Health state dependence in Europe; estimates and implications for health expenditures and pension payout schemes - PRELIMINARY VERSION

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Abstract

With the pension system under pressure due to aging and the financial downturn it is important to gain better understanding of the financial needs of elderly. In this paper we analyze the impact of health and ageing on needs based on a measure of ones ability to make ends meet. We find that people have more trouble to make ends meet when they are in bad health, even when controlling for income and wealth. In general, this holds over all income groups, however, in countries where the government and the family share the responsibility for the provision of long term care, the setback is larger for households with higher incomes. While health deterioration seems to increase financial needs, we find that age decreases those needs. Moreover, the effect of health on financial needs decreases with age. Our findings indicate that pension pay out schemes that pay out a constant amount from date of retirement to death, may not fit the needs of elderly. These needs could be better reflected using a more flexible pension pay out scheme, where it is important that there exists close coordination between policy makers on the respective fields of pensions and long term care.

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1 Introduction

Population aging comes with many challenges for public policy. Foremost the question arises how we can sustain adequate old age pensions and long term care provision, while keeping public expenditures under control. Pensions and long term health care are usually considered as two separate problems, each requiring an individual solution. However, as the two topics are obviously linked, it may be advantageous to approach them as two sides of the same coin. In this paper, we take a step in that direction by investigating how financial needs of elderly change with health and age.

Existing pension systems are designed in a way that should enable individuals to keep up a certain standard of living throughout retirement. Therefore, such arrangements in general provide a constant stream of income from the date of retirement until death at the level of a prespecified fraction of labor income. However, consumption levels seem to decline during retirement (Hurd, 1992). This could be partly explained due to money constraints, as people may be unsure of how many years they will be alive and thus how long their wealth still has to last. However, another explanation can be found in a decline in needs at old age, since physical limitations constrain consumption possibilities and preferences may shift over time. In this paper we will focus on the change in needs, both due to health and ageing. The difference in the effects of health and ageing should be carefully analyzed for sake of establishing pension pay out schemes that fit retirees needs. There is large heterogeneity in the timing and severity of physical deterioration, so if the decline in needs can be mostly attributed to bad health, each individual experiences a clearly different consumption path. Moreover, physical limitations may not only constrain consumption possibilities, but also induce new (care related) needs, such that in fact overall consumption needs increase. Indeed empirical studies on the effect of health on consumption needs provide estimates that do not only range in size, but also contradict each other in sign.

For our research we will make use of personal evaluations of one's financial situation to infer the effect of health and age on financial needs. In that way this paper is closely related to the work by Finkelstein et al. [2013], who estimate the effect of health on utility for US retirees using a subjective well being measure as

a proxy for utility, and the papers by Soede [2012] and Dudel et al. [2013], who investigate how the needs of retirees in respectively the Netherlands and Germany change with age using information on financial satisfaction. Whereas this type of data has been used more often for the construction of equivalence scales, there are not many who have used it in the context of health and ageing. Our paper differs from the above mentioned research, because we look at the effect of age and health simultaneously rather than focusing on either one of the topics. Moreover, most of the research on the impact of health and ageing is conducted in a single country setting (predominantly the US), whereas we employ a cross-European dataset. This is important because the institutional background may have huge impacts on the estimated effects, as noted by Domeij and Johannesson [2006]. Using data covering countries across Europe with different institutional backgrounds, helps us to separate these institutional effects from the actual changes in needs.

Our research indicates that decreasing health leads to increasing financial needs, even in countries where long term health care needs are largely covered by the government. Similar to the research cited above, we find a strong positive effect of age on the ability to make ends meet. Moreover, we find that with age the positive effect of health on financial needs decreases. Whereas the overall impact of health is comparable across countries, in countries where the government and family share responsibility in providing long term care we find heterogeneity in the effect of health on financial needs with respect to income levels.

We will start our analysis with an overview of what is known about the influence of health and ageing on financial needs in Section 2. Next, we will discuss the methodological challenges of using subjective dependent variables in regressions and explain our estimation strategy in Section 3. In Section 4 we will provide information on the data used for the empirical analysis of which the results are shown in Section 5. We will conclude with policy recommendations and suggestions for further research in Section 6.

2 Aging, health, and financial needs

Financial needs over the life course are usually analyzed using the optimal life cycle savings model, as introduced by Modigliani and Brumberg [1954]. Following a simple

version of the model, without any uncertainty about the future, one would expect that household expenditures increase at the early stages of life, when individuals marry and get children and hence the household expands, after which household size shrinks and thus consumption decreases again. At retirement consumption might drop as leisure time increases, to stay constant from then onwards. In empirical work it is however observed that the expenditures of retirees decrease throughout the period of retirement. Assuming peoples consumption choices reflect their needs, this would imply pensioners needs decline with age. However, in an attempt to explain this behavior early work assumed needs remain constant, but money constraints limit elderly to act upon their wants. Elderly have a limited pool of savings to consume throughout retirement and due to impatience, uncertainty about remaining lifetime and precautionary savings motives this implies optimal consumption levels decline with age (see among others Hurd [1992], Palumbo [1999], Engen et al. [1999]).

Domeij and Johannesson [2006] show that including savings motives and uncertainty does not explain the observed consumption path. For example, bequest motives and mortality risk cancel each other out, in the sense that a bequest can be seen as an insurance against loss of wealth due to death. They assume that individuals in bad health consume less and by adding a factor for health status to the optimal life cycle model they are able to replicate observed consumption levels at old age in the Swedish Consumer Expenditure Survey. Similarly, Börsch-Supan and Stahl [1991] include a constraint on consumption possibilities due to health deterioration into the life cycle savings model, which fits well to observed patterns in the West German Income and Expenditure Survey[1].

For this explanation to hold one needs to assume that individuals in bad health need less than those in good health, i.e. the marginal utility of consumption (muc) declines with deteriorating health. The effect of health on preferences can be expressed using a health state dependent utility function: a utility function that does not only use consumption, but also health status as input. The general consensus is

[1]Both papers mentioned here look at exogenous health shocks. Much of the literature around health and optimal life cycle savings views health as a stock individuals can invest in, see for example Scholz and Seshadri [2013]. However, these health investments are mostly relevant to behavior in the accumulation phase, while here we focus on the decumulation phase. Still there remains the issue of endogeneity when evaluating health and consumption, which should be carefully considered in estimations.

indeed that utility levels decline with bad health, as shown by for example Ferrer-i Carbonell and Van Praag [2002], who calculate the monetary 'worth' of good health from variations in health and well being levels. Analysis on the muc is however less straightforward, such that the assumption of declining muc with bad health is quite a bold one to make.

Health can impact consumption through various pathways, as explained by Karagiannaki [2009]. One of these pathways is the constraining effect of health mentioned above. Due to deteriorating health individuals become consumption constrained and hence need less. However, such physical constraints also induce extra costs as less mobile individuals have to outsource certain tasks that they could otherwise have performed themselves. That is, one shifts consumption from home produced to market goods, and thus experiences an increase in financial needs. Moreover, there is the obvious increase in health expenditures in case the individual would not be properly insured. Even though most countries provide some form of public long term care benefits, these are often means tested or require heavy out of pocket expenditures. Finally, a health shock impacts ones expectations about future costs and longevity, and through that remaining life time needs together with the time preference of consumption.

Finkelstein et al. [2009] give an overview of the different approaches taken in literature to estimating health state dependence, i.e. the effect of bad health on the muc. They define negative health state dependence as a lowering of muc with bad health and positive health state dependence as an increase in the muc due to bad health. The authors explain that empirical research on health state dependence has so far shown indications for both negative as positive health state dependence and that also the sizes of the effects vary substantially. In an empirical paper the authors find negative health state dependence using subjective well being as a proxy for utility (Finkelstein et al., 2013), whereas Lillard and Weiss [1997] estimate positive health state dependence when evaluating the effect of experienced and expected health shocks on consumption profiles, and De Nardi et al. [2009] find no evidence of health state dependence, when including the parameter in a bigger optimal life cycle savings model.

As Macé [2012] points out, the contradictions in empirical findings may be traced back to the different types of data used. He explains that individuals have trou-

ble understanding the extent to which they can adapt to changing circumstances (hedonic adaption), such that they basically overestimate the effect of being in bad health on their lives. Moreover, the extent of adaption may depend on the amount of wealth people hold (Smith et al., 2005). Research based on people's expectations of utility under bad health, for example using observed demand for health related insurance products or hypothetical choice experiments, thus estimates a different effect than research based on individuals experienced utility under bad health. The ambiguity of the conclusions can also at part be explained by heterogeneity in health state dependence. Hong et al. [WIP] for example show that the sign of the health state dependence changes over age. The inclusion or exclusion of certain age groups in the sample could thus affect the sign of estimated state dependence. Moreover, the institutional background of the country analyzed may have a big impact on the retrieved results (Domeij and Johannesson, 2006).

If neither cash constraints nor mobility constraints would be able to explain the drop in consumption at old age, why do expenditures decline throughout retirement? It could be that preferences simply change with age. From a theoretical perspective this seems like an odd proposition, however it fits nicely with the often acclaimed u-shape in subjective well being over the life course. Frijters and Beatton [2012] ascribe this finding to methodological flaws and issues with selection in surveys, but after correcting for this they still find increased life satisfaction around the retirement age. Recent research based on stated preference data has indeed shown that, as people get older, they are satisfied with lower levels of income (Soede, 2012) even when controlling for health (Dudel et al., 2013).

3 Estimations based on subjective measures

Taking into account that it is hard for individuals to predict how their needs will change due to health or ageing, we focus on individual's experiences rather than their predictions. Since we are moreover interested in what people need, rather than what they do, information on subjective evaluations of the individuals financial situation are best suited for our purpose. With the recent advances in the use of subjective information in regression analysis, the revealing power of such data shows much promise. The use of this data however comes with a few challenges

for estimations. First of all, the use of a subjective dependent variable requires to account for individual specific answering styles. Moreover, we need to deal with the ordinal nature of the dependent variable. In this section we will discuss both issues and explain our strategy for overcoming these problems.

3.1 Accounting for individual specific answering styles

Satisfaction with income is measured using self-reported answers on a scale. The way individuals perceive and thus use such scales may be dependent on unobserved personal characteristics. A person who is very optimistic in general is for example more inclined to use the top ends of the scale, whereas one who takes the glass to be half empty will tend to give answers more towards the bottom end of the scale, their financial situation being the same. Such personality traits could again be correlated with some of the explanatory variables, such as gender or health status. It is thus important to account for this unobserved personal effect in the regressions, as is stressed by Ferrer-i Carbonell and Frijters [2004].

Researchers have taken this advice at heart; with as a result that most of the recent research using subjective dependents is based on panel data analyzed using a fixed effects estimator. All the coefficient estimates are then determined by within person changes, such that the personal component cancels out. This solution is easy to implement and theoretically clean. It however does leave the researcher with little flexibility, as only the effect of shocks can be measured, whereas transitory effects drop out. This is particularly interesting when taking into account that people exhibit a certain degree of adaption after changing situations. The immediate effect of a shock in health on financial satisfaction could for example be large, while the effect levels out as time progresses. This difference between permanent and transitory effects cannot be captured in the fixed effects setting, see also Van Praag and Ferrer-i Carbonell [2004].

The alternative solution proposed by the authors is less widely taken on in the field, that is, to account for the individual specific effect by including a set of regressors that can capture this effect in a random effects setting. In that way one can employ both within individual variations and cross sectional variations to identify the coefficients. Moreover, when using a random effects specification cross

level interactions can be included, such that one can find out if the impact of a shock in a particular variable (for example health) depends on the level of another variables (such as income).

The problem with this method is that it is hard to find a proper set of regressors to reflect the personal component. Data on personality is scarce, and even if it is available, one can still not be sure to fully capture the effect. A solution proposed in the seventies to overcome the difference between fixed and random effects model, is to account for the individual specific effect by including individual means for each regressor, Mundlak [1978]. The assumption is that the fixed effect can be fully captured by a linear combination of these individual means. Soede [2012] uses such Mundlak correction terms to estimate the effect of age on satisfaction with income in a random effects setting.

3.2 Ordinal and cardinal approaches to satisfaction

Information on subjective well being or satisfaction are usually measured by asking a respondent either to rate his or her situation on a scale from for example 1 to 10, or to choose a verbal qualifier from an ordered list to describe the situation[2]. Thus one observes a discrete ordered variable x_{it}, rather than the latent experienced satisfaction x^*_{it}. It is then assumed that x^*_{it} is experienced on a continuous scale, which can be partitioned in a way such that the respondent i at time t will answer $x_{it} = k$, $k = 1, \ldots, K$, when his satisfaction level x^*_{it} is within μ_{k-1} and μ_k, with $-\infty = \mu_0 < \mu_1 < ..\mu_K = \infty$.

There are several ways in which such information can be handled. The simplest is to assume the observed discrete variable x_{it} as a cardinal measure of satisfaction, such that we can simply use linear regression to link satisfaction to the dependent variables. This makes sense when respondents have used a numerical scale to answer the question. However, when they were asked to rate their satisfaction according to verbal qualifiers this seems to be a quite strong assumption[3]. Alternatively econometricians use nonlinear link functions, as for example the ordered logit and ordered

[2] Another possibility is that the respondent is asked to answer yes or no to experiencing a certain emotion in the past week or month, resulting in a dichotomous variable. Using a combination of such questions a well being scale can be composed.

[3] Van Praag [1991] however does show evidence that individuals translate verbal qualifiers to numerical scales using roughly equally sized steps, the equal quantile assumption.

probit model. The problem with these methods is that estimation becomes hard if not impossible in the context of fixed effects. Similarly, the above described methods to control for individual specific effects in the random effects regression do not translate naturally to the nonlinear setting.

Solutions to this problem can be found in binary recoding or rescaling of the dependent variable. Riedl and Geishecker [2014] compare several of such methods in the fixed effects setting and conclude that as long as one is only interested in ratios of coefficients it does not matter which mapping to choose and thus a simple method is preferred. If one does need information on single coefficients, the mapping and method used should be carefully considered, as this greatly impacts the size of the estimates.

3.3 Estimating equation

As explained above in the context of subjective dependent variables, both fixed and random effects estimations have their own drawbacks and advantages. As our dataset does include many variables on personality, we can try to capture a part of the personal effect by including extra regressors. On top of that we add averages of the time varying variables to control for yet another part. What is still left unexplained after this we assume to be independent of the regressors, such that we can define a random effects model as follows,

$$x_{it} = f(\beta_1 \ln y_{it} + \beta_2 S_{it} + \beta_3 \overline{\ln y}_i + \beta_4 \bar{S}_i + \boldsymbol{z}'_{it}\boldsymbol{\gamma} + \boldsymbol{p}'_i\boldsymbol{\theta} + \eta_i + \epsilon_{it}), \tag{1}$$

where x_{it} is the observed utility proxy, $\ln y_{it}$ reflects a shock in log income, S_{it} a shock in health, $\boldsymbol{z}'_{it}$ captures relevant background variables. $\overline{\ln y}_i$ and $\bar{S}_i$ are the individual means of log income and health, the level variables, and $\boldsymbol{p}_i$ are time invariant characteristics to proxy for the unobserved personality traits. Furthermore, we have an individual specific error term η_i and the general error term ϵ_{it} both assumed to be i.i.d. standard normal and uncorrelated with each other. $f(\cdot)$ is a monotonically increasing function that maps the latent utility to the observed utility proxy. We will add interaction terms between $\overline{\ln y}_i$ and both the shock and level effect of health to this regression to capture the health state dependence of the marginal utility of income.

As the assumptions on the individual specific error term η_i are quite strong, even when largely controlling for the personal characteristics of the individuals, we check for the validity of our estimates using a fixed effects regression,

$$x_{it} = f(\beta_1 \ln y_{it} + \beta_2 S_{it} + \boldsymbol{z}'_{it}\boldsymbol{\gamma} + \alpha_i + \epsilon_{it}), \tag{2}$$

where the α_i reflect the individual fixed effects and the other terms are defined as above.

4 Data

For our estimations we make use of the Survey of Health, Ageing, and Retirement in Europe (SHARE). The survey started out in 2004 and is performed every two years in several countries in Europe. The data from the first four waves are now publicly available. For the third wave a different type of survey was set out, such that we can only use wave one, two and four for our analysis. The survey was first performed in eleven European countries and Israel and over the years seven more countries have been added.

4.1 Evaluation of financial situation

In order to measure financial needs we will use the survey respondents evaluation of his/her financial situation. SHARE has two measures available for this purpose. The first is a measure of one's ability to make ends meet, that is

> Thinking of your household's total monthly income, would you say that your household is able to make ends meet...

to which respondents can answer by choosing either one of the categories (1) with great difficulty, (2) with some difficulty, (3) fairly easily, or (4) easily, such that we have an ordered categorical variable with numerical values ranging from 1 to 4, the higher values indicating needs are met to a better extent. The second measure is a question asked to construct CASP-12, a quality of life scale designed for individuals at old age, namely

> How often do you think that shortage of money stops you from doing the things you want to do?

for which there are again four answering categories (1) often, (2) sometimes, (3) rarely, or (4) never, such that higher values correspond to better fulfillment of needs. The first question is more directed to the fulfillment of basic needs, whereas the second question relates more to a desired standard of living. For our baseline analysis we will therefor focus on the first measure and we will use the second measure to check for robustness of the results.

For Figure 1 we recategorized the answers to the ability to make ends meet question in two categories to show how the satisfaction evolves over the lifespan. In this figure we have not corrected for income nor household size. It is interesting to see that the ability to make ends meet seems to be fairly stable, while income generally declines with age. This suggests that we may indeed find that needs decline with age.

4.2 Health

SHARE includes health measures on self-perceived health, reported health problems, reported limitations, health care usage and physical performance. All but the last type are self-reported measures of health. Since we are specifically interested in health deterioration among elderly, we focus on the measures of limitations, specifically the limitations in activities of daily living, which are encountered by many at old age. As can be seen in Figure 1, indeed the number of ADL's rises with age.

Besides the specific applicability to elderly, we prefer to look at limitations over reported health problems, because of the ease in use and interpretation of the measure. In case of the latter, one aggregates effects of very different illnesses (ranging from asthma to cancer) that are likely to have different effects on needs, which is not a severe problem when aggregating limitations. Also self-perceived health status, a very suitable and interesting health measure in many other circumstances, is not preferred in this context. When using such a measure in combination with a subjective dependent variable, errors are likely to be correlated, which hinders the analysis. This could however be partly resolved by combining this measure with the

Figure 1: Age profile of financial satisfaction, health and income.

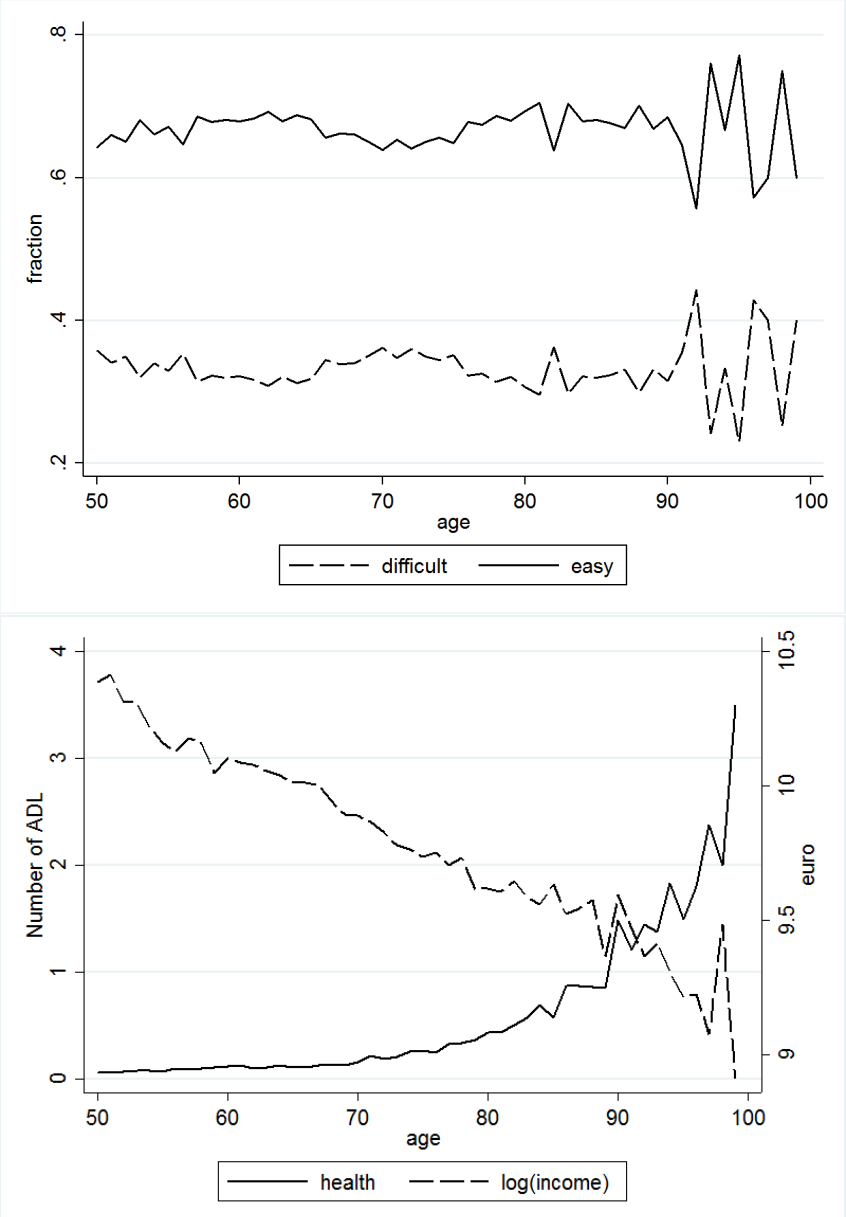

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
sufficient	44074	2.91	0.96	1	4
income	44401	32582.84	41851.87	0	3006882
health	44383	0.21	0.77	0	6
age	44393	66.22	10.02	50	104
net financial assets	44401	48128.98	168292.9	-4860721	14071952
partnerinhh	44400	0.63	0.48	0	1
household size	44402	2.03	1.03	1	12
retired	44188	0.56	0.50	0	1
male	44402	0.45	0.50	0	1
isced	43930	2.59	1.52	0	6
positive	43875	2.53	0.74	0	3
negative	43935	1.04	1.18	0	5

Sufficient is our subjective proxy for financial satisfaction, measured at household level. Income is measured as after tax household income. Health is measured as the number of limitations in activities of daily living (ADL), such as showering and eating. Isced is a cross national comparable measure of education level. Positive and negative are scales constructed using a subset of elements constituting the EURO-D depression scale, measuring respectively positive affect and negative affect. Our data set covers the following European countries: Austria, Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Czechia, and Poland.

objective health measures to obtain one general health measure, see Bound et al. [1999].

4.3 Positive and negative affectivity

As explained in Section 3 we try to capture individual specific answering styles by including time invariant characteristic of the individuals. On top of that we will use measures of positive and negative affectivity to capture the effect of being more optimistic or pessimistic in general, similar to Fischer and Sousa-Poza [2008]. We construct these measure as subscales of the EURO-D depression scale. The items underlying the negative affectivity scale measure sadness, guilt, and hostility, whereas the items underlying the positive affectivity scale measure self-assurance, attentiveness, and joviality. In the case of positive affectivity we reversed the scale of the items underlying the measure, such that a higher score implies higher positive affect.

4.4 Summary statistics

We include all household respondents older than 50 that have been in the panel for two or more waves. We only include one respondent per household since our key variables, income and financial satisfaction, are measured at the household level. We do include information on the health of the partner of the household respondent for some of the regressions. The observations from Israel are excluded from the panel, since the survey for Israel differs slightly from those of the other countries. By requiring the respondents to be visible for at least two waves, we need to drop observations from five more countries. We are thus left with information on individuals from thirteen European countries. The summary statistics for the variables used can be found in Table 1[4].

5 Results

In this section we will present the baseline estimates and the results of some specification checks. Next we will look at differences in estimates for countries with different backgrounds.

5.1 Baseline estimates

The estimates of equation (1) are reported in the first column of Table 2. As one would expect income has a positve effect on the ability to make ends meet. Similarly the sign of age is positive, hence the older one gets the less (s)he needs to make ends meet. This is in line with the effect found by Soede [2012] and Dudel et al. [2013]. On the contrary, in bad health individuals find it harder to make ends meet. This implies that the financial burden of sickness (extra expenses on outsourcing tasks etc.), outweighs the constraining effect on consumption.

One would expect that when the personal characteristics are well accounted for that the shock and permanent effect are either about equal, or that the shock effect exceeds the permanent effect if indeed people experience a type of adaption

[4]For the income and financial assets variable we use imputed data. SHARE provides five sets of imputations. For the current analysis only the first set is used. The results were similar when using the other imputations, though the level of significance was influenced in some cases. For later analysis we will combine the results from all imputations.

Table 2: Baseline estimations.

VARIABLES	(1)	(2)	(3)	(4)
log(inc) (β_1)	0.0264***	0.0269***	0.0265***	0.0260***
	(0.00553)	(0.00550)	(0.00556)	(0.00553)
bad health (β_2)	-0.0296***	-0.0320***	-0.0233**	-0.0299***
	(0.00840)	(0.00822)	(0.00917)	(0.00841)
$\overline{\text{log(inc)}}$ (β_3)	0.274***	0.274***	0.272***	
	(0.0136)	(0.0142)	(0.0137)	
$\overline{\text{bad health}}$ (β_4)	-0.0620***	-0.0633***	-0.0996***	
	(0.0114)	(0.0121)	(0.0137)	
age	0.0113***	0.0113***	0.0101***	0.00327
	(0.000708)	(0.000704)	(0.000731)	(0.00845)
retired	-0.0161	-0.0156	-0.0110	-0.0101
	(0.0107)	(0.0108)	(0.0108)	(0.0139)
$\overline{\text{log(inc)}}$· bad health ($\beta_5$)		-0.00959		
		(0.0121)		
$\overline{\text{log(inc)}} \cdot \overline{\text{bad health}}$		-0.00377		
		(0.0149)		
$\overline{\text{log(inc)}}$· age		-0.000267	-1.94e-05	
		(0.000868)	(0.000865)	
age· bad health			-0.00133*	
			(0.000772)	
age·$\overline{\text{bad health}}$			0.00503***	
			(0.000952)	
Observations	37,204	37,204	37,204	37,204
Number of id	16,043	16,043	16,043	16,043
Interpretation: relative increase in income equivalent to ..				
1 extra ADL (within)	1.13	1.14	1.10	
	(1.05, 1.20)	(1.06, 1.23)	(1.02, 1.18)	
1 extra ADL (between)	1.14	1.13	1.36	
	(1.01, 1.27)	(1.00, 1.27)	(1.18, 1.55)	
1 extra year	0.96	0.96	0.96	
	(0.95, 0.96)	(0.95, 0.96)	(0.95, 0.97)	

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The regressions are performed using a linear specification. We controlled for net financial assets, the presence of a partner in the household, household size, positive and negative affect, and the personal fixed characteristics gender, education level and country of residence. When the individual means of a variable are included, these are subtracted from the original variable to avoid issues of collinearity. For the construction of the interaction terms log(income) and age have been demeaned.

period after a shock. To compare the two effects one must make sure to subtract the shock coefficient from the level coefficient to evaluate the size of the permanent effect, since the shock variables are constructed such that they are centered around

the level variables. Comparing the shock effect to the permanent effect of health we indeed find that these are roughly equal (shock: $\beta_2 = -0.0296$, permanent: $\beta_4 - \beta_2 = -0.324$). The shock effect of income ($\beta_1 = 0.0264$) is however much smaller than the permanent effect of income ($\beta_3 - \beta_1 = 0.248$). This may be an artificial result from the lack of granularity in the scale we are using. Most probably, individuals rarely experience income shocks that are large enough to reevaluate there financial situation, such that the estimated effect of an income shock underestimates the actual effect, whereas between individuals there is enough variation to identify this effect.

Since knowing that an extra ADL leads to a decrease of 0.0296 in financial satisfaction is not that informative, we will evaluate the estimated coefficients for age and bad health relative to the effect of permanent income. The resulting figures can be found in the bottom block of Table 2. We find that when someone experiences a health shock, such that (s)he has one more limitation in ADL then before, this person needs 1.13 times his or her current income for financial satisfaction to remain unchanged. Similarly people with a limitation in ADL need 1.14 times the income of healthy individuals to be able to make ends meet with similar ease. With age income can drop with about 4

In column (4) we can find the estimates from the fixed effects regression. Reassuringly the effects of income and health shocks are similar to the ones we retrieved using the random effects regression, providing conformation for the validity of our specification. The effect of age is insignificant in this regression. This is probably due to length of the panel. There are many respondents who are only observed for two waves, such that the effect of age on income satisfaction for these people is already picked up by the wave fixed effect, letting the identification of age depend on only that part of the sample that is included for all three waves.

In column (2) and (3) we added interaction effects to check for heterogeneity in the effect of health and ageing on financial needs. In column (2) we added interaction terms of health and age with transitory income, which turn out negative, but small and insignificant in all cases. The effect is thus equivalent over different income levels. In column (3) we checked whether the effect of income and health deterioration depends on ones age. The interaction with age and a negative health shock turns out to be negative but very small relative to the direct effect of a health

shock. The interaction with age and transitory bad health is however positive and more substantial (about half as big as the direct effect), indicating that being in bad health on older ages brings less of a financial strain than when young. This makes sense as young people may try harder to keep doing the things they were used to doing than the old.

5.2 Robustness checks

In the appendix the results can be found of several robustness checks. Overall our results are quite robust to other specifications.

As a first check we compare our results to the results using the alternative measure for financial satisfaction in our dataset. As explained in Section 4 our current measure reflects the ability to meet basic needs, whereas the alternative measure is more directed towards the ability to afford luxuries. Table 4 shows the estimation results when using the alternative dependent variable. Apart from the estimated effect of a health shock, which is insignificant in all specifications, the signs of the effects correspond to what we have found before. Looking at the interpretation we see that indeed there does not seem to be an effect of health shock on financial needs, whereas the transitory effect of bad health is estimated to be much larger than before. Moreover, the decrease in needs due to age is estimated to be much larger. These results provide reassurance with respect the the direction of the effects, but seem less plausible in size than the results obtained before.

We furthermore checked for the use of mapping by re-estimating for two types of rescaling of the dependent variable (POLS and COLS, see Van Praag and Ferrer-i Carbonell [2004]) and using an ordered logit model. Similarly to others we find that the change of mappings does change the size of single coefficient estimates, but not of the ratio's of estimates, see Table 5. One might expect the results for the ordered logit model to be highly biased, since we accounted for the individual specific effect linearly. However, when comparing the estimates to those retrieved using a fixed effects estimator[5], we only find slightly different coefficient estimates, see Table 6.

Table 7 show the robustness checks to alternative sample selections. Again the results are overall similar. The income effect is much steeper when the bottom and

[5]We used the BUC estimator by Baetschmann et al. [2011] to be able to perform an ordered logit regression under fixed effects.

top percentiles are excluded, which is logically explained by the decreasing returns of scale in utility from income. In general the effects of health and income seem to be smaller for the 65+ group, corresponding to the decrease in the effect with age which we found above.

The results are robust to the use of other health measures. We looked in particular to other measures of limitations (number of limitations in IADL's[6] and number of limitations in mobility, arm function and fine motor skills), a count of chronic diseases (used by Finkelstein et al. [2013]), and a measure of subjective health status. The signs of the effect are the same throughout. The sizes do differ, as the steps on the scale or not necessarily comparable. To make them somewhat comparable we look at standard deviation increases rather than unit increases, but even then a chronic disease is not of the same severity as one extra limitation.

5.3 Cross country differences

Our data covers multiple countries in Europe with different degrees of welfare provision. Due to this difference in institutional backgrounds the measured effects may largely differ between countries. The estimates in Table 2 represent an average effect over all these different countries. Van Praag and Ferrer-i Carbonell [2004] explain that in general estimates retrieved based on financial satisfaction data can be seen as residual estimates, in the sense that households are already partly compensated for their decrease in satisfaction through government compensation. In case of health related consumption, not only the government may take on part of the burden, but also family and friends can step in. In the Netherlands for example, at the moment the government still plays the biggest part in compensating for adverse shocks. However, to keep costs of the welfare state under control, the government is calling for a 'participating society' in which the burden is placed more and more at the direct circle of the welfare recipient.

In order to distinguish the effect of health and ageing on financial needs from the institutional backgrounds of the countries we divide the countries in our sample in three groups based on their long-term care systems following Verbeek-Oudijk et al. [2014], and run separate regressions for each group. In the North the gov-

[6]IADL stands for instrumental activities of daily living, such as doing groceries or housework.

Table 3: Baseline estimations for different country groups.

VARIABLES	(1) All	(2) North	(3) Central	(4) South
log(inc) (β_1)	0.0269***	0.0346***	0.0200***	0.0336***
	(0.00550)	(0.0109)	(0.00748)	(0.00969)
bad health (β_2)	-0.0320***	-0.0257	-0.0306**	-0.0352***
	(0.00822)	(0.0162)	(0.0137)	(0.0132)
$\overline{\text{log(inc)}}$ (β_3)	0.274***	0.279***	0.286***	0.244***
	(0.0142)	(0.0370)	(0.0220)	(0.0193)
$\overline{\text{bad health}}$ (β_4)	-0.0633***	-0.0657**	-0.0836***	-0.0431**
	(0.0121)	(0.0305)	(0.0184)	(0.0185)
age	0.0113***	0.00974***	0.0126***	0.0116***
	(0.000704)	(0.00134)	(0.00115)	(0.00118)
retired	-0.0156	-0.0665***	0.0103	-0.00449
	(0.0108)	(0.0202)	(0.0181)	(0.0180)
$\overline{\text{log(inc)}}\cdot$ bad health (β_5)	-0.00959	0.00997	-0.0364*	-0.00474
	(0.0121)	(0.0191)	(0.0207)	(0.0211)
$\overline{\text{log(inc)}} \cdot \overline{\text{bad health}}$	-0.00377	0.0480	0.00250	-0.0181
	(0.0149)	(0.0458)	(0.0299)	(0.0231)
$\overline{\text{log(inc)}}\cdot$ age	-0.000267	-0.000486	-0.00209	0.000777
	(0.000868)	(0.00177)	(0.00169)	(0.00128)
Observations	37,204	10,362	13,481	13,361
Number of id	16,043	4,381	5,578	6,084
Interpretation: relative increase in income equivalent to ..				
1 extra ADL (within)	1.14	1.11	1.14	1.19
	(1.06, 1.23)	(0.96, 1.25)	(1.00, 1.29)	(1.03, 1.35)
1 extra ADL (between)	1.13	1.15	1.19	1.04
	(1.00, 1.27)	(0.86, 1.44)	(1.01, 1.37)	(0.80, 1.29)
1 extra year	0.96	0.96	0.95	0.95
	(0.95, 0.96)	(0.95, 0.97)	(0.94, 0.96)	(0.93, 0.96)

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
The regressions are performed using a linear specification. We controlled for net financial assets, the presence of a partner in the household, household size, whether one is retired or not, positive and negative affect, and the personal fixed characteristics gender, education level and country of residence. When the individual means of a variable are included, these are subtracted from the original variable to avoid issues of collinearity. For the construction of the interaction terms log(income) and age have been demeaned. North covers Sweden, The Netherlands, and Denmark. Central covers Austria, Germany, France, and Belgium. South covers Spain, Italy, Greece, Switzerland, Czechia, and Poland.

ernment is mainly responsible for organizing care. The individual costs for care are thus expected be low. The estimated coefficients for bad health will thus solely reflect the effect of health on preferences, not an increase in health expenditures. In the Southern countries the family of the individual bears main responsibility for

providing care. In these countries individuals are expected to experience increased health care expenditures when their health deteriorates. The extent to which may be highly dependent on the strength of the social network of the individual. In Central countries the responsibility for long term care is shared, the individual should first search for caring possibilities in his or her own social circle and only when that is not possible, the government steps in. In these countries the health care benefits from the government are often means tested, such that one may expect the effect of health deterioration on financial needs may be largely dependent on current income.

Table 9 provides a comparison between the different country groups on the variables relevant to our regressions. For us to be able to use the difference in estimated coefficients as an identification strategy, it is important that the characteristics of the samples in the different country groups do not differ all too much (although we also account for these characteristics in the regressions). Under the table it is indicated which countries belong to which country group. The Northern group contains fewer observations than the other two groups, as this group only covers three countries. In the North households seem to be more satisfied with income than in the Central countries even though their incomes are slightly higher on average. This difference in income is mostly offset by the higher financial assets. The Central countries report a higher percentage of retired people, who may have already drawn down some savings. Moreover, the Northern group is more healthy on average than the other groups. The Southern group falls behind greatly in both income and assets, while they have bigger households on average (children stay in house longer, people take in their parents when they cannot live alone anymore). Not surprisingly this group also reports lower average levels of satisfaction with income.

Apart from dissimilarities in the samples, there are other factors that could hinder analysis. SHARE for example only includes interviews with individuals who live independently. Elderly who live in long term care institutions are thus overlooked. In this way there is some form of sample selection, which may be correlated with the institutional background on which we make a division between countries. Moreover, we work with self reported health measures, which may be influenced by quality or access to health care systems and cultural differences in reporting.

For Table 3 we rerun column (2) of Table 2. Testing for the equivalence of the coefficient estimates for the different groups, we find that these significantly differ.

It is thus wise to use the group estimates rather than the pooled estimates. The fixed effects regressions that serve as a check for the estimates are shown in Table 10 in the appendix. Also for these regressions a Chow test indicates that the group estimates significantly differ from the pooled estimates.

The signs of the estimated effects of health, age, and income are the same over the different country groups. However, in the North the effect of a health shock is no longer significant. Since the size of the effect is very similar to the overall effect, and to the effect in the other groups, this may be due to the smaller sample size, rather than the lack of an effect. Looking at the transitory effect of health ($\beta_4 - \beta_2$) we indeed see significant negative effects for all groups, though the effects vary quite substantially in size. The estimated negative effect in the Central country group is more than six times as big as that in the Southern countries (0.053 versus 0.008), indicating that in the Central countries deteriorating health results in a much higher increase in financial needs than in the South, however we still have to relate the effects to the effect of income to be able to make proper inferences about the size of the effect. Also in these countries, as expected, the interaction effect between permanent income and the health shock is negative and significant. The higher one's income, the bigger is the increase in financial needs due to health. This can be explained as a direct effect of the means-tested system. The effect of age is present in all countries, with a slightly smaller effect in the North than in the Central and Southern countries.

In the bottom panel of the table we again provide an interpretation of the results in terms of required relative income increases to compensate for the changes in financial needs. Looking at the 95% confidence intervals the estimated effects actually do not substantially differ between country groups, however looking purely at the estimated relative increase in financial needs the needs seem to the highest in the Central countries. It is interesting to see that the permanent effect of health in the Southern countries is not significantly different from zero, and very small in size, indicating that in these countries health does not have an impact on financial needs. In the Northern countries the effect is also not significant, but so large in size, that we expect there to be an increase in financial needs due to health, however the sample size is too small to obtain enough precision. This is interesting as it suggests that the increase in financial needs measured over all countries is not that much

due to extra individual health care expenditures (as these are presumably higher in the South than in the North), but due to induced extra expenditures for wanting to maintain a certain lifestyle. This corresponds to the seemingly higher decrease in financial needs with age in the South than in the North, suggesting that elderly in the North try to keep up their old ways of living for a longer time.

6 Conclusion

In this paper we analyzed how health and ageing influence financial needs at old age. For our empirical analysis we used information on the ability to make ends meet in a panel data structure. The results retrieved in this way turned out to be highly robust to alternative specifications.

Looking at individuals living in several European countries we found that health deterioration leads to an increase in financial needs, whereas ageing lowers financial needs. The effect of bad health on financial needs decreases as individuals age. When zooming in at several groups of countries within Europe that have similar systems of long term care provision, we found that in general the estimated effects do not differ much across the different countries. However, in the Central countries, where the government and the family share responsibility for providing long term care, the effect of health on financial needs is heterogeneous with respect to income levels.

Given that health and age impact financial needs, one can wonder whether the current scheme of paying out pensions fits to the desires of the retirees. Looking at the effect of age on financial satisfaction it makes sense to start out with high pension payments and decrease the height of the payments as the individual ages. However, when health deterioration sets in, the individual will require extra income to maintain the standard of living. One could argue that the effect of age and health cancel each other out in the long run. However, as the degree and timing of health deterioration differs greatly across individuals, this generalization may not do the justice to the actual change in needs. It is important that, would pensions be paid out at a decreasing rate, individuals are somehow compensated in times of bad health. For establishing a system in which this is possible, close coordination between policy makers on the area's of pension and long term care is required, such

that the systems can be designed such that they complement each other.

For further research we aim to analyze pay closer attention to the effect of wealth in the regressions. Now we analyzed the effects of health and age relative to the effects of income on financial needs. However, in many countries wealth is much more important than pension income for making ends meet. Moreover, we want to explore the possibilities for informal care further, to see if the availability of such unpaid care influences the results.

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Appendix

Table 4: Baseline estimations using an alternative measure for needs.

VARIABLES	(1)	(2)	(3)	(4)
log(inc) (β_1)	0.0300***	0.0307***	0.0295***	0.0287***
	(0.00730)	(0.00742)	(0.00730)	(0.00731)
bad health (β_2)	0.00155	-0.00458	0.00579	0.00201
	(0.0131)	(0.0130)	(0.0144)	(0.0131)
$\overline{\text{log(inc)}}$ (β_3)	0.208***	0.210***	0.209***	
	(0.0143)	(0.0149)	(0.0147)	
$\overline{\text{bad health}}$ (β_4)	-0.0498***	-0.0485***	-0.0784***	
	(0.0146)	(0.0163)	(0.0166)	
age	0.0247***	0.0248***	0.0238***	-0.0221
	(0.000892)	(0.000895)	(0.000929)	(0.0148)
retired	0.00829	0.00726	0.0119	0.0269
	(0.0146)	(0.0147)	(0.0147)	(0.0206)
$\overline{\text{log(inc)}}\cdot$ bad health (β_5)		-0.0262		
		(0.0160)		
$\overline{\text{log(inc)}} \cdot \overline{\text{bad health}}$		0.00316		
		(0.0188)		
$\overline{\text{log(inc)}}\cdot$ age		0.000649	0.000891	
		(0.000993)	(0.00101)	
age$\cdot$ bad health			-0.00101	
			(0.00116)	
age$\cdot\overline{\text{bad health}}$			0.00428***	
			(0.00116)	
Observations	31,418	31,418	31,418	31,418
Number of id	13,929	13,929	13,929	13,929
Interpretation: relative increase in income equivalent to ..				
1 extra ADL (within)	0.99	1.03	0.97	
	(0.85, 1.13)	(0.86, 1.20)	(0.82, 1.12)	
1 extra ADL (between)	1.33	1.23	1.60	
	(1.04, 1.63)	(0.96, 1.51)	(1.20, 2.00)	
1 extra year	0.87	0.87	0.88	
	(0.85, 0.89)	(0.85, 0.89)	(0.86, 0.90)	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Robustness check for choice of mapping from latent to observed satisfaction (RE).

VARIABLES	(1) OLS	(2) POLS	(3) COLS	(4) ologit
log(inc)	0.0264***	0.0260***	0.00739***	0.116***
	(0.00553)	(0.00528)	(0.00160)	(0.0235)
bad health	-0.0296***	-0.0282***	-0.00844***	-0.119***
	(0.00840)	(0.00814)	(0.00239)	(0.0334)
$\overline{\text{log(inc)}}$	0.274***	0.265***	0.0783***	1.135***
	(0.0136)	(0.0132)	(0.00388)	(0.0602)
$\overline{\text{bad health}}$	-0.0620***	-0.0591***	-0.0176***	-0.255***
	(0.0114)	(0.0109)	(0.00327)	(0.0480)
age	0.0113***	0.0108***	0.00325***	0.0484***
	(0.000708)	(0.000687)	(0.000203)	(0.00310)
retired	-0.0161	-0.0179*	-0.00457	-0.0903**
	(0.0107)	(0.0104)	(0.00305)	(0.0458)
Observations	37,204	37,204	37,204	37,204
Number of id	16,043	16,043	16,043	16,043
Interpretation: relative increase in income equivalent to ..				
1 extra ADL (within)	1.13	1.13	1.13	1.12
	(1.05, 1.20)	(1.05, 1.20)	(1.05, 1.20)	(1.05, 1.20)
1 extra ADL (between)	1.14	1.14	1.14	1.14
	(1.01, 1.27)	(1.01, 1.27)	(1.01, 1.27)	(1.01, 1.27)
1 extra year	0.96	0.96	0.96	0.95
	(0.95, 0.96)	(0.95, 0.96)	(0.95, 0.96)	(0.95, 0.96)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Robustness check for choice of mapping from latent to observed satisfaction (FE).

VARIABLES	(1) OLS	(2) POLS	(3) COLS	(4) ologit
log(inc)	0.0266***	0.0262***	0.00743***	0.0938***
	(0.00551)	(0.00526)	(0.00159)	(0.0257)
health	-0.0306***	-0.0291***	-0.00876***	-0.138***
	(0.00838)	(0.00812)	(0.00239)	(0.0403)
age	0.00254	0.00124	0.000926	-0.0336
	(0.00843)	(0.00823)	(0.00240)	(0.0441)
retired	-0.0115	-0.0131	-0.00336	-0.0492
	(0.0138)	(0.0136)	(0.00394)	(0.0668)
Observations	37,577	37,577	37,577	19,810
Number of id	16,207	16,207	16,207	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Robustness check for alternative sample selections.

VARIABLES	(1) baseline	(2) 65	(3) retired	(4) low income	(5) r(1)-r(9)
log(inc)	0.0264***	0.0190**	0.0303***	0.0244***	0.0564***
	(0.00553)	(0.00959)	(0.00860)	(0.00889)	(0.00719)
bad health	-0.0296***	-0.0301***	-0.0332***	-0.0356***	-0.0314***
	(0.00840)	(0.0103)	(0.00990)	(0.0104)	(0.00816)
$\overline{\text{log(inc)}}$	0.274***	0.294***	0.317***	0.302***	0.430***
	(0.0136)	(0.0248)	(0.0216)	(0.0287)	(0.0125)
$\overline{\text{bad health}}$	-0.0620***	-0.0451***	-0.0564***	-0.0577***	-0.0609***
	(0.0114)	(0.0131)	(0.0134)	(0.0142)	(0.0114)
age	0.0113***	0.0155***	0.0117***	0.0126***	0.0128***
	(0.000708)	(0.00135)	(0.00101)	(0.00112)	(0.000709)
retired	-0.0161	-0.00428	0.0738***	0.0624**	-0.00985
	(0.0107)	(0.0192)	(0.0266)	(0.0297)	(0.0108)
Observations	37,204	16,859	19,771	17,081	36,071
Number of id	16,043	7,325	8,595	7,469	15,616
Interpretation: relative increase in income equivalent to ..					
1 extra ADL (within)	1.13	1.12	1.12	1.14	1.09
	(1.05, 1.20)	(1.03, 1.20)	(1.04, 1.20)	(1.05, 1.23)	(1.04, 1.13)
1 extra ADL (between)	1.14	1.06	1.08	1.08	1.08
	(1.01, 1.27)	(0.93, 1.18)	(0.96, 1.21)	(0.95, 1.22)	(1.00, 1.16)
1 extra year	0.96	0.95	0.96	0.96	0.97
	(0.95, 0.96)	(0.93, 0.96)	(0.95, 0.97)	(0.94, 0.97)	(0.96, 0.97)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Robustness check for alternative health measures.

VARIABLES	(1) # ADL	(2) # IADL	(3) mobility	(4) chronic	(5) sphus
log(inc)	0.0266***	0.0265***	0.0264***	0.0268***	0.0265***
	(0.00554)	(0.00553)	(0.00554)	(0.00552)	(0.00553)
bad health	-0.0298***	-0.0190***	-0.0177***	-0.0132***	-0.0222***
	(0.00840)	(0.00704)	(0.00328)	(0.00439)	(0.00560)
$\overline{\text{log(inc)}}$	0.274***	0.274***	0.269***	0.271***	0.263***
	(0.0136)	(0.0136)	(0.0135)	(0.0134)	(0.0132)
$\overline{\text{bad health}}$	-0.0619***	-0.0532***	-0.0585***	-0.0614***	-0.111***
	(0.0114)	(0.00953)	(0.00365)	(0.00507)	(0.00720)
age	0.0113***	0.0119***	0.0140***	0.0127***	0.0123***
	(0.000709)	(0.000727)	(0.000724)	(0.000713)	(0.000700)
retired	-0.0162	-0.0187*	-0.0217**	-0.00911	-0.00990
	(0.0107)	(0.0107)	(0.0107)	(0.0107)	(0.0107)
Observations	37,163	37,163	37,163	37,163	37,163
Number of id	16,025	16,025	16,025	16,025	16,025
Interpretation: relative increase in income equivalent to ..					
sd increase in illness (within)	1.06	1.05	1.10	1.05	1.07
	(1.03, 1.10)	(1.01, 1.08)	(1.06, 1.14)	(1.02, 1.08)	(1.03, 1.10)
sd increase in illness (between)	1.06	1.08	1.33	1.24	1.35
	(1.01, 1.11)	(1.02, 1.14)	(1.23, 1.42)	(1.16, 1.32)	(1.25, 1.45)
1 extra year	0.96	0.95	0.94	0.95	0.95
	(0.95, 0.96)	(0.95, 0.96)	(0.94, 0.95)	(0.94, 0.96)	(0.94, 0.96)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Summary statistics split up for country groups.

Variable	All	North	Central	South
mean(sufficient)	2.91	3.35	3.04	2.47
mean(income)	32582.84	36770.12	37501.94	24755.61
mean(# ADL's)	0.21	0.15	0.22	0.24
mean(net financial assets)	48128.98	55906.9	55906.9	28893.8
mean(household size)	2.03	1.83	1.89	2.32
mean(age)	66.22	65.99	66.44	66.19
mean(isced)	2.59	2.95	2.87	2.05
mean(positive)	2.53	2.69	2.54	2.40
mean(negative)	1.04	0.85	1.09	1.14
% retired	56.14	52.66	60.60	54.45
% male	45.40	47.76	46.41	42.68
% partner in household	62.74	64.99	60.10	63.60
observation	44401	12198	15768	16435

Table 10: Fixed effects estimations split up per country group.

	(1)	(2)	(3)	(4)
VARIABLES	All	North	Central	South
log(inc) (β_1)	0.0266***	0.0377***	0.0170**	0.0334***
	(0.00551)	(0.0108)	(0.00746)	(0.00974)
health	-0.0306***	-0.0264	-0.0251*	-0.0342**
	(0.00838)	(0.0166)	(0.0133)	(0.0138)
age	0.00254	-0.0149	-0.0263*	0.00728
	(0.00843)	(0.0169)	(0.0136)	(0.0166)
retired	-0.0115	-0.0490**	0.00831	0.00590
	(0.0138)	(0.0241)	(0.0227)	(0.0253)
Observations	37,577	10,476	13,607	13,494
Number of id	16,207	4,432	5,632	6,143

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1