Essays on wealth, health, and data collection

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3 Health and Consumption Preferences - Estimating the Health State Dependence of Utility using Equivalence Scales

Abstract

This chapter estimates health state dependence of utility in Europe. For identification we introduce a new method using insights from the research domain of living standards. We estimate how much extra (or less) income is needed to maintain the same level of financial wellbeing after a health shock, and we derive a simple relation between this estimate and the health state dependence parameter. The results show positive health state dependence. This is not driven by medical expenditures, and is robust across alternative specifications and health measures. Interestingly, for cognitive limitations we find negative health state dependence, presumably resulting from a decreased ability to plan.

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3.1 Introduction

Assumptions about the degree and sign of health state dependence of the utility function, i.e. the change in the marginal utility of consumption with health status, have large implications for the optimal design of social security and long term care systems (Viscusi and Evans 1990, and Finkelstein et al. 2013). Health state dependence of utility influences the optimal level of life-cycle savings and health insurance. Health state dependence can also serve as an explanation for observed spending phenomena, such as the decreasing consumption path in old age (Börsch-Supan and Stahl 1991, and Domeij and Johannesson 2006).

Theoretically, health state dependence of utility could be positive just as well as negative. Some goods are valued more in bad health (so called complements to good health) and will raise marginal utility of consumption when ill, whereas other goods are less valuable in bad health (the substitutes to good health), thereby decreasing the marginal utility of consumption when ill. Examples of the first category are market services for physically demanding housework, like doing laundry, gardening, house-cleaning, and cooking. Consumption of leisure activities is often placed under the second category (e.g. traveling may become less enjoyable in bad health). However, if individuals do not lose interest in leisure activities, but the activities become more costly due to the extra help or comfort required (e.g. travel assistance rather than solo traveling), those leisure activities actually fall under the first category. Whether marginal utility of consumption increases in bad health (positive health state dependence) or decreases (negative health state dependence), depends on the importance of both the complements and the substitutes and the importance attached to keeping up the pre-sickness lifestyle and activities when ill.[1] The size and sign of health state dependence may thus be determined by factors like socio-economic status and cultural background. Without

[1] For clarification, health state dependence is about the utility of nonmedical consumption. Changes in utility following a tightened budget constraint due to decreased income or increased medical expenditures are not captured by the concept of health state dependence.

empirical grounding, it is impossible to make assumptions on health state dependence.

Unfortunately, empirical work on the effects of health on consumption preferences provide ambiguous results. Research, mostly based on US data, shows evidence in favor of negative health state dependence of utility (Finkelstein et al. 2013), in favor of positive health state dependence (Lillard and Weiss 1997), and against the existence of health state dependence in either direction (De Nardi et al. 2010). The variation in outcomes may be attributed to the different methods used (Finkelstein et al. 2009). However, there may also be important heterogeneities in the effect, such that the choice of sample and health measure may be the source of the variety in results.

This chapter estimates health state dependence of utility in Europe using the Survey of Health, Aging and Retirement in Europe (SHARE). In order to do so, we build upon insights from the research domain of living standards and income adequacy (Pradhan and Ravallion 2000). We derive a 'health equivalence scale' and show that health state dependence is a transformation of this parameter.[2]

The results indicate positive health state dependence in Europe. We show that the findings are not driven by medical expenditures. Furthermore, the results are robust for different (physical) health measures and functional form assumptions. Among the robustness checks we find one interesting anomaly: cognitive limitations lead to negative health state dependence. When cognitive health declines, the willingness to undertake (leisure) activities may decline and this may lower expenditures. On the other hand, with physical health problems leisure activities may become more expensive because of the extra help required.

The contribution of this chapter to the literature is threefold. First, we introduce a new simple method for estimating the health state dependence of utility using questions widely available in survey data. Second, by

[2]We define the health equivalence scale as the relative change in income needed to maintain the same standard of living after a health shock. This equivalence scale is named after the common 'household equivalence scale', which measures the relative change in income needed to maintain the same standard of living with additional household members.

analyzing different measures of physical and cognitive health, we provide insight into the mechanisms underlying health state dependence. Third, to our knowledge we are the first to estimate health state dependence of utility for Europe. Differences in consumption patterns between US and Europe (Banks et al. 2015) may give rise to different sizes and even signs of health state dependence.

The rest of this chapter is set up as follows. Section 3.2 discusses the theoretical and empirical model underlying the analysis. Section 3.3 describes the data used, followed by the results of the empirical analysis in section 3.4. Finally, section 3.5 concludes.

3.2 Method

Many different methods have been developed to estimate health state dependence of the utility function, all with their own benefits and flaws. The contradictory results in the empirical work on the relationship between health and the marginal utility of consumption can in large part be attributed to differences between these methods. Finkelstein et al. (2009) distinguish two classes of methods to investigate health-state dependence. The first class exploits individuals' revealed demand for reallocating resources across health states. If there is some form of health state dependence of utility and individuals are forward-looking, they can be expected to already reallocate resources across health states before they fall sick, so that more can be consumed when marginal utility is highest. One could for example investigate health insurance demand or compare consumption paths across individuals who vary in their predicted probability of entering poor health (Lillard and Weiss 1997, and Butrica et al. 2009).

The second class of methods focuses on observed utility changes. By comparing within-individual utility changes associated with a health shock for poor and rich individuals, one can identify the change in the marginal utility of consumption due to a health shock. This can be done by using a direct proxy for utility, such as happiness (Finkelstein et al. 2013). Another way is to ask individuals how much money would be required to compensate them for hypothetical exposure to specific health risks, and examine how these self-reported compensating differentials vary with income (Viscusi and Evans 1990, Evans and Viscusi 1991, and Sloan et al. 1998).

The method we propose builds upon the second class of methods. Similar to the second class of models, we make use of within individual comparisons associated with a health shock. However, rather than comparing overall utility changes at different income levels, we analyze average individual changes in financial wellbeing. In this way the method is less sensitive to bias stemming from unobserved characteristics correlated with income, that influence the effect of a health shock on overall utility. The intuition behind our method is as follows. Suppose an individual is asked: "are you able to make ends meet, yes or no?" and answers affirmative. In that case, his financial means must be above a personally set benchmark level. No suppose this individual falls ill, his financial means remain the same, but he now answers no to the posed question. Then his personally set benchmark level must have changed. We argue that, in case medical expenditures are covered by insurance, this change can only come from a shift in the marginal utility of consumption and thus the size of the average change in individual benchmark levels is sufficient to identify health state dependence of utility.

Section 3.2.1 explains the theoretical framework used to analyze the health state dependence parameter. Here, we also show the relation between the health state dependence parameter and the health equivalence scale. Section 3.2.2 explains how to estimate the health equivalence scale using data on financial wellbeing. Finally, the assumptions underlying our approach are laid out in section 3.2.3, together with the possible threats to identification.

Theoretical framework 3.2.1

Our theoretical model is strongly related to that of Finkelstein et al. (2013), who provide a thorough description of the theoretical framework under which one can study health state dependence of the utility function.[3] Consider a retired individual and let S denote this individual's health status. For expositional purposes we define health to be binary: one is either healthy ($S = 0$) or sick ($S = 1$). An individual lives two periods. In the first period the individual is healthy. In the second period a negative health shock arises with probability p. The health shock itself is unanticipated, but the individual is aware of his chances to fall ill.

We assume that retired individuals derive utility $U(C(S), S)$ from consumption (C) and health (S). Health thus has a direct effect on overall utility (in general people do not like to be ill), but can also have an indirect effect on utility through consumption (which may be positive or negative). This is in accordance with Viscusi and Evans (1990) and Evans and Viscusi (1991), who explain that an adverse health shock may not only reduce utility, but can also alter the structure of the utility function (i.e., it may change the marginal utility of consumption). We are interested in this last part: how does health affect the marginal utility of consumption.

Consider the following standard intertemporal utility maximization problem of an individual

$$\max \quad U = \frac{1}{1-\gamma}C_1^{1-\gamma} + \frac{1}{1+\delta}\left(-\phi_0 S + (1+\phi_1 S)\frac{1}{1-\gamma}C_2^{1-\gamma}\right) \quad (3.1)$$
$$\text{s.t.} \quad Y = C_1 + \frac{1}{1+r}C_2$$

where C_t is consumption in period t, Y is lifetime income, γ denotes the coefficient of relative risk aversion, δ the discount rate and r the real interest rate. This chapter aims to estimate ϕ_1, the health state dependence parameter. Sickness decreases second period utility with ϕ_0 and multiplies

[3]For sake of simplicity we use a standard intertemporal utility function. Finkelstein et al. 2013 adopt a more general model. Comparing (3.6) and (3.7) in this chapter with equations (9) and (10) in Finkelstein et al. 2013, we find that this leads to the same indirect utility functions in case $b = 1$ and except for ϕ_0, which ends up in β_4 of equation (15) in Finkelstein et al. 2013. When using the more general model, w also includes a parameter for the elasticity of intertemporal substitution. In addition, Finkelstein et al. generalize the model by including health insurance, which covers a fraction b of second-period health expenditures. In the analysis, they select respondents with full health insurance. In the European countries under consideration in this study, most of the medical expenditures are covered by health insurances. Therefore, we assume $b = 1$. In section 3.4.2 we test whether this assumption is justified.

the marginal utility of second period consumption by a factor $(1 + \phi_1)$. We assume $\gamma \geq 0$ and $\phi_1 \geq -1$. By rewriting the budget constraint, we obtain

$$C_1 = Y - \frac{C_2}{1+r}. \tag{3.2}$$

Health in period two is a random variable with probability of sickness p. Combining (3.1) and (3.2) gives us expected utility

$$\begin{aligned} E[U] = {} & \frac{1}{1-\gamma}\left(Y - \frac{C_2}{1+r}\right)^{1-\gamma} \\ & + \frac{1}{1+\delta}\left(-\phi_0 p + \frac{1}{1-\gamma}(1+\phi_1 p)C_2^{1-\gamma}\right) \end{aligned} \tag{3.3}$$

which is maximized for

$$C_1^* = Y - \frac{C_2^*}{1+r} \tag{3.4}$$

where

$$C_2^* = \frac{((1+\phi_1 p)(1+r)/(1+\delta))^{1/\gamma}}{1 + ((1+\phi_1 p)(1+r)/(1+\delta))^{1/\gamma}/(1+r)} Y \equiv wY. \tag{3.5}$$

w is a proportionality factor, which is a function of the probability of sickness, the real interest rate, the discount rate, the coefficient of relative risk aversion, and the health state parameter ϕ_1. In the remainder of this chapter we denote Y to be permanent income. Since permanent income is a fraction of lifetime income, this only changes the definition of w. From (3.5) it follows that indirect second period utility in the healthy and sick state are as follows

$$V(Y, S=0) = \frac{1}{1-\gamma}(wY)^{1-\gamma}, \tag{3.6}$$

$$V(Y, S=1) = -\phi_0 + (1+\phi_1)\frac{1}{1-\gamma}(wY)^{1-\gamma}. \tag{3.7}$$

These two equations are equivalent to equations (9) and (10) in Finkelstein et al. (2013)[4] and show that ϕ_1 can be identified separately from δ in equation (3.1). The idea is that in period 1, before individuals know their future health status, individuals choose how much of permanent income Y to consume in the first period and how much to save for the second period. In the second period health is realized, and individuals experience utility $V(Y, S = 0)$ or $V(Y, S = 1)$, dependent on being in the healthy or the sick state.

We define μ to be the proportionality factor indicating how much extra (or less) income is needed in the sick state to be *financially* as well of as in the healthy state and give it the name 'health equivalence scale' after the more common household equivalence scales, which illustrate how needs change when household size increases. The value of μ is such that

$$V(\mu Y, S = 1) + \phi_0 = V(Y, S = 0). \tag{3.8}$$

That is, μ equates the indirect utility derived from income in the sick state and the healthy state and *does not* capture the direct effect of health on indirect utility. This is in correspondence with the construction of household equivalence scales, which do not take into account the utility derived from having a spouse or children, but only aim to capture economies of scale in a household.

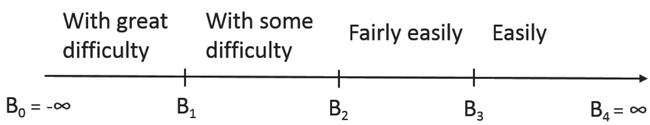
Combining equations (3.6), (3.7), and (3.8) we find that

$$\mu = (1 + \phi_1)^{-\frac{1}{1-\gamma}}. \tag{3.9}$$

The aim of our empirical analysis is to obtain an unbiased estimate of ϕ_1. If we find an unbiased estimate of μ, we can retrieve $\hat{\phi}_1$ using (3.9). To find an estimate of μ we rely on information about financial wellbeing, as we will explain in the following section.

[4] In case $b = 1$ and except for ϕ_0, as explained in footnote 3.

Figure 3.1: Benchmark levels making ends meet



Empirical model 3.2.2

Time periods in the empirical analysis can be thought of as repeated observations of an individual in period 2 of the theoretical model. To estimate the health equivalence scale μ we follow the reasoning of Pradhan and Ravallion (2000). For each individual i in period t we observe answers to a question on financial wellbeing (z_{it}) on a qualitative scale. Answers range from $z_{it} = 1$ to $z_{it} = K$, with higher values corresponding to higher levels of wellbeing.[5]

Financial wellbeing (making ends meet) depends on income and individual specific benchmark levels. Individual i reports financial wellbeing level k if his permanent income Y_i is at or above a certain benchmark B_{k-1}, but below B_k (see figure 3.1 for the situation where $K = 4$), with

$$\ln B_{k,it} = \alpha_k + \rho \ln Y_i + \beta S_{it} + X_{it}\eta + \nu_i + \varepsilon_{it} \quad \text{for } k = 1, \ldots, K-1,$$
$$B_{0,it} = -\infty, \text{ and } B_{K,it} = \infty, \tag{3.10}$$

where S_{it} and Y_i are health status and permanent income, respectively. X_{it} is a vector of time constant and time varying variables of individual i in period t, ν_i an individual specific effect, and ε_{it} errors which we assume to be distributed as standard normal with mean zero and variance one independent of ν_i. Note that the individual benchmark levels $B_{k,it}$ depend on income Y_i. Just as Pradhan and Ravallion (2000), we follow the literature and assume a log-linear specification for the benchmark levels.

[5] Specifically, we observe whether individuals can make ends meet with great difficulty ($z_{it} = 1$), with some difficulty ($z_{it} = 2$), fairly easily ($z_{it} = 3$), or easily ($z_{it} = 4$).

The probability of observing outcome k is given by,

$$\begin{aligned} Prob(z_{it} = k) &= Prob(B_{k-1,it} \leq Y_i < B_{kit}), && (3.11)\\ &= Prob(\ln B_{k-1it} \leq \ln Y_i < \ln B_{kit}), && (3.12)\\ &= Prob(\alpha_{k-1} + \rho \ln Y_i + \beta S_{it} + X_{it}\eta + \nu_i + \varepsilon_{it} && (3.13)\\ &\quad \leq \ln Y_i < \alpha_k + \rho \ln Y_i + \beta S_{it} + X_{it}\eta + \nu_i + \varepsilon_{it}), \\ &= Prob(-\alpha_k + (1-\rho)\ln Y_i - \beta S_{it} - X_{it}\eta - \nu_i && (3.14)\\ &\quad \leq \varepsilon_{it} < -\alpha_{k-1} + (1-\rho)\ln Y_i - \beta S_{it} - X_{it}\eta - \nu_i), \\ &= \Phi(-\alpha_{k-1} + (1-\rho)\ln Y_i - \beta S_{it} - X_{it}\eta - \nu_i) && (3.15)\\ &\quad - \Phi(-\alpha_k + (1-\rho)\ln Y_i - \beta S_{it} - X_{it}\eta - \nu_i), \\ &\quad k = 1, \ldots, K, \end{aligned}$$

such that we estimate the following random effects ordered probit model

$$z^*_{it} = \theta \ln Y_i + \beta S_{it} + X_{it}\eta + \nu_i + \varepsilon_{it}, \quad (3.16)$$

where $\theta = -(1-\rho)$ and where observed ordinal responses z_{it} are generated from a latent continuous response such that

$$z_{it} = \begin{cases} 1 & \text{if } -\alpha_1 < z^*_{it}, \\ 2 & \text{if } -\alpha_2 < z^*_{it} \leq -\alpha_1, \\ \vdots & \\ K & \text{if } z^*_{it} \leq -\alpha_{K-1}. \end{cases} \quad (3.17)$$

To investigate within individual changes in health (and other time varying variables), we follow Mundlak (1978) and parameterize the individual specific effect as a linear function of the average time-varying explanatory variables over time, plus a random individual specific effect that is assumed to be independent of the explanatory variables,

$$\nu_i = \zeta_0 \bar{S}_i + \bar{X}_i \zeta_1 + \xi_i, \quad (3.18)$$

where $\bar{S}_i$ and $\bar{X}_i$ are the individual means of S_{it} and X_{it} respectively (the Mundlak terms) and ξ_i i.i.d. normal distributed with mean zero and variance σ_{ξ}^2.[6] Equation (3.16) can now be rewritten as

$$z_{it}^* = \theta \ln Y_i + \beta S_{it} + X_{it}\eta + \zeta_0 \bar{S}_i + \bar{X}_i \zeta_1 + \xi_i + \varepsilon_{it}. \tag{3.19}$$

μ is defined as the proportionality factor indicating how much extra (or less) income is needed in the sick state to be financially as well off as in the healthy state. From (3.19) it follows that the extra income needed in the sick state to reach the same level of financial wellbeing as in the healthy state is

$$\mu = \exp\left(\frac{\beta}{-\theta}\right), \tag{3.20}$$

combining equations (3.9) and (3.20) shows that $\hat{\phi}_1$ can be consistently estimated by

$$\hat{\phi}_1 = \hat{\mu}^{\gamma-1} - 1 \tag{3.21}$$

$$= \left(\exp\left(\frac{\hat{\beta}}{-\hat{\theta}}\right)\right)^{\gamma-1} - 1, \tag{3.22}$$

where we need to fill in an appropriate value for the risk aversion parameter γ.

Underlying assumptions and threats to identification 3.2.3

To summarize, we identify health state dependence of utility from the effect of a health shock on within individual financial wellbeing. Compared

[6] Permanent income is constant across time. θ is thus identified by variation between individuals and we assume that there are no unobserved characteristics that influence both permanent income and financial wellbeing. If any, however, we would expect a positive correlation between permanent income and the individual unobserved effect. For example, someone has an expensive hobby, therefore he works relatively much and he receives a relatively high permanent income, but he is also demanding and therefore he is more inclined to struggle to make ends meet. In this case the estimated θ is higher than the true θ and this would bias our estimated health state dependence parameter towards zero, whether or not the true state dependence were positive or negative (so, the sign of the health state dependence parameter would not change because of this possible bias).

to other methods this has the advantage that it is sufficient to analyze average compensating differentials within individuals, rather than comparing compensating differentials across poor and rich individuals. In this way the method is less sensitive to bias stemming from unobserved characteristics correlated with income, that influence the effect of a health shock on overall utility. As an example one could think of the distance between individuals and their social network. High income people often live further away from their social network (e.g. a carpenter can find a job near to his family rather easily, whereas the university professor will have more difficulties in finding a job close to his family and will generally move greater distances during his life, which may also lead to friends being more geographically spread, Kalmijn 2006). This may lead high income individuals to suffer relatively more from a negative health shock, when they become physically less able to visit their social network because of the larger distances (e.g. they do not have the energy anymore to bridge large distances). In the second class of models, described in section 3.2, this may bias health state dependence. When using financial wellbeing one does not have to unravel the effect of health on consumption preferences from the effect of health on other aspects of life. This may lead to more precise estimates.

A number of assumptions, however, are still needed when using this approach. First, in the above model we assume that wealth in the sick state is predetermined. Our sample is therefore limited to retired individuals of age 65 and over, such that health shocks do not have a first order effect on income (as in Finkelstein et al. 2013). Threats, however, can occur because of changes in mortality risk, changes in out-of-pocket (OOP) medical expenditures, or when health changes are anticipated. If a health shock increases the (perceived) mortality risk, wealth per remaining year increases and in that way financial wellbeing may increase even if the marginal utility of consumption does not change, leading to a negative bias in the estimates of health state dependence[7]. We cannot control for this in our model, but we compared the results from the full sample to the results from a sample limited to those with more than 75% of wealth

[7]This bias is weakened under the existence of a bequest motive.

annuitized. The results are highly similar, which is as expected since wealth is relatively small compared to income (appendix A). OOP medical expenditures may bias us towards finding positive state dependence. We check for this in section 3.4.2 and find that OOP medical expenditures do not drive our results. In case health changes are anticipated, people who know that they will become sick save more (less) than they otherwise would have in case of positive (negative) health state dependence. Then, the actual health shock will not result in a lower or higher financial wellbeing, biasing our estimate of health state dependence towards zero (but the sign remains correct). Finally, health shocks may decrease home production and/or increase informal care, which can be considered as income in broad terms. In this chapter we consider a narrow income definition, such that the health state dependence parameter increases in case more domestic services and repairs need to be bought in bad health.[8]

Second, a disadvantage stemming from the use of subjective data is that of differential item functioning: different people interpret scales in different ways. An optimistic individual may be more inclined to use the top ends of the scale, whereas one who sees the glass half empty will give answers towards the bottom end of the scale (Ferrer-i Carbonell and Frijters 2004). We take differential item functioning into account by investigating the effect of within individual health transitions on the ability to make ends meet. However, answering styles are not necessarily fixed over time. Health shocks, for example, may change an individual's answering style with regard to financial wellbeing. Our data shows that individuals with limitations report negative feelings more often (such as sadness, self-blame, and irritability), which may influence answering styles. When we add negative and positive feelings as control variables in the model the conclusions do not change (Appendix A.3). However, by including positive and negative feelings in the model we introduce simultaneity bias, such that the cure could be worse than the disease.

[8]This is common in the literature. For example, Finkelstein et al. (2009) mention that the marginal utility of consumption could increase with deteriorating health, as prepared meals or assistance with self-care may be substitutes for good health. Furthermore, Banks et al. (2015), among others, classify domestic services and repairs as 'housing related' expenditures and not as medical spending.

Third, socioeconomic status and other third factors can make it difficult to establish causal relationships. Socioeconomic status (a combination of factors like education, income, and family background) may influence both health and financial wellbeing. As far as it concerns income and education, we control for these variables in the model. As far as it concerns factors such as family background, this is captured by following individuals over time and by analyzing variation in health within individuals. Similarly, if risk aversion is correlated with permanent income or the likelihood of a negative health shock this is controlled for by following individuals over time.

Fourth, people who struggle to make ends meet may experience more stress and this may affect their health negatively (reverse causality). The effect of stress on health is, however, probably more substantial in the long run than in the short run. Long term stress may lead, amongst other things, to a higher probability of cardiovascular diseases and thereby also to more problems with activities of daily living in old age. These long term differences between people, that probably arose already before retirement, are captured by the individual specific effects. Reverse causality may also arise when people who struggle to make ends meet are unable to pay for customary medical interventions. This may lead to a higher probability to encounter health problems. In the European countries under consideration customary medical interventions are generally paid for by health insurance or the government and we do not expect this reverse causality to have a big influence on our results. Finally, a problem may arise when health shocks lead to administrative help and making ends meet improves through this pathway. This would lead to a negative bias in our estimate of ϕ_1.[9]

Fifth, attrition may be systematically related to health. However, there is no reason to assume that the probability of leaving the panel after a health shock depends on the (change in) ability to make ends meet. We thus believe that the results will not be heavily affected by attrition bias.

[9]This is biasing against our finding of positive state-dependent utility, such that the true health state dependence parameter would even be more positive.

Data 3.3

To estimate the parameters of the model we use the Survey of Health, Aging, and Retirement in Europe (SHARE). SHARE is a multidisciplinary database on health, socioeconomic status and social and family networks of individuals aged 50 and over. Data are collected in 2004/2005, 2006/2007, 2008/2009, 2011/2012 and 2013 in several European countries. In 2004/2005 eleven European countries and Israel contributed data to the SHARE project. Over the years, eight more countries started to participate. Data were collected by face-to-face computer-aided personal interviews (CAPI), plus a self-completion drop-off part with questions that require more privacy.

The CAPI questionnaires of waves 1, 2, 4, and 5 are divided into eighteen modules of which the order remained roughly unchanged over the waves.[10] The interview is split in two parts, in between which some physical measurements are taken. The health module is in the first half of the interview, together with a module about demographics, and followed by a module on employment and pensions. Questions about informal care, income, wealth, and consumption take place in the second half of the questionnaire.

It is well known that questions asked earlier in a survey may influence how people respond to later questions. Fortunately, questions about health and about 'making ends meet' (in the consumption module) are in different parts of the questionnaire.

The remainder of this section describes the data used for the baseline regressions. We refer to appendix 3.A for more details and a description of the data used for the additional analyses.

Sample selection 3.3.1

For all households we select the 'household respondent', who answers the question on 'making ends meet'. Furthermore, our interest is in

[10] Wave 3 is a special wave which focuses on people's life histories and collects retrospective information.

Table 3.1: Summary statistics

	mean	sd. within	sd. between	min	max	N
Age	75.85	2.93	5.83	65	102	25827
Male	0.36	0	0.48	0	1	25827
Partner in household	0.41	0.19	0.45	0	1	25827
Highly educated	0.15	0	0.36	0	1	25827

Note: A respondent is considered highly educated with an ISCED level of five or higher.

individuals of age 65 and older, for whom the spouse (if present) is 65 or older, and for whom annual household income from a job or from self-employment is less than 2000 euro. In this way we drop those households for whom a health shock may lead to a substantial loss of income, due to a job loss or early retirement.

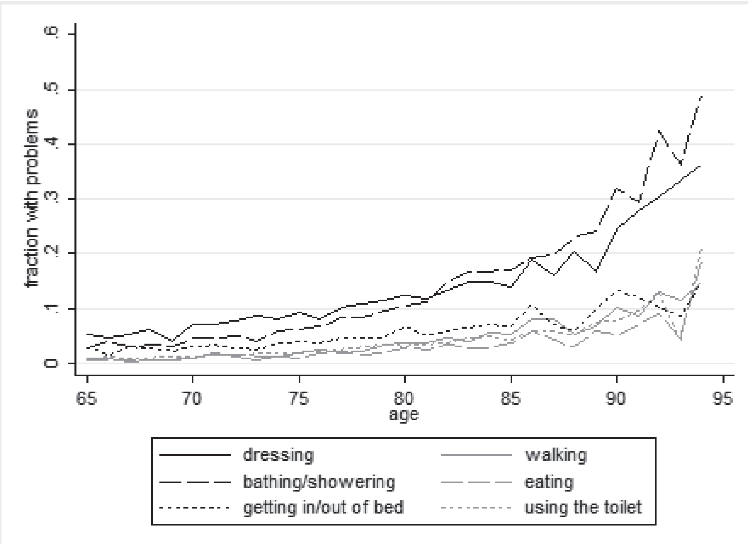
We select singles and 'household respondents' with a spouse and do not consider households with more than two people. SHARE only samples individuals living independently (i.e. not in a nursing home). However, if individuals make a transition into a nursing home over the course of the survey they remain in the sample. We drop individuals who are permanently living in a nursing home and we only consider individuals for whom data on two or more waves are available, so that we are able to measure transitions in health status. Because of this constraint we are left with fifteen countries, namely: Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, Greece, Italy, the Netherlands, Sweden, Czech Republic, Poland, Estonia, and Slovenia.[11] Finally, we drop individuals in the top and bottom percentile of the income distribution, for each wave and country separately. The resulting data set contains 25,827 observations on 10,943 individuals. Table 3.1 shows descriptive statistics.

3.3.2 Health

SHARE includes many different measures of health, ranging from self-perceived health status to reported limitations and major health conditions,

[11]Israel is excluded because their surveys were conducted at different points in time than the rest and differ slightly from those of the other countries.

Figure 3.2: Prevalence of limitations in activities of daily living across age



health care usage, and physical performance measures. In this chapter our main health measure is limitations in activities of daily living (ADL), which are encountered by many in old age. Figure 3.2 plots the prevalence of the six types of limitations in ADL against age. The prevalence of limitations increases with age and the most common problems are those with dressing, bathing, and showering. We define individuals to be 'limited' when they have one or more problems with ADL. 19.5% of the individuals in our sample experience a health shock, measured by the presence of ADL limitations.

The use of ADL limitations has several advantages. First of all, by taking a measure of physical limitations, we focus on that aspect of health that is assumed to be a mediating factor between health and consumption. When considering a measure like the number of chronic diseases, the range of illnesses (from asthma to cancer) could make it hard to differentiate the possible implications of these illnesses to everyday life, hindering interpretation of the estimation results. Moreover, ADL limitations are relatively objective, in the sense that the domains of functionality are narrowly focused and the interviewer can partly validate the answer by observing the respondent.[12] This is important since the variable we aim to explain (making ends meet) has a subjective component. Would the measure of limitations also be subjective (for example self-assessed health status), then correlated errors could bias the results.[13] We also conduct analyses using measures of IADL, chronic disease count, and cognitive functioning. More information on these health measures can be found in Appendix 3.A.1.

3.3.3 Income and assets

SHARE contains data on income, assets, and housing wealth. We construct an aggregated measure of household income by computing the sum of net household income and 5 percent of net financial assets (following Finkelstein et al. 2013).[14] In this way we account for the fact that elderly households may be spending down their accumulated financial savings. As a measure of permanent income we take the average of income over the different waves for each individual. All amounts are equivalized to a one person household using the OECD equivalence scale[15] and ppp-adjusted to 2004 German price levels.

For our selected sample average net household income equals 17,999 euro per year. Net household income is right skewed, with a median of 13,080 euro (substantially lower than the average). The average value of net financial assets equals 31,620 euro, with a median of 7914 euro. Permanent income is on average 19,225 euro, with a median of 15,092 euro. We control for the presence of positive net housing wealth and we add wave dummies to take into account possible effects of the Great Recession.

[12] Mete (2005) calls ADL limitations a quasi-objective health measure by using scare quotes ('objective').

[13] Responses to self-assessed health questions are not that robust. Using SHARE data, Lumsdaine and Exterkate (2013) show that self-assessed health suffers from question order and framing effects, which depend on observable characteristics such as health.

[14] We only use the income and wealth information from the observations included in the sample. If for example an individual is present in all waves, but only retired in wave 4, only the information from wave 4 and 5 is used to construct the permanent income measure.

[15] This means that income is divided by 1.5 for two person households.

Appendix 3.A.2 provides detailed information on income and assets per country.

Like all major household surveys, SHARE suffers from item non-response. In this chapter we make use of the imputations provided by SHARE for total net household income, net financial assets and net housing wealth. A multiple imputation technique has been used, which means that we have five different complete data sets that differ from one another only with respect to the imputed values. To capture uncertainty due to the imputation of missing values we perform the regressions on each dataset separately and then combine the results from all five datasets using the imputation method explained by Christelis (2011).[16]

Making ends meet 3.3.4

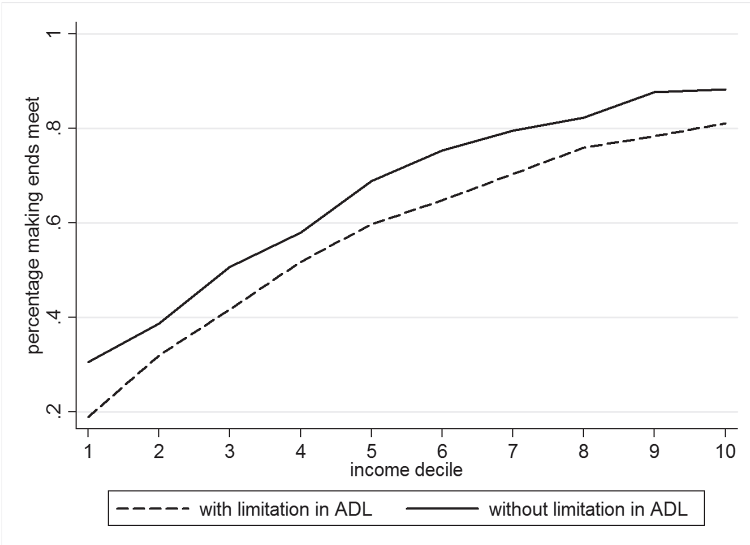
To measure financial wellbeing, respondents were asked the following question:

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

Respondents can answer by choosing either one of the categories (1) with great difficulty, (2) with some difficulty, (3) fairly easily, or (4) easily. Figure 3.3 shows the fraction of individuals without difficulties to make ends meet (i.e. they answered fairly easily, or easily) across income percentiles for two groups: (1) those without any ADL limitations and (2) those with one or more ADL limitations. As expected, the ability to make ends meet increases with income. Moreover, conditional on income, individuals without physical limitations struggle less to make ends meet.

[16]The averages in this section are based on the first set of imputations.

Figure 3.3: 'Making ends meet' across health and income



3.4 Results

3.4.1 Baseline

Column (1) of table 3.2 presents the baseline estimation results. The first coefficient in panel A shows that after a health shock individuals report a lower ability to make ends meet. More income is required after a health shock for individuals to reach the same level of financial wellbeing as before. This is reflected by the health equivalence scale reported in panel B, which has a point estimate of 1.133. This implies that individuals on average need 13.3% more income after a health shock to be financially as well off as before. To calculate the corresponding health state dependence parameter we assume the risk aversion parameter γ to be 3, which is a reasonable value obtained by previous studies (e.g. Skinner 1985, and Palumbo 1999). We find positive health state dependence: the marginal utility of consumption is higher in bad health than in good health, with a proportionality factor of $\widehat{\phi}_1 = 0.284$.

Table 3.2: Baseline results

	(1) baseline	(2) excl. wave 4	(3) excl. wave 4 + OOP med. exp.
A. Estimation results			
limitation	-0.110***	-0.0813	-0.0719
	(0.0353)	(0.0564)	(0.0561)
$\ln(Y)$	0.880***	0.834***	0.844***
	(0.0323)	(0.0476)	(0.0479)
HH OOP med. exp.			-3.75e-05*
			(2.10e-05)
age	-0.0482**	0.00848	0.00786
	(0.0217)	(0.0312)	(0.0313)
has partner in household	0.281***	0.213***	0.216***
	(0.0596)	(0.0810)	(0.0811)
positive housing wealth	-0.0186	-0.0598	-0.0590
	(0.0467)	(0.0799)	(0.0800)
male	0.169***	0.169***	0.169***
	(0.0264)	(0.0410)	(0.0410)
high education	0.328***	0.331***	0.330***
	(0.0371)	(0.0597)	(0.0596)
cut-off point 1	8.552***	8.142***	8.261***
	(0.372)	(0.548)	(0.551)
cut-off point 2	10.14***	9.714***	9.834***
	(0.375)	(0.554)	(0.556)
cut-off point 3	11.63***	11.22***	11.34***
	(0.379)	(0.559)	(0.561)
σ^2_ξ	0.890***	0.895***	0.893***
	(0.0327)	(0.0509)	(0.0507)
Observations	25,827	11,000	11,000
Number of individuals	10,943	4,882	4,882
b. Health state dependence			
unit change in limitations			
Health equivalence scale ($\widehat{\mu}$)	1.133	1.102	1.089
	(1.044, 1.223)	(0.956, 1.249)	(0.947, 1.231)
Health state dependence ($\widehat{\phi}_1$)	0.284	0.215	0.186
	(0.081,0.487)	(-0.108, 0.538)	(-0.124, 0.495)
sd change in limitations			
Health equivalence scale ($\widehat{\mu}$)	1.029	1.022	1.019
	(1.010, 1.047)	(0.992, 1.053)	(0.989, 1.049)
Health state dependence ($\widehat{\phi}_1$)	0.058	0.045	0.039
	(0.020,0.096)	(-0.018, 0.107)	(-0.022, 0.010)

Standard errors clustered at the individual level. Income and OOP medical expenditures in 2004 German euros and equivalized to a one-person household using the OECD equivalence scale. Mundlak terms and dummies for countries, waves, and wave participation are included. $\widehat{\mu}$ and $\widehat{\phi}_1$ are constructed according to equations (3.20) and (3.22), choosing $\gamma = 3$. Panel A: standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Panel B: 95% confidence intervals between parentheses.

In order to be able to compare the results for different kinds of health limitations, we also provide the estimates for a standard deviation change in limitations, rather than a unit change. In this way we can take into account that the scale as well as the severity of limitations differ. After a standard deviation increase in limitations, one needs 2.9% more income to be financially as well off as before, with a health state dependence parameter of 0.058.[17]

3.4.2 Medical costs

For the baseline estimates we assumed that health insurance coverage in Europe is universal and that the insured in Europe have negligible OOP medical expenditures, so that we do not need to worry about private expenditures on health care. However, if individuals do bear medical costs in (some) European countries and are not insured for that, the positive health state dependence of utility that we find could be driven by increased medical expenditures, rather than an increase in the marginal utility of non-medical consumption. OECD (2015) shows that especially in the north of Europe health care is mainly financed by the government and social security. Private OOP medical expenses are low. However, other sources raise concern when it comes to universal coverage and OOP medical expenses (Cylus and Papanicolas 2015, and Scheil-Adlung and Bonan 2012). Therefore, we perform two tests for medical expenditures.

First, we include survey data on OOP medical expenditures in our regression. Unfortunately, data on OOP medical expenditures in SHARE are erratic.[18] The non-response rate is high and as from wave 4 the question components were changed. More importantly, in wave 4 the questions were

[17] The health state dependence parameter is sensitive to the risk aversion parameter γ, however, it does not change the sign of health state dependence. When we assume a risk aversion parameter of 2, health state dependence for a standard deviation change in health is 0.029. When we assume a risk aversion parameter of 4, health state dependence is 0.123.

[18] Therefore, we did not include them in the baseline regression.

temporarily moved to the drop-off questionnaire[19], so that imputations are not available for wave 4. If we want to include OOP medical expenditures we thus need to drop wave 4, leading to a large decline in the number of observations. To facilitate comparisons, we first re-estimate the baseline model on the new (smaller) sample. The results are shown in column (2) of table 3.2. The estimated health state dependence of utility is slightly smaller for this subsample, namely $\widehat{\phi}_1 = 0.215$ and insignificant, probably due to the lack of observations. Next, we add household OOP medical expenditures to the regression, for which the results are shown in column (3) of table 3.2. The point estimate for health state dependence hardly changes, from 0.215 to 0.186. We thus conclude that the presence of OOP medical expenses may lead to a slight overestimation of the health state dependence parameter, but does not drive our results.

Second, we exploit variation in institutions between countries. The data cover fifteen European countries that can be roughly divided into three groups based on their health care system. In the northern European countries the government is mainly responsible for organizing care. In the south/eastern countries, on the contrary, the family of the individual bears the main responsibility for providing care. In central countries, the responsibility for care is shared between the government and the family.[20] Medical costs are likely to be higher in countries where the government plays a small role in health care. Therefore, we expect individuals in central and south/eastern European countries to encounter more medical costs than individuals in northern European countries. In table 3.3 we interact all variables in the baseline model with the north, central and south/east European country groups. In correspondence with the test for OOP medical expenses, we find a slightly higher health state dependence parameter for central and southern/eastern European countries (0.272 and

[19]The drop-off questionnaire is a traditional paper questionnaire separately from the CAPI questionnaire. This questionnaire has a higher non-response than the regular CAPI questionnaire.

[20]Because of the number of observations we group countries together. Verbeek-Oudijk et al. (2014) classify northern countries: Denmark, Sweden, the Netherlands; central countries: Austria, Belgium, France, Germany; and south/eastern countries: Czech Republic, Estonia, Hungary, Italy, Poland, Portugal, Slovenia, Spain, Switzerland. We classified Greece to the south/east group.

Table 3.3: Test for coverage of health care costs

	North	Central	South/East
a. Estimation results			
limitation	-0.0837	-0.106**	-0.113*
	(0.0810)	(0.0525)	(0.0589)
$\ln(Y)$	0.901***	0.876***	0.913***
	(0.0873)	(0.0458)	(0.0533)
age	-0.0662**	-0.0216	-0.0726***
	(0.0264)	(0.0240)	(0.0252)
partner in household	0.483***	0.160	0.270***
	(0.110)	(0.104)	(0.0983)
positive housing wealth	0.266**	-0.0635	-0.0608
	(0.124)	(0.0711)	(0.0706)
male	0.0895	0.258***	0.112***
	(0.0602)	(0.0407)	(0.0433)
high education	0.187**	0.297***	0.485***
	(0.0802)	(0.0515)	(0.0718)
Observations		25,827	
Number of individuals		10,943	
b. Health state dependence			
unit change in limitations			
Health equivalence scale ($\widehat{\mu}$)	1.097	1.128	1.131
	(0.903, 1.292)	(0.995, 1.261)	(0.988, 1.275)
Health state dependence ($\widehat{\phi}_1$)	0.204	0.272	0.280
	(-0.223, 0.632)	(-0.028, 0.573)	(-0.046, 0.606)
sd change in limitations			
Health equivalence scale ($\widehat{\mu}$)	1.020	1.029	1.029
	(0.981, 1.060)	(1.000, 1.058)	(0.999, 1.060)
Health state dependence ($\widehat{\phi}_1$)	0.041	0.059	0.059
	(-0.039, 0.122)	(-0.001, 0.118)	(-0.004, 0.122)

Standard errors are clustered at the individual level. Income is in 2004 German euros and equivalized to a one-person household using the OECD equivalence scale. Mundlak terms and dummies for countries, waves, and wave participation are included. $\widehat{\mu}$ and $\widehat{\phi}_1$ are constructed according to equations (3.20) and (3.22), choosing $\gamma = 3$. Panel A: standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Panel B: 95% confidence intervals between parentheses.

0.280 compared to 0.204). However, health state dependence of utility in the central and south/east European countries is not significantly different from health state dependence in north European countries, suggesting that (OOP) medical expenses are not driving our results.

Alternative health measures 3.4.3

In order to improve our understanding of the mechanisms underlying health state dependence of utility, we re-estimate our model using other health measures. First, we examine problems with instrumental activities of daily living (IADL) and a measure of mobility problems. IADL and mobility problems are composite measures for a range of problems that can be encountered in daily life (just as ADL problems). Examples of IADL are shopping for groceries, taking medications and preparing a hot meal. Examples of mobility tasks are walking 100 meters, climbing stairs, and pulling/pushing large objects. IADL and mobility problems are of a milder nature than the ADL limitations, are observed at a higher frequency, and occur already earlier in life.

Columns (1) and (2) of table 3.4 show that IADL and mobility problems result in slightly larger estimates of health state dependence than ADL problems (0.377 and 0.366, compared to 0.284). This may indicate that, apart from increased preferences for assistance in housework, increased preference for assistance in leisure activities causes the positive effect (e.g. special transport and adapted leisure activities to keep up old ways of living). When physical limitations are mild, one might try hard to maintain the old lifestyle, but if physical limitations become too severe, one rather gives up on some of these activities. When we include the three types of limitations in one model simultaneously, the estimates are not significantly different.

Column (3) of table 3.4 shows that for each additional chronic disease, individuals need about 5.9% more income to be just as well off as before, corresponding to a parameter of health state dependence equal to 0.121. So, also here we measure positive health state dependence. The estimates are highly comparable, with a health state dependence parameter of 0.058

Table 3.4: Results for alternative health measures

	(1) limitations in IADL	(2) limitations in mobility	(3) # chronic diseases	(4) cognitive dysfunctioning
a. Estimation results				
limitation	-0.138***	-0.135***	-0.0501***	0.0807***
	(0.0294)	(0.0283)	(0.0194)	(0.0287)
$\ln(Y)$	0.866***	0.868***	0.878***	0.886***
	(0.0319)	(0.0323)	(0.0316)	(0.0327)
Observations	25,827	25,824	25,797	25,334
Number of id	10,943	10,942	10,928	10,736
b. Health state dependence				
unit change in limitations				
Health equivalence scale ($\widehat{\mu}$)	1.173	1.169	1.059	0.913
	(1.094, 1.252)	(1.093, 1.244)	(1.013, 1.105)	(0.855, 0.971)
Health state dependence ($\widehat{\phi}_1$)	0.377	0.366	0.121	-0.166
	(0.191, 0.562)	(0.190, 0.542)	(0.024, 0.218)	(-0.272, -0.060)
sd change in limitations				
Health equivalence scale ($\widehat{\mu}$)	1.044	1.044	1.030	0.976
	(1.025, 1.063)	(1.026, 1.063)	(1.007, 1.052)	(0.959, 0.992)
Health state dependence ($\widehat{\phi}_1$)	0.090	0.091	0.060	-0.048
	(0.050, 0.129)	(0.052, 0.130)	(0.013, 0.107)	(-0.081, -0.015)

Standard errors are clustered at the individual level. Income is in 2004 German euros and equivalized to a one-person household using the OECD equivalence scale. Age, dummies for the presence of a partner in the household, positive housing wealth, gender, education, countries, waves, and wave participation are included in addition to Mundlak terms. $\widehat{\mu}$ and $\widehat{\phi}_1$ are constructed according to equations (3.20) and (3.22), choosing $\gamma = 3$. Panel A: standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Panel B: 95% confidence intervals between parentheses.

for a standard deviation in ADL limitations and a parameter of 0.060 for a standard deviation in the number of chronic diseases. This strengthens our baseline results.

In addition to measures of physical health, column (4) of table 3.4 shows the results for cognitive functioning as a measure of health status. As individuals age, their ability to take initiative, to plan, and to organize activities decreases. This is, amongst others, probably due to a decline in the functioning of the frontal lobe, which is vulnerable to the effects of aging (this has been found both in behavioral and MRI studies, Craik and Grady 2002). The frontal lobe is also heavily demanded in memory tasks. In this study we use a test on long term word recall to construct a measure of cognitive functioning.[21] Whereas we find a positive effect of physical limitations on the marginal utility of consumption, we find that cognitive limitations have a negative effect on the marginal utility of consumption. This suggests that, in contrast to individuals with physical limitations, individuals that experience a cognitive decline probably might not be willing to invest in adapted activities, as their motivation and will to undertake any activities declines.[22]

Robustness checks 3.4.4

The functional form of a model may have an impact on the size of the coefficients. Following the method of Pradhan and Ravallion (2000) we estimate the coefficients using a random effects ordered probit model. However, one could also think about a linear specification. Riedl and Geishecker (2014) compare linear and nonlinear ordered response estimators and find that in general the choice seems to have little effect on the size of ratios of estimated coefficient. Column (2) of table 3.5 shows the results for the linear specification. The estimated health state depen-

[21]See appendix 3.A for more details on the measure of cognitive functioning.

[22]One could argue that after a negative shock in cognitive health, administrative help may increase, and this could be the reason that making ends meet improves. However, only 6.8% of the individuals with a negative shock in cognitive health start to receive administrative help between two waves, which is not significantly different from those without a negative shock in cognitive health (on average 8.3% of them start to receive administrative help from one wave to the other).

Table 3.5: Specification checks

	(1)	(2)	(3)	(4)	(5)	(6)
		specification:			exclude individuals with	
	baseline	linear	country x year FE	< 75% wealth annuitized	low perm. income (Q1)	high perm. income (Q4)
a. Estimation results						
limitation	-0.110***	-0.0603***	-0.112***	-0.115***	-0.146***	-0.105**
	(0.0353)	(0.0196)	(0.0354)	(0.0372)	(0.0454)	(0.0419)
$\ln(Y)$	0.880***	0.468***	0.899***	1.130***	0.636***	1.214***
	(0.0323)	(0.0161)	(0.0331)	(0.0390)	(0.0469)	(0.0575)
age	-0.0482**	-0.0262**	-0.0393*	-0.0233	-0.0556**	-0.0251
	(0.0217)	(0.0116)	(0.0237)	(0.0221)	(0.0246)	(0.0239)
Observations	25,827	25,827	25,827	23,946	17,441	16,727
Number of id	10,943	10,943	10,943	10,224	7,412	7,123
b. Health parameter estimates						
unit change in limitations						
Health equivalence scale ($\widehat{\mu}$)	1.133	1.138	1.132	1.107	1.258	1.09
	(1.044, 1.223)	(1.044, 1.231)	(1.044, 1.220)	(1.035, 1.179)	(1.078, 1.438)	(1.016, 1.164)
Health state dependence ($\widehat{\phi}_1$)	0.284	0.294	0.281	0.226	0.582	0.188
	(0.081,0.487)	(0.081, 0.507)	(0.082, 0.480)	(0.067, 0.385)	(0.129, 1.035)	(0.026, 0.35)
sd change in limitations						
Health equivalence scale ($\widehat{\mu}$)	1.029	1.03	1.029	1.023	1.051	1.02
	(1.010, 1.047)	(1.001, 1.049)	(1.010, 1.047)	(1.008, 1.038)	(1.018, 1.083)	(1.004, 1.037)
Health state dependence ($\widehat{\phi}_1$)	0.058	0.06	0.058	0.047	0.104	0.041
	(0.020,0.096)	(0.021, 0.100)	(0.021, 0.095)	(0.016, 0.077)	(0.036, 0.172)	(0.008, 0.075)

Standard errors are clustered at the individual level. Income is in 2004 German euros and equivalized to a one-person household using the OECD equivalence scale. Age, dummies for the presence of a partner in the household, positive housing wealth, gender, education, countries, waves, and wave participation are included in addition to Mundlak terms. $\widehat{\mu}$ and $\widehat{\phi}_1$ are constructed according to equations (3.20) and (3.22), choosing $\gamma = 3$. Panel A: standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Panel B: 95% confidence interval between parentheses.

dence parameter is very similar (0.294 compared to 0.284). Also, including country-by-year fixed effects rather than country effects and year effects separately (to account for possible country-specific shocks), does not affect our results (0.281 compared to 0.284), as shown in column (3).

An important assumption underlying our model is that permanent income is not affected by health. This does not need to be the case since a health shock can affect life expectancy and thereby the amount of wealth that can be consumed each remaining year. When we rerun our model on the subsample of households with 75% of wealth annuitized the results hardly change (column (4) of table 3.5), so that our assumption seems justified.

Financial wellbeing is measured on a four-point scale. The fact that the scale is finite may lead to a bias in our estimates. The baseline estimates show that, on average, individuals rate their financial wellbeing lower after a health shock than before. Now imagine a healthy individual who is very dissatisfied with his or her financial situation. When this individual experiences a health shock, (s)he might experience an even lower financial wellbeing than before, but cannot express this in the answer to the survey question, because he was already at the lowest category of financial wellbeing. This would bias our estimate of the health state dependence of utility downward.

As a robustness check we therefore repeat the baseline regression, while excluding those in the lowest or highest income quartile for each country within the selected sample. As shown in figure 3.3, healthy individuals with low incomes often provide answers on the bottom end of the scale. Therefore, we would expect to find a larger decline in financial wellbeing after a health shock and thus a higher estimate of health state dependence when excluding the lowest income quartile. Indeed, as shown in column (5) of table 3.5, the estimated parameter is larger than in the baseline (0.582 compared to 0.284). The higher estimate can also be the result of heterogeneous effects for poor and rich individuals. In any case, the positive health state dependence found in our baseline specification remains convincing. This also holds when we exclude the highest income quartile for each country (column (6) of table 3.5).

In a recent paper, Finkelstein et al. (2013) find negative health state dependence using a measure of chronic disease count on a sample of elderly US citizens. For a comparable sample to ours (age ≥ 65, not in the labor force, and with health insurance) and under the assumption of $\gamma = 3$, they find a proportionality factor of -0.142 for a one standard deviation change in limitations.[23] To ensure that these differences in estimates do not stem from methodological differences, we re-estimate the model of Finkelstein et al. (2013) on our dataset.[24] Our hypothesis is that as long as there are no unobserved characteristics that are correlated with income and have an effect on the change in utility after a health shock, the methods should provide roughly the same results.

Finkelstein et al. (2013) use happiness as a proxy for utility. Unfortunately, this variable is not available in SHARE. Instead, we use general life satisfaction. General life satisfaction and happiness are no exchangeable concepts (as pointed out by Kahneman and Deaton 2010), but we believe it suffices for this context. We apply a linear random effect specification with Mundlak terms to deal with possible problems of endogeneity. Because the answering scale of the life satisfaction question was different in wave 1 than in the other waves, we drop wave 1 for this part of the analysis. Column (1) of table 3.6 shows the results of the baseline regression excluding the observations of wave 1. The estimate is almost equal to the estimate including wave 1, and has only a slightly larger 95% confidence interval. Column (2) shows the estimates based on the same sample, but using overall life satisfaction and the method of Finkelstein et al. (2013). We find the same sign of health state dependence, but the coefficient is somewhat larger ($\hat{\phi}_1 = 0.438$ instead of 0.285) and not significant. Lastly, we re-estimate column (2) using the same health measure as Finkelstein et al. (2013), namely the number of chronic diseases. This measure has been constructed in correspondence with the baseline health measure used in Finkelstein et al. (2013). As shown in column (3) of table 3.6 we find an

[23] See table 3, column 2b of Finkelstein et al. (2013).

[24] The alternative, to apply our method to the HRS data, unfortunately will not work, since individuals in this dataset are likely to have out-of-pocket health expenditures (also when they are insured), which are not recorded in the data.

Table 3.6: Robustness check: method

	(1) Baseline excl. wave 1	(2) Method Finkelstein et al. (2013)	(3)
	at least one ADL	at least one ADL	# chronic diseases
a. Estimation results			
limitation	-0.114***	-0.295***	-0.114***
	(0.0400)	(0.0513)	(0.0270)
$\ln(Y)$	0.911***		
	(0.0367)		
$Y^{1-\gamma}$		-0.0801***	-0.0773***
		(0.0195)	(0.0281)
limitation$*(Y^{1-\gamma})$		-0.0351	-0.0316*
		(0.0391)	(0.0179)
age	-0.0727**	-0.0123	-0.00427
	(0.0307)	(0.0371)	(0.0376)
partner in household	0.344***	0.257***	0.249***
	(0.0711)	(0.0786)	(0.0785)
positive housing wealth	0.0195	0.0222	0.0213
	(0.0526)	(0.0616)	(0.0617)
male	0.201***	0.00546	0.00868
	(0.0292)	(0.0316)	(0.0321)
high education	0.306***	0.244***	0.261***
	(0.0402)	(0.0378)	(0.0379)
Observations	20,025	20,508	20,490
Number of individuals	9,022	9,222	9,213
b. Health state dependence			
unit change in limitations			
Health state dependence ($\widehat{\phi}_1$)	0.285	0.438	0.409
	(0.063, 0.507)	(-0.540, 1.417)	(-0.102, 0.919)
sd change in limitations			
Health state dependence ($\widehat{\phi}_1$)	0.057	0.098	0.192
	(0.017, 0.098)	(-0.121, 0.316)	(-0.048, 0.431)

Dependent variable: general life satisfaction. Standard errors are clustered at the individual level. Income is in 2004 German euros and equivalized to a one-person household using the OECD equivalence scale. For sake of readability of the coefficients in column (2) and (3) Y is divided by 10,000. Mundlak terms and dummies for countries, waves, and wave participation are included. For the calculation of health state dependence in column (1) and the construction of the income measure in columns (2) and (3) we assume $\gamma = 3$. Panel A: standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Panel B: 95% confidence intervals between parentheses.

estimate of 0.192 (insignificant at a 5% level) for a one standard deviation change in limitations.

This analysis shows that the contradictory signs of the health state dependence of utility found between the US and Europe seem to be due to heterogeneity in the population, as opposed to methodological differences. This may be due to cultural differences, institutional differences or differences in consumption patterns. Banks et al. (2015) compare life-cycle consumption patterns for the US and the UK.[25] They show that budget shares on recreation are higher in the UK than in the US. If people in Europe find recreation a more essential consumption good than people in the US, they may need more money to keep doing these activities in bad health (e.g. more help and assistance during a holiday). Transportation costs, on the other hand, are relatively high in the US compared to the UK (maybe because of the longer distances in the US). The question arises whether Americans still incur these costs when they become sick. If not, this may explain (part of the) negative health state dependence in the US. Future research on consumption data is needed to provide clear answers.

3.5 Conclusion

This chapter estimates health state dependence of utility in Europe. We develop an approach that uses insights from the domain of living standards and income adequacy (Pradhan and Ravallion 2000). We derive a simple relationship between the health state dependence parameter within the optimal life cycle framework and a so called 'health equivalence scale', which we define as the relative change in income needed to maintain the same level of financial wellbeing after a health shock. This allows us to identify health state dependence of utility using a measure of financial wellbeing. Compared to other observed utility approaches a benefit of this method is that it does not require to compare individual level changes at different income levels to overcome the obstacle that health shocks affect both the level and shape of the utility function. Since making ends meet is

[25] The UK is not included in SHARE, but this comparison may give us some clue about differences between the US and Europe.

a common question in questionnaires, this method can easily be used by researchers all over the world.

We implement the approach using panel data from the Survey of Health, Aging and Retirement in Europe. Our baseline estimates show positive health state dependence of the utility function, with a proportionality factor equal to 0.284 in the presence of ADL limitations. We show that our results are not driven by medical expenditures, and that they are robust against alternative physical health measures and specifications. Interestingly, for cognitive health limitations we find negative health state dependence. When cognitive health declines, people's ability to plan, organize, and take initiative becomes worse. These developments seem to lower the marginal utility of consumption.

To compare the results for the US and Europe, we also apply the approach of Finkelstein et al. (2013) on the SHARE data. Because of data limitations the comparison is not completely clean, but again, we find positive health state dependence. The sign thus remains the same, however, the coefficient is somewhat larger and not significantly different from zero. Remarkably, for the European countries in our sample we find positive health state dependence repeatedly, whereas Finkelstein et al. (2013) find negative health state dependence in the US for the same age group (retirees). The results suggest that this is due to heterogeneity in the population as opposed to methodological differences. Differences in consumption patterns, such as budget shares on leisure and transportation may explain the contradictory signs in the US and Europe for health state dependence of the utility function. Further research on consumption patterns is needed to explain this difference. Further research could also aim at exploring heterogeneities in health state dependence of utility across individuals with different characteristics.

The health state dependence parameter is important for many economic questions such as the optimal savings rate and the optimal level of health insurance. Positive health state dependence implies that both the optimal savings rate and the optimal level of health insurance increase, relative to the situation where health state dependence is not taken into account. However, in old age cognitive health also declines and this lowers the marginal utility of consumption. As far as health limitations occur early in the life-cycle when people are in good cognitive health, extra money may be desirable to be able to keep doing (leisure) activities. On the other hand, in old age, where health limitations coincide with a decline in cognitive health, our results show that extra money or a high insurance for health costs is less necessary.

Additional descriptive statistics 3.A

This appendix provides details about the data and a description of the data used for the additional analyses.

Health 3.A.1

This chapter uses five different health measures. In the baseline analysis we use data on limitations in activities of daily living, described in section 3.3. In the additional analyses we use data on instrumental activities of daily living, physical mobility, the number of chronic diseases and cognitive functioning. This section provides a description of these variables.

IADL and mobility

Both limitations in instrumental activities of daily living (IADL) and limitations in physical mobility are closely related to limitations in activities of daily living (ADL). IADL is scored with a list of seven activities: (1) using a map to get around, (2) preparing a hot meal, (3) shopping for groceries, (4) making telephone calls, (5) taking medications, (6) working around the house or garden, and (7) managing money. These type of limitations are slightly milder than limitations with ADL, therefore are more prevalent: 26% of observations have at least one limitation in IADL, see table 3.7. The most common limitations are limitations with house and garden work, grocery shopping and using a map. After the age of 80 also problems with managing money and preparing a hot meal start to become more prevalent, see figure 3.4.

Table 3.7: Summary statistics for health variables

	mean	sd. within	sd. between	min	max	N
limitation in ADL	0.16	0.29	0.23	0	1	25827
# chronic disease	1.59	0.65	1.03	0	7	25797
limitation in IADL	0.26	0.34	0.28	0	1	25827
limitation in mobility	0.65	0.35	0.32	0	1	25824
limitation in cognitive ability	0.75	0.35	0.26	0	1	25334

Figure 3.4: Limitations in instrumental activities of daily living across age

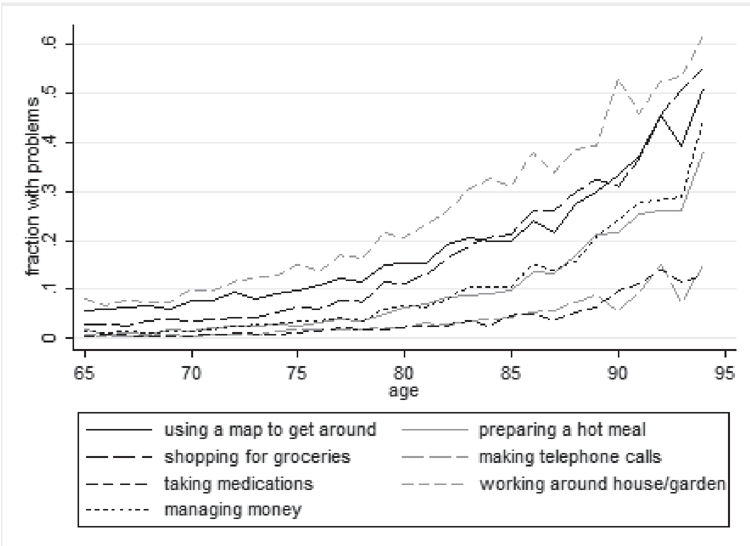
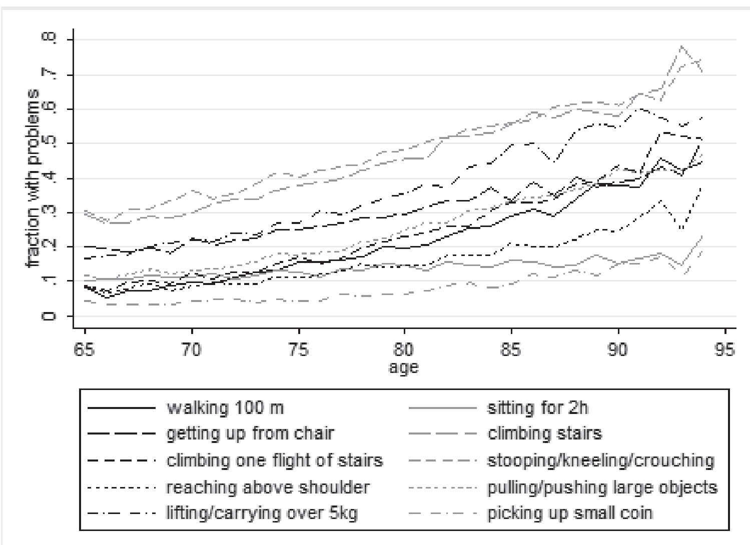


Figure 3.5: Limitations in physical mobility across age



Physical mobility is scored with a list of ten activities: (1) walking 100m, (2) sitting for 2 hours, (3) getting up from a chair, (4) climbing stairs, (5) climbing one flight of stairs, (6) stooping, kneeling or crouching, (7) reaching above one's shoulder, (8) pulling or pushing large objects, (9) lifting or carrying over 5kg, and (10) picking up a small coin. These limitations are even milder than those listed for IADL, not only do more individuals experience these type of limitations (65% of all observations, see table 3.7), also they start to appear earlier in life. At early ages individuals often report problems with stooping, kneeling or crouching or climbing stairs, followed by sitting for 2 hours and getting up from a chair, see figure 3.5.

As the listed limitations in physical mobility and IADL are slightly milder than those in ADL, often individuals who report to have limitations in ADL, also report to have limitations in one of the other categories. Figure 3.6 shows the prevalence of the different limitations across age.

Chronic diseases

The prevalence of chronic diseases is an objective measure of health which is often used in the literature. For sake of comparability, we construct this variable in correspondence with Finkelstein et al. (2013). SHARE contains a list of 18 chronic diseases (three of which are not included in the first wave), for which the respondents should indicate whether a doctor has ever told that them they had or that they are currently being treated for or bothered by that condition. We include (1) heart attack/heart problems, (2) high blood pressure/hypertension, (3) stroke/cerebral vascular disease, (4) diabetes/high blood sugar, (5) chronic lung disease (e.g. chronic bronchitis or emphysema), (6) arthritis, including osteoarthritis or rheumatism, (7) cancer or malignant tumor, including leukemia or lymphoma, but excluding minor skin cancers. Contrary to ADL limitations, chronic diseases are considered permanent. For each chronic disease, prevalence is modeled as an absorbing state. 82% of the person-year observations have at least 1 chronic disease. High blood pressure and arthritis are the most common diseases, see figure 3.7.

Figure 3.6: Different type of limitations across age

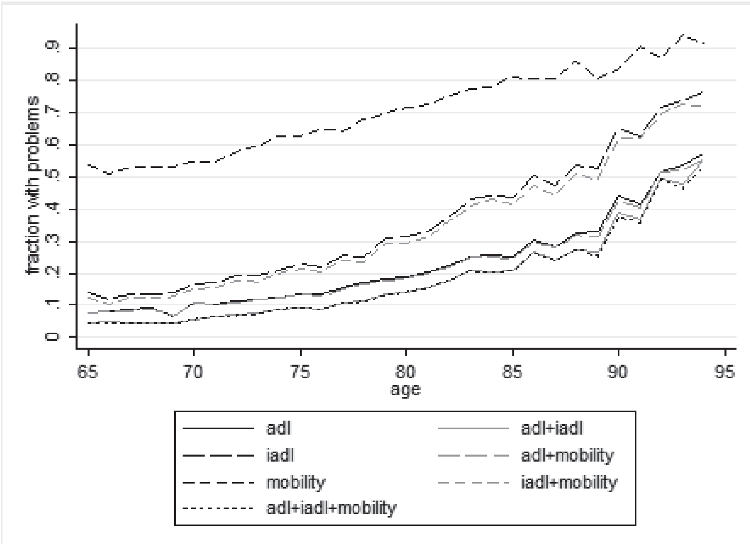
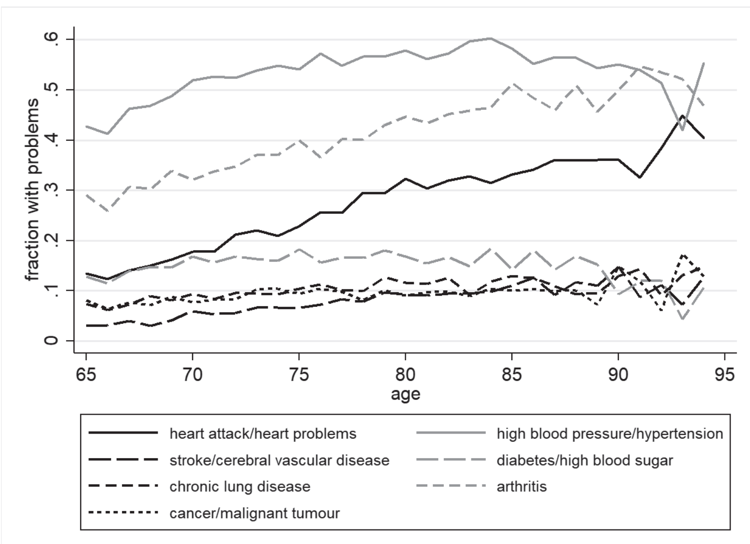


Figure 3.7: Chronic diseases across age



Cognitive functioning

Cognitive functions encompass aspects like attention, memory, perception, language, and decision making (Glisky 2007). As individuals age cognitive functioning may decline, such that the ability to take initiative, plan, and organize activities decreases and individuals experience more fear.

Our measure of cognitive functioning is based on a word recall question. The interviewer reads a list of 10 words to the survey respondent. After the interviewer is finished he asks the respondent to recall aloud as many words as possible, in any order. The number of words that the respondent remembers is stored and seen as the ability of short term recall. After this task the respondent is given a verbal fluency task and a series of computational tasks. Then he is asked again to remember aloud the words provided in the beginning of the series of tasks, in any order. He gets one minute to complete the task. The amount of words that the respondent remembers at this point is seen as the ability of long term recall. We use this second variable to measure cognitive functioning: the more words one can remember, the higher the cognitive functioning. We dichotomize the variables, in correspondence with the other health measures, by defining someone to experience cognitive limitations if the number of words recalled is less than average in our sample (5/10 words recalled). According to this cut off 75% of individuals has a limitation in cognitive functioning, see table 3.7.

Income and assets 3.A.2

SHARE contains detailed questionnaires on income and assets. Different income components are elicited stepwise, so that we can be sure transfers from private and public pension programs are earmarked as income.

Over the years there are some slight changes in the wording of the questionnaire. Most importantly, in the first wave the respondents are asked to provide gross amounts of income, whereas from wave two on net amounts are elicited. To correct for this we translated the gross amounts to net amounts using information from the OECD on each country's average

Table 3.8: Income split up by component and country

	permanent income		household income			financial wealth			housing			
				conditional on ownership			conditional on ownership			conditional on ownership		
	mean	median	owner	mean	median	owner	mean	median	owner	mean	median	N
Austria	18648	16183	1.00	18108	15562	0.92	13938	4231	0.46	164692	132314	2415
Germany	17899	16205	1.00	16990	15065	0.92	22548	9078	0.54	146961	125253	1259
Sweden	25376	23371	1.00	23715	18625	0.91	37430	20317	0.68	94539	64884	2005
Netherlands	24796	20786	1.00	23420	17802	0.96	34800	11185	0.49	189272	173505	1790
Spain	10651	9052	0.99	10366	8766	0.87	9472	2110	0.93	149524	101360	1519
Italy	12912	10771	0.98	12640	10373	0.76	14658	5901	0.80	138570	110357	1622
France	21227	18023	1.00	19196	15741	0.95	43641	10416	0.73	191325	143973	3100
Denmark	18930	16108	1.00	17645	13115	0.89	32815	13731	0.61	106058	76290	1596
Greece	9683	8550	0.98	9635	8169	0.42	11137	5859	0.84	90396	77316	954
Switzerland	34902	29106	1.00	30749	24983	0.95	89015	37597	0.49	317244	210254	1529
Belgium	29053	19547	1.00	26864	15139	0.95	49482	15455	0.75	162389	144667	3069
Czechia	9305	8988	0.98	9101	8887	0.66	10270	5473	0.69	83186	66327	1763
Poland	6223	5549	1.00	6115	5463	0.66	4123	3621	0.71	48101	32429	260
Slovenia	19022	12246	0.99	19029	10301	0.86	4489	502	0.84	116696	92260	804
Estonia	7217	6651	1.00	6558	5829	0.90	15029	2092	0.81	335775	92674	2142
Total	19225	15092	0.99	17999	13080	0.87	31625	7914	0.68	167822	114943	25827

Based on the first set of imputations

tax rate per decile for singles and couples separately.[26] Table 3.8 provides detailed information on income and assets per country.

Positive and negative feelings 3.A.3

Our results may be biased due to time-varying optimism and pessimism correlated with health status lead to changes in answering styles. Although we cannot control for this in a proper way, we do want to check what happens when we include measures of positive and negative feelings in the model. This is not without problems, since by including these variables in our estimating equation we introduce simultaneity bias into our model. The results from this model should thus definitely by interpreted with caution.

Using questions from the EURO-D depression scale, we construct measures of positive and negative feelings, similar to Fischer and Sousa-Poza (2008). Our variable 'negative feelings' is the summation of dummy variables indicating whether an individual experiences feelings of sadness, guilt, and hostility. The variable 'positive feelings' is a summation of dummy variables indicating whether an individual experiences feelings of self-assurance, attentiveness, and joviality. As shown in table 3.9, individuals with ADL limitations tend to experience less positive feelings and more negative feelings. When including the measures of positive and negative feelings to the regressions, the estimated health state dependence parameter is still significant at a 5% level and only slightly smaller than the baseline estimate, 0.208 compared to 0.284 (column (1) of table 3.10).

[26] OECD.stat: Benefits, Taxes and Wages - Net incomes 2004 retrieved from http://stats.oecd.org/Index.aspx?DataSetCode=FIXINCLSA.

Table 3.9: Percentage of respondents experiencing positive and negative feelings.

	$\geq$ 1 ADL problem	no ADL problem
Positive feelings		
- has hopes for the future	66%	82%
- has enjoyed an activity recently	75%	88%
- has good concentration on reading/entertainment	62%	82%
Negative feelings		
- has been sad or depressed in the last month	60%	40%
- has felt to rather be death in the last month	21%	8%
- has feelings of guilt or self-blame	11%	7%
- has been irritable recently	31%	21%
- has cried in the last month	39%	25%

Table 3.10: Results including measures of positive and negative feelings

	(1) baseline	(2) incl. pos. and neg. feelings
a. Estimation results		
limitation	-0.110***	-0.0811**
	(0.0353)	(0.0361)
$\ln(Y)$	0.880***	0.857***
	(0.0323)	(0.0322)
age	-0.0482**	-0.0243
	(0.0217)	(0.0217)
positive feelings		0.0720***
		(0.0164)
negative feelings		-0.0333***
		(0.0121)
Observations	25,827	25,128
Number of id	10,943	10,658
b. Health parameter estimates		
unit change in limitations		
Health equivalence scale ($\widehat{\mu}$)	1.133	1.099
	(1.044, 1.223)	(1.008, 1.190)
Health state dependence ($\widehat{\phi}_1$)	0.284	0.208
	(0.081,0.487)	(0.008, 0.409)
sd change in limitations		
Health equivalence scale ($\widehat{\mu}$)	1.029	1.021
	(1.010, 1.047)	(1.002, 1.04)
Health state dependence ($\widehat{\phi}_1$)	0.058	0.043
	(0.020,0.096)	(0.005, 0.082)

Standard errors are clustered at the individual level. Income is in 2004 German euros and equivalized to a one-person household using the OECD equivalence scale. For sake of readability of the coefficients in column (2) and (3) Y is divided by 10,000. Mundlak terms and dummies for countries, waves, and wave participation are included. For the calculation of health state dependence in column (1) and the construction of the income measure in columns (2) and (3) we assume $\gamma = 3$. Panel A: standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Panel B: 95% confidence intervals between parentheses.