shocks, which affected the individuals later in life, suggests that not only early life circumstances have long lasting effects on health later in life. As a consequence, there are other mechanisms, different from undernutrition during the period of the body

formation, through which macroeconomic turbulence affects health. Possible channels could be the adverse effects of drops in income, periods of unemployment, and early retirement on health. More research is necessary to understand the mechanisms which are at work, to link macroeconomic cycles to individual career pathways, and ultimately to point to possible policy interventions. In a consecutive paper we will investigate this using retrospective life histories provided by SHARELIFE, the third wave of SHARE.

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Appendix A

Table A1: Years of GDP crises by countries for the period 1954-2004

Country	Periods of GDP crises
Austria	-
Belgium	1975, 1981, 1993
Denmark	1974
France	1975, 1993
Germany	1990, 1993
Greece	1974, 1993
Italy	1975, 1993
Netherlands	1958, 1961, 1981, 1982
Spain	1959, 1993
Sweden	1977, 1991-1993
Switzerland	1958, 1975, 1982, 1991, 1992, 1993

Table A2: Summary statistics

	All sample			
	Mean	Std.dev	Min. value	Max. value
Health measures:				
Good health	0.37	0.48	0	1
Symptoms	1.28	1.47	0	11
Grip strength	36.66	12.25	0	100
IADL	0.25	1.01	0	13
Chronic diseases	1.28	1.29	0	12
Mobility limitations	0.99	1.73	0	10
Depression symptoms	2.03	2.08	0	12
Recall	9.05	3.36	0	20
Crises measures:				
No. of crises - GDP, 5%	1.85	1.17	0	5
No. of booms - GDP, 5%	1.01	1.93	0	8
No. of crises - GDP, 10%	3.59	1.77	1	9
dummy(≥ 1 GDP crisis) 20-25	0.231	0.421	0	1
dummy(≥ 1 GDP crisis) at age 26-30	0.237	0.425	0	1
dummy(≥ 1 GDP crisis) at age 31-35	0.230	0.420	0	1
dummy(≥ 1 GDP crisis) at age 36-40	0.303	0.460	0	1
dummy(≥ 1 GDP crisis) at age 41-45	0.314	0.464	0	1
dummy(≥ 1 GDP crisis) at age 46-50	0.240	0.968	0	1
mean GDP growth (in %) at age 20-25	3.892	1.375	-0.094	8.696
mean GDP growth (in %) at age 26-30	3.139	1.69	-0.552	9.184
mean GDP growth (in %) at age 31-35	2.505	1.469	-0.552	8.388
mean GDP growth (in %) at age 36-40	1.99	1.082	-0.806	6.209
mean GDP growth (in %) at age 41-45	1.729	0.903	-0.829	4.399
mean GDP growth (in %) at age 46-50	1.872	0.968	-0.829	4.399
mean unemp. rate (in %) at age 20-25	2.539	1.668	0.004	7.349
mean unemp. rate (in %) at age 26-30	3.735	2.748	0.003	15.865
mean unemp. rate (in %) at age 31-35	5.617	3.948	0.003	20.523
mean unemp. rate (in %) at age 36-40	7.062	4.051	0.205	20.523
mean unemp. rate (in %) at age 41-45	8.392	4.18	0.283	22.547
mean unemp. rate (in %) at age 46-50	8.615	4.025	0.598	22.547
Covariates:				
Females	0.51	0.50	0	1
Age	59.80	5.94	50	72
Low education	0.43	0.50	0	1
Middle education	0.35	0.48	0	1
High education	0.22	0.41	0	1

Note: Summary statistics for the sample including 22880 respondents from waves 1 and refreshment sample of wave 2 of SHARE data set who satisfy all the following conditions: 1) were born between 1934 and 1954; 2) reside in one of the following countries: Austria Belgium Denmark France Germany Greece Italy Netherlands Spain Sweden Switzerland; 3) did not immigrate in the country after the age of 20; 4) report having worked at least once in life.

Table A3: Average marginal effects of explanatory variables in the baseline regression

	(1) All	(2) Low educ.	(3) Middle educ.	(4) High educ.
No. of crises	-0.0225**	-0.0424***	-0.0149	0.0232
	(0.010)	(0.013)	(0.019)	(0.025)
Birth year	0.0122***	0.0109***	0.0103***	0.0083***
	(0.001)	(0.001)	(0.001)	(0.002)
Female	-0.0436***	-0.0452***	-0.0234**	-0.0233*
	(0.006)	(0.009)	(0.010)	(0.014)
Wave	-0.0244***	-0.0243**	-0.0052	-0.0495***
	(0.008)	(0.012)	(0.013)	(0.017)
AT	0.0885	-0.141	0.0728	0.252
	(0.095)	(0.164)	(0.159)	(0.205)
DE	-0.324***	-0.304*	-0.445***	-0.130
	(0.089)	(0.181)	(0.147)	(0.186)
SW	0.0250	0.0121	0.0193	0.245
	(0.085)	(0.111)	(0.172)	(0.202)
ES	-0.179**	-0.107	-0.370	-0.0382
	(0.090)	(0.107)	(0.324)	(0.254)
IT	-0.181**	-0.146	-0.233	-0.0184
	(0.083)	(0.103)	(0.176)	(0.293)
NL	0.150	0.233*	0.0228	0.226
	(0.096)	(0.125)	(0.189)	(0.223)
FR	-0.272***	-0.168	-0.404**	-0.204
	(0.086)	(0.114)	(0.167)	(0.193)
DK	0.147*	0.0891	0.0702	0.219
	(0.085)	(0.139)	(0.145)	(0.174)
GR	-0.115	-0.0444	-0.0392	-0.0641
	(0.082)	(0.106)	(0.168)	(0.215)
CH	0.124	0.0684	0.0582	0.891**
	(0.103)	(0.149)	(0.161)	(0.366)
Observations	22880	9778	7838	4914

Note: Average marginal effects of a probit model. In addition we control for country-specific linear and quadratic trends in birth year.

Table A4: Marginal effect of the number of crises on the probability to report good health

	(1) Baseline	(2) incl. those who never worked	(3) incl.immigrants and those who never worked
No. of crises	-0.0225**	-0.0189*	-0.0149
	(0.010)	(0.010)	(0.010)
Observations	22880	23981	25140

Note: Excluded immigrants are those who migrated after the age of 20.

Appendix B

Table B1: Definition of health outcomes

Health measure	Definition	Set of possible answers	Model used
Good health	Reporting very good/good health in wave 1 or excellent/very good health in wave 2	W1: very good, good, fair, bad, very bad; W2: excellent, very good, good, fair, poor	Probit regression
Symptoms	No. of Symptoms experienced in the last 6 months from the list of 12 symptoms	Pain in the back/other joint, Heart trouble/angina, breathlessness, persistent cough, swollen legs, sleeping problems, falling down, fear of falling down, dizziness/faints/blackout, stomach/intestine problems, incontinence, other (wave1) or fatigue (wave2)	Linear regression
Grip strength	Grip strength measured during the interview	0-100	Linear regression
No. of mobility limitations	No. of activities with which respondent reports to have difficulty, from the list of 10 activities	Walking 100m, sitting for about 2 hours, getting up from a chair, climbing several flights of stairs, climbing 1 flight of stairs, stooping, reaching or extending your arms above shoulder level, pulling or pushing large objects, lifting or carrying weights over 10 pounds, picking up a small coin from the table	Linear regression
Chronic	No. of chronic conditions ever diagnosed, wave 1: list of 14 chronic diseases, wave2: list of 17 chronic diseases	Heart attack, high blood pressure, stroke, cerebral vascular disease, diabetes, chronic lung disease, asthma, arthritis, osteoporosis, cancer, ulcer, Parkinson disease, cataracts, hip fracture, other fractures, Alzheimer disease, benign tumor	Linear regression
IADL	No. of instrumental activities of daily living (IADLs) from the list of 13 activities with which respondent reports to have difficulties	Dressing, walking across room, bathing or showering, eating, such as cutting up your food, getting in or out of bed, using the toilet, using a map, preparing hot meal, shopping for groceries, making phone calls, doing work around the house or garden, managing money	Linear regression

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Health measure	Definition	Set of possible answers	Model used
Depression symptoms	No. of depressions symptoms experienced in the last month out of 12 symptoms forming EuroD scale	Depressed mood, pessimism, suicidality, guilt, sleeping problems, lack of interest, irritability, lack of appetite, fatigue, problems with concentration, lack of enjoyment, tearfulness	Linear regression
Recall	Sum of no. of words remembered at the immediate recall and delayed recall	Max. 20 words	Linear regression