Università
Ca'Foscari
Venezia

Corso di Dottorato di ricerca
in Economia

ciclo XXXII

The effect of health on the marginal utility of consumption expenditures and on attitudes towards risk

SSD: SECS-P/01

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Acknowledgements

First and foremost I am grateful to my supervisor Agar Brugiavini for her support and guidance during these years, for showing me with patience that being a researcher involves time, dedication and critical thinking.

A special thanks goes to my second supervisor Irene Mammi, for helping me figuring out where I was going with my research, for the hard work during the submission time, including all the last minute sprints, that I will never ever forget.

I am grateful to James Banks for all the moments he dedicated me during my visiting period at The University of Manchester. Thank you James for our insightful discussions, for being such a source of inspiration and support during my Phd journey.

My sincere thanks for helpful comments and constructive suggestions to Giacomo Pasini, Cinzia Di Novi and Marteen Lindeboom.

From my heart, a huge thanks goes to my dearest colleagues Caterina, Arianna, Irene, Giulio, Andrea and Francesco. I could not have had a better team during these three years. We were as close as a family and we did a great job all together. I wish everyone could find people like you in their life.

Many thanks also to my Mancunian friends (although none of them is really from Manchester :)): Josefina, Nico, Tatiana, Andrea and Myroslav. My time with you made me feel at home.

Thanks to all my colleagues in Venice, to my good home-town friends and to all new friends met in Venice. Special mention to Yao, Luca, Giovanna and Matteo.

To my mum and my beloved dad, for all their love, for all the books they bought me since I was a kid, and for letting me do what I wanted and chose to pursue this path. To all my family for the support.

Finally, and most of all, to my partner Oliviero, for his love and patience, for all the flights we took to pursue our careers and for being always on my side. We made through this, we will go further.

My PhD has been like one of the half-marathon that I used to run: at the beginning of the training it was hard and stressful, then steady and rewarding, and at the end, as all the great experiences in life, it was over before I could even realize it.

Life as a PhD student is a beautiful journey. Embrace every day.

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Preface

Standard models of microeconomic theory have relied on the hypothesis that the individual's preferences are stable over time and, for example, that with one single parameter is possible to capture the degree to which an individual is willing to take risks. However, some scholars have started to question not only the preference stability but also the impact of other factors such as health on the utility specification.

With increasing shares of older people in Western countries, the ageing process has been at the core of the economic research too. Since people live longer, and spend more years at older ages, understanding the effect health deterioration during a life span has become crucial. With the influential contribution of Grossman (1972), health enters the utility function and thus contributes to individual's choices. However, whether health can influence preferences is still under debate (Finkelstein et al. 2009).

This thesis aims to address some fundamental issues of the microeconomic modeling by implementing an empirical strategy on European data. By focusing on the older generations, I conducted several analyses to disentangle whether health deterioration is able to shape the utility function, influence the marginal utility to consume, and affect risk preferences.

In this framework we outline several effects of health that suggest a re-examination of some of the standard hypothesis of microeconomic theory. Health deterioration is a fundamental factor that will continue to influence older people in developed countries, and its effect might change individual choices and preferences. Classical models of life cycle might underestimate the impact of health.

The thesis is composed of three chapters. Chapter 1, written jointly with Professors James Banks and Irene Mammi, investigates risk attitudes at older ages in 14 European countries. Using panel data we are show that the relationship between financial risk attitudes and age is not due to cohort effects or selective mortality. We also show that key mechanisms driving the change in financial risk attitudes with age are health changes and other life events. In our preferred specification around half of the overall evolution of risk attitudes with age can be explained by health shocks, retirement, and widowhood or marital change that occur increasingly as individuals age. These life-events are a particularly important explanation of the evolution of risk attitudes for women.

Chapter 2 addresses the presence of health state dependence on utility on a panel of European countries. I estimate whether utility depends on the health status of the individual and to what extent health deterioration impacts on the marginal utility to consume. I follow the strategy of Finkelstein et al. (2013) and extend their analysis by focusing on the individuals living in couples. The results show that utility exhibits positive state dependence in the marginal utility to consume with respect to physical health deterioration and negative state dependence for cognitive decline. Furthermore, when focusing on individuals in couples, the female spouse's health influences the male partner's utility and the marginal utility to consume. When focusing on females, we found has no significant effect of the male partner's health. This result points out differences within couples as an additional source of heterogeneity.

Chapter 3 conducts a descriptive analysis of risk and patience attitudes in different domains (general, financial,and health) exploiting the English Longitudinal Study of Ageing (ELSA). I study an English sample representative of the 55+ population and explore the cross validity and behavioral prediction of these elicited preferences. Evidence suggests that the domain-specific measures for risk are correlated. The same applies for the patience measures. Attitudes toward risk exhibit heterogeneity among different class of individuals which we describe through a multinomial logit analysis. Differences in educational attainment seem to explain part of the heterogeneity present in the replies. When focusing on the behavioral prediction, results show that these measures are a good predictor of risky behaviors, in particular of smoking, financial and labor choices. This chapter provides further evidence on the value of financial and health attitudes in shaping the risk and time preferences parameters.

In conclusion, this thesis employs an empirical perspective to examine hypotheses under debate in the economic discipline. Our results demonstrate space to reconsider some of the assumptions of the main microeconomic models. Furthermore, policy makers should take this evidence into account when designing new welfare system policy.

As society evolves through the decades, so should the economic discipline renovate itself and embrace challenges with new foundations.

Chapter 1

Changing Attitudes to Risk at Older Ages: The role of health and other life events[1]

1.1 Introduction

Individual attitudes towards risk shape a broad set of decisions relating to important outcomes such as savings and investments, occupational choice and labour supply, retirement decisions, insurance and health services purchase, health behaviors and lifestyles. As a consequence, the study of the determinants of risk attitudes and risk preferences has attracted a great deal of attention in the economic literature. Amongst the findings of the literature to date it has been shown that richer people display on average a lower degree of risk aversion (Shaw, 1996) and risk attitudes appear to be influenced also by other factors including personality traits (Bucciol and Zarri, 2017), language structure (Chen, 2013) and education (Kapteyn and Teppa (2011) and Outreville (2013)).

Given this background, the way that risk attitudes might evolve over the life-cycle is an important topic for research - the majority of theoretical models assume that risk preferences are time invariant but such a view has been challenged by the empirical literature which shows that risk preferences may vary substantially over the life-cycle (Chuang and Schechter (2015) and Schildberg-Hörisch (2018)). In addition, Dohmen et al. (2011) have shown that older individuals are less willing to take financial risks and in subsequent work Bonsang and Dohmen (2015) argue that such changes in risk attitude might occur via the cognitive decline that happens at older ages. These recent empirical findings motivate our research question which is focused on investigating in more detail the changes in risk attitudes and how they are associated with the broader types of changes and major life events that occur at older ages.

Our specific contribution is to this strand of literature and we document and investigate the change in attitudes to financial risk at older ages in more detail. In particular, we test and extend previous findings and disentangle the impact of life-events from that of ageing, showing that some changes in attitudes towards risk that occur as people age are actually due to life-event related shocks, and importantly to health shocks. We do this using panel data from 14 European countries and

[1] This chapter is based on a joint work with James Banks and Irene Mammi.

exploiting changes over time for the individuals in our data to identify the effects of the typical life-events and health changes that happen as individuals move through old age. To our knowledge we are the first to show that age, life events and health shocks are all independently important drivers of the changes in self-reported financial risk attitudes that occur for older individuals.

Understanding not just the cross-sectional distribution of financial risk attitudes but also the evolution over age and time in the latter part of the life-cycle is also particularly important for policy. With increasing fractions of the population entering older ages due to ageing and demographic change, knowledge of the financial risk attitudes of future older cohorts is essential information for the successful design of important welfare programs. In areas such as pensions, long-term care and health insurance, coverage for risks specific to older ages is typically based on a mix between public and private schemes. Thus gaining insights on the changes in financial risk attitudes that will occur in future generations of the elderly supports policy makers in implementing public programs that will effectively interact with private plans and can improve overall social welfare. Such information is useful also for broader policy interventions related to annuity or insurance markets where, simply due to demographic change and increasing cohort sizes, older cohorts are playing an increasingly relevant role.

Ageing is associated with a number of concurrent processes in multiple dimensions that are likely to affect risk attitudes and the role of each needs to be assessed. Exit from the labour force, increased dependence on pension and annuity incomes, changes in household composition and family ties and the loss of cognitive ability may all contribute to reshape risk preferences. A major role is also potentially played by health changes which are a distinctive feature of the ageing process. Some of these health changes may be a slow and anticipated physiological erosion of general health capital, but in many circumstances there can be large unanticipated shocks such as a trauma or a diagnosis of a chronic condition. In addition to documenting the importance of such health changes and other life-events in changing risk attitudes at older ages, our contribution is to provide some first empirical evidence of the relative important of each of the individual component changes.

In this paper we use data from the Survey of Health Ageing and Retirement in Europe (SHARE) which contains longitudinal measures of self-reported risk attitudes on individuals aged 50+ in 14 different countries. SHARE also contains detailed measurements of other aspects of the respondents' life-course trajectories such as family circumstances, employment and pension arrangements, cognitive function and a large battery of questions on health and health events. With such data we are able to set up a sequence of empirical models to describe and investigate the way in which risk attitudes change with age. Crucially, there are approximately 25,000 individuals in the SHARE sample who have had two measurements of risk attitudes taken so we are able to use this subsample to construct estimators that rely on within-individual changes to identify the effects of interest. We are able to show that the change in risk attitude that is observed at older ages is not just a cross-sectional phenomenon that may be a result of cohort effects or the fact that people with systematically different risk attitude are more likely to survive until older ages — a panel data model with random effects still shows an important and significant role for age.

Following on from this we then investigate the degree to which the mechanisms driving this overall raw age pattern may be actually the kind of life-events that increasingly happen to older individuals as they age. Our analysis confirms the findings of previous literature in that we also find a role for income changes and for cognition changes, although we add to the evidence in this dimension by confirming these findings in a robust panel data specification with controls for individual heterogeneity. However our main contribution is to find and document an important role for other life-events such as widowhood, leaving work, drawing a pension, and also particular health[2]. And we show that our conclusions are robust to a number of different ways of measuring health events. In doing so, we improve upon the existing literature by shedding new light on the main determinants of changes in risk attitudes within individuals over time. But life-events and socio-economic status also play a role in explaining changes in risk attitudes and unless one controls for these one might overstate the important of age in the evolution of risk attitudes. Taken together, when we add controls for all these events to our models they can, on average, explain roughly half of the age pattern observed in the raw data.

With such a large sample we are also able to carry out sub sample analysis, to investigate the sensitivity or robustness of our results but also to consider potentially heterogeneous effect of life-events and age on risk attitudes. We find qualitatively consistent effects, in terms of the importance of life-events and health changes in explaining the evolution of attitudes to financial risk, for the older and younger members of our sample and for men and women. Quantitatively, however, the age patterns in the raw data for those older ages (65 and over) are less marked than in the younger sub-sample and the life events and health changes make a greater contribution to explaining the age pattern for women (of all ages) than for men. Finally, we investigate the geographical heterogeneity in our European sample by taking account of regional differences, with regional clusters being defined by a simple measure of the broad nature of welfare systems. We find systematic differences between country clusters, both in the overall patterns of risk attitudes across geographical groups and also in the way age and life-events affect our risk measure, consistent with the idea that the nature of the welfare state and social protection is a determinant of individuals willingness to take financial risks.

The rest of the paper proceeds as follows: section 2 describes the existing literature, section 3 presents the dataset and its variables, section 4 provides the identification strategy and results; finally section 5 concludes.

1.2 Literature Review

Standard life-cycle models assume that risk preferences do not vary at different stages of life, thus implying that attitudes towards risk remain stable over time (Pratt (1964), Arrow (1971), Stigler and Becker (1977)). Challenges to this prediction have come from theoretical and empirical perspectives. Prospect theory suggests that individuals exhibit different risk preferences when the same choice is presented in different frameworks (Kahneman and Tversky, 1979) and that individuals weight losses and gains with different probabilities, displaying different degrees of risk tolerance. In the empirical literature, experimental studies find variability of risk preferences over time and observational studies show that risk preferences tend to change not only over time but also according to various different domains (Dohmen et al., 2016). Still, there is also some evidence pointing to substantial correlation of individual risk attitudes across alternative domains (Dohmen et al., 2011). Many studies have looked to assess the drivers of changes in risk attitudes and risk preferences, focusing in particular on the effect of factors such as changes in income or cognition, or exogenous shocks such as civil wars and natural disasters (see Chuang and Schechter (2015) and

[2]We only consider a small subset of potential life-events in this study, being limited by the measures captured by the SHARE questionnaire where transitions occur with sufficient frequency to give us statistical power. Whilst we believe employment and health transitions, widowhood and changes in pension status are certainly among the key life-events that are important at older ages, other events, for example those associated with deaths of parents, or the arrival of grandchildren, could be particularly interesting and worthy of investigation in future research.

Schildberg-Hörisch (2018) for and extensive review on these).

One key issue in the resulting literature has been the way in which risk attitudes are measured. Two broad types of studies have emerged, differentiated by whether they use consumer outcomes (often in terms of the riskiness of financial portfolios), which are a function of an individual's preferences and their other circumstances and constraints, or focus on either direct measures such as lottery choices or measures of elicited preferences and attitudes. Our study is in the latter of these groups. Elicited risk attitudes based on individual statements in surveys have been found to have good predictive power for household's choices (Guiso et al. (1996), Guiso and Paiella (2005)). Put differently, the resulting data suggest that stated preferences and attitudes vary across individuals in a way that is consistent with individual behavior. For example, individuals with high stated risk aversion, are less likely to be self-employed or to hold risky securities.

A number of studies have focused on the relationship between fixed individual characteristics and attitude towards risk. The empirical evidence about the association between risk aversion and education is mixed. Some works find a negative correlation between years of education and aversion to risk (Kapteyn and Teppa (2011), and Outreville (2013)), whereas in other cases the relationship appears to be positive (Hersch (1996) and Jianakoplos and Bernasek (1998)). More recently Bucciol and Zarri (2017) and Jones et al. (2018) have stressed also the role of personality traits in financial choices. They argue that personal characteristics such as agreeableness, anxiety and cynical hostility are negatively correlated with risk-taking. Finally, family background can matter – using stated preferences measures, Dohmen et al. (2012) show that attitudes towards risk and trust are passed across generations, suggesting that transmission of family values encompasses various dimensions of economic and social interactions.

When it comes to predicting time-varying risk attitudes, a number of studies have focused on the link between exogenous shocks and risk attitudes. Looking at financial crises, Bucciol and Miniaci (2018) find that background macroeconomic conditions and personal exposure affect propensity to take financial risk. In particular risk tolerance drops when investors enter a recession. The results are in line with Guiso et al. (2018) who highlight that, after the crisis, investors appear significantly more reluctant to take financial risk than before. The shift is not associated with the actual loss they incurred in, but it is rather due to fear and changes in perception. The evidence of correlation with changes in emotions is consistent with prior research (Necker and Ziegelmeyer, 2016). Mixed results emerge from the studies about the effects on risk preferences of conflicts as they find both increase (Voors et al., 2012) and decrease (Callen et al. (2014), (Kim and Lee, 2014) and (Moya, 2018)) in risk aversion. Contributions about the effect of natural events are in general inconclusive (Chuang and Schechter, 2015).

Turning to the specific topic of our paper, the literature has generally found a positive correlation between age and risk aversion. For instance Dohmen et al. (2011) show that risk seeking attitudes are less prevalent at older ages – younger cohorts seem to be more willing to take risk than older ones, with men being less risk averse than women. This relationship does not appear to be monotonic but reaches a plateau around the age of 65. Other studies (Gollier (2002) and Gollier (2004)) get to similar conclusions and find that younger individuals are on average more willing to take risk and argue that such evidence can be rationalised by the fact that consumers at younger ages enjoy a longer expected lifetime horizon and therefore have more opportunity to smooth consumption, including possible losses. More recently, Brooks et al. (2018) use questionnaire data filed by investors meeting their financial advisors to assess the link between ageing and risk attitude. Their study finds a modest influence of age on risk aversion compared to other factors such as retirement or length of the investment horizon. Moreover, cognitive decline does not seem to contribute significantly to explain the lower risk aversion of older investors.

Since the seminal contribution by Grossman (1972), the importance of health status as a component of individual utility functions, and hence choices, is well rooted in economic theory. Health can increase or decrease the marginal utility of consumption – Finkelstein et al. (2013) points to the negative effect of health deterioration on the marginal utility of consumption, but other scholars such as (Lillard and Weiss, 1997) find a positive effect. Health conditions can increase precautionary savings in the face of (uncertain) increases in future health expenditure (Hubbard et al. (1995) and Palumbo (1999)) and health deterioration can trigger the demand for early retirement (Disney et al., 2006), as well as disability benefits (Blundell et al., 2002), or reduction in working hours (Trevisan and Zantomio, 2016). Finally, a stream of work has explored the effect of health deterioration on portfolio choice (Rosen and Wu (2004), Edwards (2008), Atella et al. (2012), Bressan et al. (2014)) and finds that declining health conditions increase the ownership of less risky assets, in line with an increasingly important precautionary savings motive. [3]

Within this stream of literature, one particularly relevant paper is that of Bressan et al. (2014), since it also uses the SHARE data that we use for our study. But even leaving aside the differences in methodological approach, there are also further important differences in the data and empirical analysis used. The authors consider cross sectional data and exploit the first wave of SHARE only, which is not considered in our analysis since it does not include the information on financial risk tolerance. And since Bressan et al. (2014) look at the portfolios of the sub-population of asset holders a further key difference is that their sample comprises the relatively better-off respondents who hold financial assets, instead of all SHARE respondents.

Although the impact of health decline has been analysed in the consumption, saving, labour and portfolio choice literature, its role in shaping the underlying risk attitude directly has not been explicitly addressed in detail. To the best of our knowledge, the effects of health on risk attitudes were first investigated by Hammitt et al. (2009) exploiting a gambling elicitation method. They study the association between income risk tolerance, health and life expectancy on a fairly small sample of individuals from the US (less than 3,000 observations). Their findings point to a positive correlation between health and risk tolerance. Subsequently Sahm (2012) investigated changes in risk tolerance in response to ageing, health shocks and job displacement using US data on hypothetical gambles, finding that risk tolerance differs greatly across individuals, while individual preferences are largely persistent over time.

In stark contrast to the literature on the effect of health and other life-events such as retirement on risky portfolio outcomes and lottery choices, there are few studies using longitudinal data to link health changes to respondent statements on risk attitudes directly. Among these, Decker and Schmitz (2016) exploit longitudinal data from the Socio-economic Panel for Germany. Individual health conditions are proxied by grip-strength. The analysis looks at how grip strength loss relates to risk tolerance. An additional distinctive feature is that the estimating sample covers the entire population aged 20+, whereas our interest is targeted to the elderly population.

Finally, one important paper, which is related to our study, links the health and age dimensions. (Bonsang and Dohmen, 2015) investigate in detail the role of health and cognitive abilities for the same European sample aged 50 and over that we use here, using an indicator that combines numeracy, fluency and memory scores. Based on a single cross-section of SHARE data, their study

[3] Continuing this stream of literature, a recent paper by Jones et al. (2018) investigates the role of personality traits and their interaction with health shocks on stock market participation, using longitudinal data for the US.

documents heterogeneity in risk aversion across age groups, as we do. They argue that the lower willingness of older individuals to take risks can mostly be ascribed to cognitive impairment, while disability or chronic diseases play less of a role.

In contrast to the previous literature, our study builds on the fact that we observe each respondent at two different points in time, and hence we can model the evolution of directly measured financial risk attitudes, life-events and health status as they age. Moreover, our health measures span a comprehensive array of indicators both subjective and objective that account for the multidimensional nature of respondents' health.

1.3 Data

The data for this study is drawn from the SHARE survey which samples individuals aged 50+ from fourteen European countries. The sample of respondents is representative at country level. The survey uses Computer Assisted Personal Interviewing to collect a rich array of information on household characteristics, individual attitudes, socio-economic and health conditions. Hence, it has been extensively exploited to study retirement and health care use by older people (Börsch-Supan et al. (2011) and Börsch-Supan et al. (2015)), as well as savings and investment decisions (Christelis et al. (2013), Bucciol et al. (2017)).

The first wave of SHARE data was collected in 2004/5 and interviews have been taking place every two years since then. Refreshment samples have been periodically added so not all individuals have been present in the data from the start. Six waves of SHARE data are available but our analysis uses three waves – waves 2 (2006/2007), 4 (2011/12) and 5 (2013/14).[4] This selection is due to our analysis exploiting a specific question on respondent's attitude towards financial risk which was only asked in these years as discussed below. Since our aim is to capture the effect of changes in risk attitudes we restrict our analysis to respondents who have answered this question twice. We select individuals who were between 50 to 75 years old at the time of the first measurement of risk attitudes (wave 2 or wave 4), this to avoid attrition due to death by the time of the second measurement (wave 5). This yields an estimation sample of around 25,000 individuals.

1.3.1 The measure of risk attitudes

The dependent variable for our empirical analysis is based on the following question:

When people invest their savings they can choose between assets that give low return with little risk to lose money, for instance a bank account or a safe bond, or assets with a high return but also a higher risk of losing, for instance stocks and shares. Which of the statements on the card comes closest to the amount of financial risk that you are willing to take when you save or make investments?

1. *Take substantial financial risks expecting to earn substantial returns*
2. *Take above average financial risks expecting to earn above average returns*
3. *Take average financial risks expecting to earn average returns*
4. *Not willing to take any financial risks*

[4]See (Börsch-Supan, 2018a), (Börsch-Supan, 2018b) and (Börsch-Supan, 2018c), respectively.

The elicitation method draws upon a well-established question format, included also in the Survey of Consumer Finances[5] and already used in the literature (e.g. Bonsang and Dohmen (2015)). This measure of risk attitudes is considered to be an accurate measure for general studies and demonstrates face validity and construct validity (Grable and Lytton, 2001b). Along these lines, we show in Appendix .1.1 that this measure of risk attitude is a good predictor of the likelihood of owning financial investments in the SHARE sample.

In table 1.1 we present the distribution of responses for each wave separately and for the entire sample. The answers range from 1 (*willing to take substantial financial risks*) to 4 (*not willing to take any financial risk*), but the large majority of respondents concentrates in category 4 (74.18%) and 3 (21.3%), with only a residual share of individuals displaying above average or substantial willingness to take risks. Because of that, we recode the original scores as a dummy variable, which takes value 1 if the respondent is not willing to take any financial risk (category 4) and 0 otherwise (categories 1, 2 or 3). Consequently, our dependent variable cannot be interpreted as an indicator of risk aversion in the formal sense of a parameter in a utility function. Instead we interpret it as a discrete indicator of risk attitudes or simple willingness to take risks.

Figures from 2.2 to 2.5 illustrate the level of risk attitudes across different groups: unwillingness to take risks is higher for women (Fig.1); for individuals not living in couple (Fig.2); it is decreasing in the level of education (Fig.3) and increasing in self-perceived poor health status (Fig.4).

One important aspect of the question and survey design is key to our analysis, and underlies the particular construction of our estimation sample and this concerns the issue of who in the survey received the risk attitudes question in each wave. Only financial respondents (those who were responding to the wealth and income questions on behalf of their couple) were asked the risk preference questions in SHARE wave 2.[6] In wave 4, all respondents who were being added to the SHARE sample for the first time were asked the risk preference questions. In wave 5 all respondents were asked the risk preference questions. Thus there are two types of respondent in SHARE with two measures of the risk preference. Financial respondents at wave 2 had a second measurement of risk attitudes taken six years later at wave 5. And all new respondents in the refreshment sample at wave 4 had a second measurement of risk attitudes taken two years later at wave 5. This rather unique sample design actually gives us more age and time variation than were all respondents to simply have been followed up two years later.

Table 1.2 reports responses for risk attitudes controlling for whether or not the individual was the household financial respondent. Financial respondents in wave 2 were slightly less risk averse than those in wave 4, perhaps since the wave 2 respondents were interviewed in 2004, prior to the start of the economic crisis. But, more importantly, within wave 4 there was no marked difference between the risk attitudes of financial respondents and non-financial respondents suggesting the two parts of our longitudinal sample can be treated similarly. Nevertheless we will still take care to control for respondent type in all the models that we estimate.

When looking at the transitions in risk attitudes from the first to the second measurements, presented in the bottom panel of Table 1.3 for each subset of our sample, common patterns appear among the respondents. Indeed, around half of the individuals that report to be willing to take some risks in the first reply change their answer in the second survey and report an unwillingness to take risks. These transition rates, marginal distributions of risk attitudes and cellsizes are combined

[5]See federalreserve.gov/econres/scfindex for more details.

[6]A small number (n=20) of respondents seem to have been routed into this question in error but we cannot make any inferences from such a small group.

in the calculations which show how the overall sample breaks down across the two measures of risk attitudes. Over half the sample report unwillingness to take financial risks at both measurements (55.5% and 65.4% in the two parts of the sample respectively) but around one quarter of the sample report changes between waves that we will be able to use to identify the key coefficients in our empirical analysis.

1.3.2 Health Measures

Health shocks occurring at older ages have important distinctive features. In particular, despite the treatment provided to patients, they often lead to a permanent deterioration in health status. As a consequence, they can have a deep impact on aspects of life that go beyond the demand of health or long-term care services. Permanent health shocks may influence labour market decisions (e.g. early retirement, reduction in hours worked, etc), affect savings, investments and more general budgetary planning. Hence we examine the health channel as one of the possible drivers of changes in risk attitude, which may be particularly important given that we are focusing on respondents aged 50+ who are relatively more vulnerable to long-lasting traumas and to the onset of chronic conditions. One of our purposes is to test whether an enduring drop in health status, which increases exposure to future medical costs and reduces earning capacity, makes agents less willing to take financial risks.

Given its multidimensional nature, the measurement of health status is a challenging task in empirical analyses. We take advantage of the rich set of information available in the SHARE dataset and we consider a number of different measures that capture both objective and subjective evaluations of respondent's health. Firstly we use a measure (*num_ disease*) that is the simple number of illnesses the patient has received a diagnosis of, from the following list: hypertension, heart disease, lung disease, stroke, diabetes, cancer and arthritis. This measure focuses mainly on chronic or very severe conditions and has been largely used in the literature (see (Smith, 1999), Finkelstein et al. (2013), Trevisan and Zantomio (2016), among others). Second, we use self-preceived health status (*self_ perceived_ health*) with responses ranging from 1 (excellent), 2 (very good) 3 (good), 4 (fair) to 5 (poor). We convert the scores into a binary variable, that takes value 1 for individuals in '*fair*' or '*poor*' health and 0 otherwise. The third measure is based on the major-minor approach (Smith, 2005). It considers seven acute conditions, but separates major from minor ones. Indicator variables are constructed for whether the respondent suffers from any minor illnesses including diabetes, arthritis, and hypertension, or major ones (defined as stroke, cancer, heart, and lung disease). This approach allows investigation of potential differences in the impact of health changes due to disease severity. Finally, we use the health index proposed by Poterba, Venti and Wise (PVW henceforth) (Poterba et al., 2017). The PVW index (*health_ index*) is computed using principal component analysis, based on up to 20 indicators and is the most comprehensive as it combines information from all the other measures, including *self_ perceived_ health* as well as other indicators such as disability. In order to disentangle the effect of subjective evaluation of health in the index, we compute an additional indicator (*health_ index1*) that does not exploit information for *self_ perceived_ health*. When we include *health_ index1*, the measure for self-perceived health is allowed to enter the model separately.

Table A2 in the Appendix presents summary statistics for the health measures in our sample, as well as for the other control variables for each wave and for the three waves considered jointly. On average each individual reports having (almost) one acute disease among cancer, stroke, diabetes, arthritis, hypertension, heart and lung diseases and the number of illnesses increases from the first to the second interview, in line with the health deterioration associated with ageing. Minor diseases are more prevalent than major ones as expected. Despite this, most individuals self-report being in good health, while around one third of them claim to be in fair or poor health. Finally, the PVW index, which is increasing in worse health, is about 3 out of 5, with a high standard deviation, meaning that there is quite high variability within the sample.

1.3.3 Other controls

In order to control for characteristics potentially correlated with risk attitudes and health status, we consider a set of additional indicators, most of which are measured at the individual or household level. We consider time invariant variables such as the respondent being female and years of education (*years_ educ*). The empirical literature has generally found that women are more risk averse than men, so we expect *female* to be positively correlated with risk attitude (Dohmen et al., 2011). Education is expected to be negatively correlated with risk attitudes since more educated people tend to be more risk tolerant (Outreville, 2013).

We also add dummies for countries and respondent 'type', to reflect the key aspects of the SHARE questionnaire design that affect our sample structure. *Type* is coded as 1 if the individual has been interviewed in both wave 2 and wave 5, while 0 corresponds to individuals interviewed in both wave 4 and 5. We expect the coefficients for type to be positive: the interval between the first answer and the second one (wave 5) is longer (6 years) than that for people interviewed in wave 4 (2 years). A larger time span between the first and the second interview possibly increases the probability of observing changes in risk attitudes. Moreover, we interact *age* with *type* to capture the potential effect of belonging to one group or the other. In doing so we also ensure that our age coefficients are flexible enough to allow for differences among these groups, whether these arise from differences in the age patterns of risk attitudes between the two type of respondents, or just because of the longer time elapsed between the two measurements. At the same time, we also make our analysis robust to possible confounding effects of unobserved time effects on our analysis.

We include a quadratic term in age in all our models in order to allow for potentially non linear age effects. We control also for time varying characteristics such as household size (*household_ size*), marital status and occupational status. More precisely, we include dummies for the respondent being single, a widow(er) and being unemployed. Other socio-economic conditions are captured by a measure for permanent income (*pincome*) which we construct by adding 5% of the net financial household wealth to household income as in Finkelstein et al. (2013). We average permanent income across individuals within the household. This measure of income considers not only yearly earnings but also a percentage of net wealth which includes the home value (minus mortgage value if present), household net financial assets and annuities. We expect this measure to be negatively correlated with risk attitudes, since wealthier people tend to be more risk tolerant (Shaw, 1996).

Finally, given the influence of cognitive skills on risk preferences and attitudes (Christelis et al., 2010), we add a '*numeracy*' indicator taking value 1 if the respondent reports an incorrect answer to the question involving a simple financial calculation, and 0 otherwise. Such a measure can thus be interpreted as proxy for poor cognitive skills and hence we might expect it to be correlated with willingness to take risks (see Bonsang and Dohmen (2015)).

1.4 Empirical Strategy and Results

1.4.1 Empirical Strategy

We estimate a random effects probit model by Maximum Likelihood, in which the conditional probability of being unwilling to take risks is specified as:

$$\mathrm{P}(y_{iw} = 1|\boldsymbol{x}_{iw}, c_i) = \Phi(\boldsymbol{x}_{iw}\boldsymbol{\beta} + c_i) \tag{1.1}$$

where $w = 1, 2$ indicates the first or the second wave in which the respondent is interviewed, Φ is the standardised normal cumulative density function and c_i is the individual unobserved heterogeneity assumed to be independent of $\boldsymbol{x}_i$.

In addition to the covariates discussed in the previous sections, we control also for receiving a pension since movement out of the labour market and onto a pension income is a natural potential drive of financial risk attitudes. The expected impact of retirement on risk attitudes is ambiguous given that there are two counteracting effects. On the one hand, whist it is not risk-free, retirement income is likely to be more certain than pre-retirement income given that retirees are not exposed to labour market shocks. On the other hand, the financial consequences of other health or life-related shocks are less insurable once the individual is no longer active, since the worker cannot adjust their labour supply. Hence, which of the two effects prevail in affecting risk attitudes remains an empirical matter. We use the self-reported information provided in the questionnaire about being retired, but, unlike with health events, divorce or widowhood, one might be particularly concerned with potential endogeneity and measurement errors in this variable measure. This concern arises because, on the one hand, both occupational choice and retirement decisions may be endogenous in themselves (see King (1974) and Paiella and Guiso (2004)) and, on the other hand, there might exist country heterogeneity in the definition of being retired and receiving annuities, this potentially leading to measurement error in the pension indicator.

Following Angelini et al. (2009), we exploit institutional information about statutory and early retirement ages [7], and we build our measure of pension through the following procedure.

For each individual we compute:

$$\Delta_{iw}^{ER} = ER_{iw} - Age_{iw} \tag{1.2}$$

$$\Delta_{iw}^{SR} = SR_{iw} - Age_{iw} \tag{1.3}$$

where ER is early retirement age and SR stands for statutory retirement age. These variables indicates the number of years left to early and statutory retirement, respectively.

First we regress the raw indicator for being a pension recipient as obtained from the survey on Δ_{iw}^{ER}, Δ_{iw}^{SR} and the set of controls, specifying the following RE probit model:

$$\mathrm{P}(Pension_{iw} = 1|\boldsymbol{x}_{iw}, c_i) = \Phi(\beta_1\Delta_{iw}^{ER} + \beta_2\Delta_{iw}^{SR} + \boldsymbol{x}_{iw}\boldsymbol{\beta} + c_i). \tag{1.4}$$

We obtain the generalised residuals (Gourieroux et al., 1987) from equation (2.19); then, following a control function approach (see Wooldridge (2015)) for nonlinear models with binary endogenous variables, we estimate the model in (1.1) including the generalised residuals and the raw indicator $Pension$ among the regressors. To account for the inclusion of a generated regressor in the second stage equation, the standard errors for all coefficients are bootstrapped. This strategy allows us to

[7] This information is available from ssa.gov/policy.

address the potential endogeneity of being a pension recipient; furthermore, the Wald test on the coefficient of the generalized residuals provides a straightforward test for endogeneity.

In what follows we estimate three alternative different sets of specifications, each including a full set of country dummies and the control for the waves in which each respondent was interviewed (*type*). The first specification controls solely for age, education, gender and country dummies and is included to provide a simple summary of the raw age patterns that are in the data. Then we run a specification with controls for intervening life-events and in which we address the potential endogeneity of being a pension recipient. Finally, we also include indicators for health events, based on the alternative measures described above. All specifications are estimated on the full sample, and, in Appendix .1.1, we also provide two pieces of additional evidence, splitting our sample by age and gender respectively, to investigate the importance of interactions of these two key variables with our coefficients of interest.

Two final methodological points are necessary before we report our empirical results. Firstly, although sample weights are available in the SHARE survey we do not use them in our analysis. The available weights are cross-sectional weights capturing response patterns in each wave individually but our sample is a complex longitudinally constructed sample comprising a subset of individuals who responded to waves 2 and 5 and a subset of individuals who responded to waves 4 and 5. Hence the use of full wave cross-sectional weights would not be appropriate. Furthermore, our models control for many of the characteristics that are typically used to construct sample weights so our estimated coefficients should at least be robust to non-response along these dimensions. Secondly, since the ageing process, often associated with deterioration in cognitive and physical skills, is a common driver for several control variables we account for the possibility that our estimating equation includes correlated regressors, potentially affecting multiple testing and inference, by adopting the Holm-Bonferroni's correction (Holm, 1979) throughout and adjusting the p-values for the coefficients of age, numeracy and health accordingly[8].

1.4.2 Results

Table 1.4 displays the results for the model presented in equation (1), where the right hand side variable exclude health events. We report average marginal effects, standard errors and p-values. Column (I) shows the effect of age on risk attitudes, controlling only for time invariant individual characteristics (gender and years of education), country dummies and type of respondent in the random effects probit specification. For the age variable, the average marginal effects are calculated from the joint inclusion of the linear, the squared and the interaction terms to account for non-linear effects. Similarly, for the *type* variable, the marginal effect includes interaction terms as well.

As for the results in column (I), we find that risk aversion increases with age, with older respondents being significantly more reluctant to take any financial risk. Such evolution of risk attitude over the life-cycle is in accordance with prior studies and provides a useful benchmark for quantifying the raw age patterns in our data. Unlike previous studies, however, the random effects specification we can adopt here as a result of having longitudinal data, makes our results robust to potential cohort effects or selective mortality that might have accounted for such a relationship in the cross-section.

To give a sense of the magnitude of the estimated effect, getting 10 years older increases the chance

[8]The coefficients of the model estimated with the Holm-Bonferroni's correction are available upon request from the authors.

of being completely unwilling to take risks by about 5 percentage points, other things equal. We find also that females are 10.6 percentage points more likely to be risk averse than males, while one additional year of education decreases the probability of risk aversion by around 1.6 percentage points. Once again, the direction of both effects confirms previous evidence in the literature. Respondent type has a small effect when we take into consideration its interaction with age, even though the sign of the coefficient is positive and in line with expectations.

Finally, we also find evidence of substantial heterogeneity in the level of reported risk aversion across countries.[9] Controlling for such differences is important given that country-specific cultural factors and institutional features might affect risk attitudes in general and reactions to health deterioration in particular. Respondents from Sweden and Denmark are more willing to take risks, in comparison to the Italian benchmark. Other countries such as Spain, Slovenia and Estonia are instead more risk averse at the baseline with respect to the benchmark.

In the remainder of table 1.4 we add time-varying controls to capture income changes and life-events, such as household size, log of permanent income and dummy variables for being single, widow(er), unemployed, and pension recipient. In column II we treat the pension indicator as exogenous and enter the raw information as retrieved from the questionnaire. In column (III) we will use a control function approach to capture the potential endogeneity of the pension status variable, as described above.

The sign and statistical significance of the marginal effect of age on risk attitudes is in line with the previous specification, but the age pattern is attenuated considerably by the inclusion of the life events, suggesting they are a key mechanism underlying the pattern in the raw data: the predicted increase in the probability of being risk averse is now around 3 percentage points for a decade. Thus, the life events added explain about half of the raw age patterns estimated in column (I).

As for the effects of life-events and socio-economic indicators themselves, our estimates show that permanent income is negatively correlated with risk aversion and being unemployed increases the chance of being risk averse by 2 percentage points. Once again our findings are consistent with previous research showing that individuals enjoying higher earnings are relatively less reluctant to take financial risk (Shaw (1996) and Paiella and Guiso (2004)). When treated as exogenous, the effect of receiving a pension decreases risk tolerance by 2.2 percentage points. This effect is significant and rises up to 5 percentage points, however, when we allow for potential endogeneity of the decision to retire and to draw a pension. This is consistent with a conjecture that the loss of the labour market margin of adjustment in response to health-events or life-related shocks outweighs the effects of the change in riskiness of pension as opposed to labour market incomes. The Wald test suggests a strong rejection of the exogeneity of pensioner status (p-value=0.014). In this latter specification, the effect of the unemployment status disappears and the income effect remains unaffected. Since the Wald test on the coefficient of the generalised residuals points to endogeneity of the pension indicator we continue with the control function specification in all subsequent estimates.

Finally, becoming widow(er) increases risk aversion, in line with the conjecture that the presence of a partner may act as an informal insurance device in the face of adverse events, while household size displays generally a negligible effect.

We enrich both specifications in columns II and III further by adding an indicator for low numeracy

[9] For brevity we do not report the average marginal effects on the Country dummies. Coefficients and standard errors are available from the authors on request.

skills, taken as a proxy for cognitive ability. Controlling for deficiencies in cognitive ability in subsequent specifications will be crucial to disentangle the different health channels that might affect risk attitudes and also in separating out health effects from any smooth deterioration due to the progressive loss in cognitive skills associated to ageing. In line with expectations, the sign of the coefficient is positive, indicating that poor cognitive skills are correlated with a reduced propensity to take financial risks. Individuals who fail to respond correctly to the simple calculation task assigned in the survey record a higher probability of being risk averse by about 2.6 percentage points.

Taken together, our findings consistently indicate that the presence of strong age patterns in risk aversion. However, changes in income and cognition capacity, together with relevant life-related events such as drawing pensions, or the presence of a partner, can explain a substantial part of that pattern.

In the next set of models we investigate effects of the health deterioration and health events that may also occur with age, using the array of different health measures that can be retrieved from SHARE. Results are reported in Table 1.5. From column (I) through (V), we include our various different measures of health as discussed in section 3.2. Most notably, health status is always significant and positively correlated with the dependent variable across all the specifications considered — Health deterioration contributes to increased risk aversion, even after controlling for age, socio-economic status, life-related events and cognitive abilities.

Among the health measures, the largest impact is associated with *self_perceived_health*. Respondents that evaluate their health status as relatively poor have a probability of being risk averse that is around 5 percentage points higher than the reference group. This evidence could suggest that changes in self-perception of health status affect the attitude towards risk relatively more than changes due to more objective events such as newly diagnosed diseases, although one might worry about potential correlations between two subjective responses confounding such an interpretation. Consequently it is also interesting to look at the effects of objectively measured health conditions such as the number of diseases or the index of different health and disability indicators. The estimated health effect comes out as relatively small for most of the individual indicators proposed, but strongly significant for all. If we consider the diagnosis of a new disease, this event increases the probability of being risk averse by 0.7 percentage point (column(I)), while a new minor or major disease (column (IV)) increases the chance of risk aversion by 1 and 0.9 percentage point respectively. As for the PWV index (column (III)), a change by about 1.4 percentage points increases the likelihood of being risk adverse. Our results show that self-assessment of health conditions plays a major role among the components of the index, as it is confirmed also by column (V), where the impact of *self_perceived_health* is entered separately from the other components of the index.

Importantly, almost all the effects of the other regressors are preserved in the specification including also the control for health conditions, pension, income, and numeracy variables are both statistically significant after controlling for health. As with the previous specifications with endogenous retirement variables (but excluding health), the not working variable is not statistically significant in columns II and III, presumably as a result of correlations between health, pension status and the ability or willingness to work. When we look at the age coefficients in Table 1.5 it is clear there is no further attenuation of the age coefficients in comparison to Table 1.4 suggesting that the effects of health on risk attitudes are independent of age, in contrast to the life-events and socio-economic controls which, as evidenced in the previous table, were clearly one of the main mechanisms underlying age patterns in the data.

Finally in this section, we also investigate further the joint evolution of risk attitudes, life events and health changes by replicating our analysis on two important sub samples, split by age and gender respectively. The estimated models are presented in Appendix Tables A3 to A4 and show similar effects of health changes across the two age groups but slightly bigger effects of other life events on risk attitudes for the 50–64 age group. More importantly, we find rather different patterns in the way in which both age and life-events impact on risk attitudes for men versus women (Tables A5 to A6). Specifically, a greater proportion of the age pattern in risk attitudes that we observe for women can be explained by life events and socio-economic status.

1.4.3 Geographical Pattern

In this section we discuss the heterogeneity among countries within the SHARE sample in more detail and relate this to a broad characterisation of the welfare systems. Different welfare systems can provide different degree of social protection to individuals and this might translate in different willingness to take financial risks. Our analysis assesses whether there are relevant welfare system effects that may affect individual statements about risk aversion, whether directly or through correlation with other factors, and in particular age. To do so, we group countries in three broad categories based on the exogenous classification by Esping-Andersen (1990). Sweden, Netherlands and Denmark belong to a social democratic welfare system where the state provides high levels of health care for any individuals. Spain, Italy, and France promote a family-based assistance system and are classified as conservative systems, as are Austria, Germany, Switzerland, Belgium and Luxembourg in our analysis. Czech Republic, Estonia and Slovenia are characterized by a recently established welfare system, born after the dissolution of the Soviet Regime. Their welfare systems are considered to be hybrid since they borrowed features from both social democratic and conservative systems. We also include Israel in this group and take this set of countries as the baseline for the analysis.

In Table 1.6 we present the estimates for model (1.1) where we control for class of country/welfare-state through dummy variables capturing whether the country is social-democratic (*social demo*) or conservative (*conserv*) according to the Esping-Andersen classification defined above. We also include interactions of these dummies with age, health, employment status and pension indicator. The top half of the table reports all coefficients and standard errors, including those on the interaction terms, and the bottom panel of the table computes the average marginal effects in each dimension as before.

We expect that individuals from countries that have a more comprehensive welfare system exhibit less reluctance to take risks and indeed this is borne out in our estimates. Many country-type interactions are statistically significant, suggesting that the nature of the welfare state in each of these broad regions (or anything that might be correlated with those systematic welfare state differences) is an important mediator of the effects of life-events, socio-economic circumstances and health on willingness to take risks. The magnitude and the significance of the remaining set of covariates are in line with previous results.

1.5 Conclusion

In this paper, we use survey data to study how risk attitudes over financial decisions change at older ages, and we focus on the role of health deterioration and other life events in shaping individual attitudes. Our analysis covers respondents from 14 European countries and considers country-representative samples of individuals aged between 50-75. Each agent in our sample is interviewed at successive points in time and their willingness to take financial risks is elicited using a question format based on stated preferences. Given the distribution of individual responses, our dependent variable is constructed as a dichotomous indicator that separates individuals not willing to take any financial risk (around three quarters of the responses) from the rest of respondents.

Our empirical strategy relies on the estimation of probit random effect models, where the dummy indicator for risk aversion is regressed against a rich set of explanatory variables that allow controlling for household demographics and socio-economic respondent characteristics as well as unobserved heterogeneity. In addition we control for the endogeneity of retirement and pension status. Thanks to the rich set of information contained in the questionnaire, also we include alternative measures for respondent's health status, comprising both subjective and objective health indicators, as well as a proxy for cognitive deficiency.

Our findings concerning the impact of age on risk attitude fit with previous results in the literature even in this more robust empirical framework — older individuals appear more reluctant to take financial risks than younger respondents do. Yet, the effect comes out as rather small in magnitude once we control for heterogeneity using repeat measures. Moreover, we found that part of this age pattern is due to individuals varying their risk attitude as a consequence of life-events such as becoming unemployed or receiving benefits (disability or invalidity pension for example).

In the same vein, also the effects of proxies for socio-economic conditions are in line with priors and significantly contribute to explain variations in risk attitudes. Permanent income or being employed both reduce risk aversion, consistent with the view that a better socio-economic status and regular flows of earnings contribute to make individuals more willing to take financial risks.

Finally, we also address the potential role of health deterioration and health events on risk attitudes. Previous work had already stressed the importance of controlling for loss of cognitive abilities in order to properly identify the genuine impact of ageing on individual risk attitudes (Bonsang and Dohmen, 2015). Our contribution moves a step forward in that we include in the analysis also an array of alternative health indicators, alongside controls for cognitive skills, and we do so in a framework that is more robust to unobserved heterogeneity. By doing so, we are able to account not only for the progressive cognitive decline associated to ageing, but also for sudden drops in health status, possibly due to events such as the diagnosis of new diseases or traumas. Throughout the ageing process, such negative shocks have often major and enduring consequences in the life of the elderly and their influence should be accurately accounted for. Our empirical evidence consistently shows that health deterioration significantly increases risk aversion, with the largest impact being produced by worsening in self-perceived health status.

On a more general note, our empirical analysis captures changes in attitudes towards risk due to changes in health and life circumstances. But whether such change arises from a change in the underlying risk preference parameters has yet to be established, as the data available to us, and hence our empirical strategy, does not allow the separate identification of preferences parameters from overall risk attitudes. This would be an important question for future research which one could address either using well-targeted experimental methods or else using a structural framework to ask whether or not a model with constant risk preference parameters can generate big enough changes in risk attitudes given the nature of changes in expected life-time wealth and the riskiness of lifetime resources that typically occur as a result of life-events and health changes that happen as individuals age.

A major strength of the SHARE survey is the rich set of the available information, although it has also limitations that affect our analysis. In addition to the relatively crude nature of the risk preference question, a further limitation is that each individual, for whom the attitude towards risk is elicited, is surveyed in two distinct waves only. Whilst two measurements is considerably better than one, being able to extend the longitudinal dimension even further would allow tracking changes in risk attitude at different stages of life more accurately. Moreover, the dataset includes only individuals aged 50 and over. To provide a more comprehensive view of changes in preferences over the life-cycle, it would be particularly interesting to explore also how health shocks affect changes in risk preferences at younger ages, given that the relative importance of the potential drivers of risk preferences may vary substantially. We are aware of no study having addressed this issue so far.

Finally, our findings concerning the interplay of ageing and health status suggest important policy implications. On the one hand, our results support the widely held view that risk aversion increases with age. On the other, we show that worsening in health status, as captured either by self-perceived health or by the onset of new diseases, further strengthens such process. Given that the increase in life expectancy in developed countries is strongly associated with a rising incidence of chronic and severe conditions, policy makers should be aware that average risk aversion is likely to rise among increasingly large and influential segments of the population. This is likely to exert pressures to re-orient public policies in favour of a higher degree of social protection.

Tables and figures

Table 1.1: **Distribution of financial risk attitude**

	wave 2		wave 4		wave 5		Total	
Financial risk attitude	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.
1.Take substantial financial risks	125	1.34	173	0.93	269	0.96	567	1.01
2.Take above average financial risks	698	7.45	503	2.70	765	2.73	1966	3.50
3.Take average financial risks	2,110	22.64	3,804	20.41	5,992	21.45	11931	21.3
4.Not willing to take any financial risks	6,392	68.57	14,159	75.96	20,917	74.86	41468	74.18
Total	9,321	100.00	18,639	100.00	27,940	100.00	55900	100.00

Table 1.2: **Summary statistics for risk attitude**

Variable	Wave 2			Wave 4			Wave 5		
Risk Attitude	0	1	Total	0	1	Total	0	1	Total
Fin Resp									
N	2926	6375	9301	3217	9976	13193	5383	15649	21032
P	31.45%	68.54%	100%	24.38%	75.61%	100%	26.48%	73.51%	100%
Non Fin. Resp									
N	3	17	20	1263	4183	5446	1640	5268	6908
P	15%	85%	100%	23.20%	76.80%	100%	23.50%	76.50%	100%
Tot			9321			18639			27940

NOTE: This table shows prevalence of response (N) and percentage (P) for Risk attitude for Financial Respondents (Fin Resp) and non Financial Respondents (Non Fin Resp) per each wave.

Figure 1.1: Gender

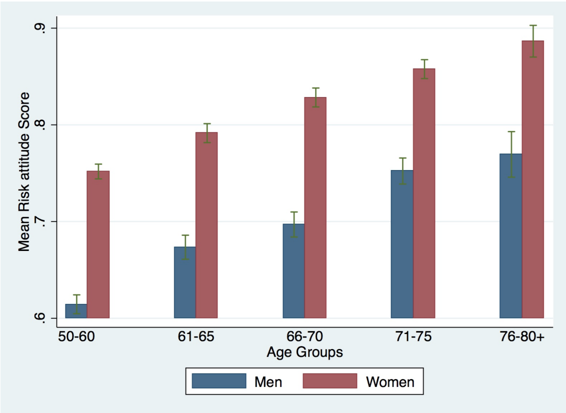


Figure 1.2: Couple

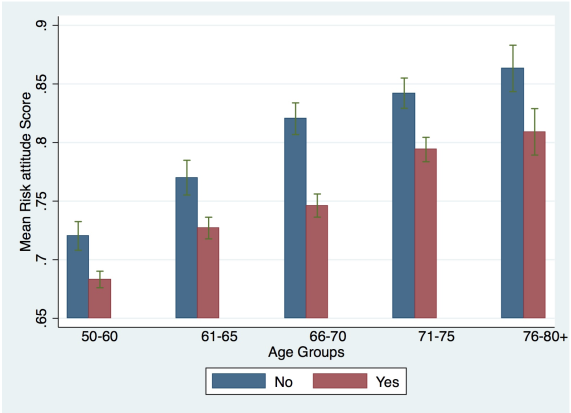


Figure 1.3: Education:

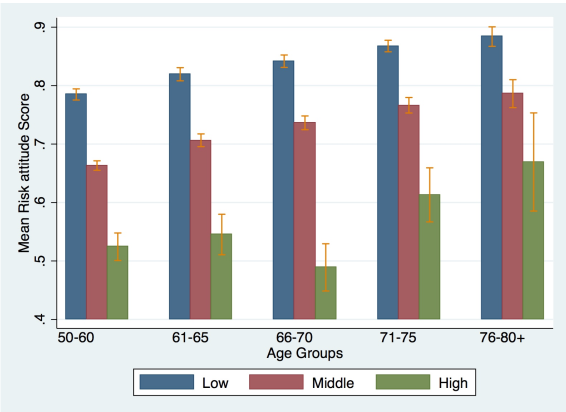
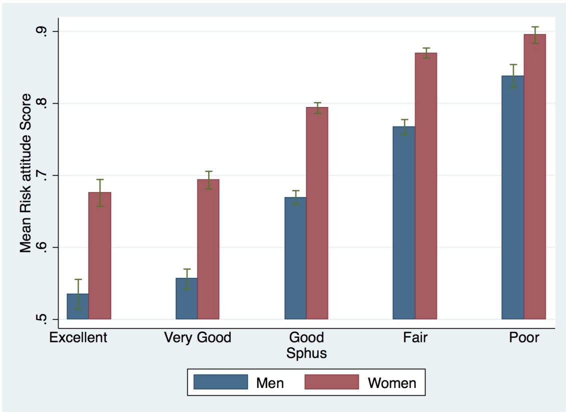


Figure 1.4: *self_perceived_health*



NOTE: Figures from 1 to 4 show prevalence of risk attitude , according to 4 different specifications: men-women (fig. 1), being in couple or not (fig. 2), education level (fig. 3) and self perceived health status (*self_perceived_health*) (fig. 4).

Table 1.3: **Distribution of changes in risk attitudes**

W2 interviewed also in W5		W4 also interviewed in W5	
N	9311	N	18629
P (w2)	68.6%	P (w4)	75.9%
P (w5)	70.1%	P (w5)	77.2%
p(0,0)	16.9%	p(0,0)	12.1%
p(0,1)	14.5%	p(0,1)	11.9%
p(1,0)	13.1%	p(1,0)	10.6%
p(1,1)	55.5%	p(1,1)	65.4%

NOTE: The upper panel shows the fractions reporting an unwillingness to take risks in each wave. The lower panel shows the percentage of respondents not changing reply (p(0,0) as well as p(1,1)); the percentage of individuals becoming unwilling to take risks (p (0,1)) or becoming willing (p(1,0)) from the first to the second interviews.

Table 1.4: **Model for financial risk attitude**

Dep: risk_attitude	(I)	(II)	(III)
log_pincome		-0.128***	-0.129***
		(0.0040)	(0.0054)
not working		0.020***	0.000
		(0.0062)	(0.0098)
pension		0.022***	0.051***
		(0.0059)	(0.0134)
numeracy		0.026***	0.026***
		(0.0093)	(0.0078)
household_size		-0.004	-0.004
		(0.0025)	(0.0027)
single		-0.028***	-0.030***
		(0.0065)	(0.0071)
widow		0.018*	0.016*
		(0.0081)	(0.0079)
female	0.106***	0.098***	0.099***
	(0.0040)	(0.0044)	(0.0049)
years_educ	-0.016***	-0.010***	-0.010***
	(0.0005)	(0.0005)	(0.0007)
type	0.005	0.008	0.008*
	(0.0036)	(0.0039)	(0.0039)
age	0.051***	0.031***	0.024***
	(0.0028)	(0.0041)	(0.0051)
Country Dummy	Yes	Yes	Yes
N	55900	49691	49687

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. The model is estimated via probit random effect, columns from (I) to (III) report average marginal effects for each correspondent specification. Standard errors are in parenthesis, p-value: * p<0.05, ** p<0.01, *** p<0.001. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table 1.5: **Model for financial risk attitude accounting for health**

Dep: risk_attitude	(I)	(II)	(III)	(IV)	(V)
num_disease	0.007**				
	(0.0024)				
self_perceived_health		0.050***			0.040***
		(0.0050)			(0.0054)
health_index			0.014***		
			(0.0016)		
minor_diseases				0.010***	
				(0.0026)	
major_diseases				0.009	
				(0.0045)	
health_index1					0.006***
					(0.0020)
log_pincome	-0.102***	-0.095***	-0.098***	-0.101***	-0.095***
	(0.0027)	(0.0025)	(0.0028)	(0.0027)	(0.0030)
pension	0.027	0.029*	0.025	0.029**	0.024*
	(0.0151)	(0.0137)	(0.0131)	(0.0109)	(0.0122)
not working	0.018	0.013	0.015	0.016*	0.015
	(0.0103)	(0.0099)	(0.0096)	(0.0080)	(0.0086)
numeracy	0.036***	0.034***	0.034***	0.036***	0.033***
	(0.0097)	(0.0084)	(0.0103)	(0.0089)	(0.0077)
years_educ	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***
	(0.0004)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
household_size	0.004	0.005*	0.005	0.005	0.005*
	(0.0029)	(0.0023)	(0.0028)	(0.0026)	(0.0024)
single	-0.009	-0.009	-0.009	-0.010	-0.008
	(0.0056)	(0.0048)	(0.0055)	(0.0072)	(0.0062)
widow	0.008	0.008	0.008	0.008	0.008
	(0.0079)	(0.0103)	(0.0091)	(0.0092)	(0.0095)
female	0.098***	0.098***	0.096***	0.098***	0.097***
	(0.0041)	(0.0045)	(0.0036)	(0.0047)	(0.0035)
type	-0.003	-0.004	-0.004	-0.003	-0.004
	(0.0036)	(0.0037)	(0.0039)	(0.0037)	(0.0041)
age	0.026***	0.026***	0.025***	0.026***	0.026***
	(0.0053)	(0.0047)	(0.0047)	(0.0047)	(0.0050)
Country Dummy	Yes	Yes	Yes	Yes	Yes
N	49599	49687	49596	49687	49596

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. The model is estimated via probit random effect, columns report average marginal effects for each correspondent specification. Standard errors are in parenthesis, p-value: * $p<0.05$, ** $p<0.01$, *** $p<0.001$. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table 1.6: Model for financial risk attitude (geography)

Coefficients

Regressors	num_disease	age	age^2	single	widow	not working	numeracy	log_pincome	social demo	conserv
b	0.028	0.412	-0.081	-0.059	0.030	-0.044	0.154	-0.461	0.002	0.388
se	0.018	0.124	0.046	0.029	0.041	0.055	0.036	0.0183	0.088	0 .079
p	0.122	0.000	0.077	0.040	0.455	0.418	0.000	0.00	0.974	0.000
	years_educ	female	household_size	type	type*age	type*age^2	social demo*not working	social demo*pension	social demo*age	social demo*age^2
b	-0.062	0 .446	0.0100	0.100	-0.249	0.097	0.157	-0.070	-0.071	-0.024
se	0.002	0.017	0.010	0.054	0.105	0.040	0.079	0.068	0.154	0.051
p	0.00	0.00	0.356	0.065	0.0182	0.015	0.046	0.304	0.644	0.639
	social demo*num_disease	conserv*not working	conserv*pension	conserv*age	conserv*age^2	conserv*num_disease	pension	residuals	cons	
b	-0.010	0.111	-0.074	-0.320	0.082	0.0132	0 .186	-0.037	5.508	
se	0.028	0.070	0.064	0.140	0.046	0.021	0.070	0 .025	0.179	
p	0.706	0.114	0 .250	0 .022	0.078	0.543	0.008	0.132	0.00	

Average Marginal Effects

Regressors	age	years_educ	female	household_size	single	widow	not working	numeracy	log_pincome	pension
dy/dx	0.028	-0.013	0.098	0.002	-0.013	0 .006	0.010	0.033	-0.101	0.029
se	0.004	0.0005	0.003	0.002	0.006	0.009	0.009	0.007	0.004	0.012
p	0.00	0.00	0.00	0 .357	0.040	0.455	0.264	0 .000	0.00	0.019
	social demo	conserv	num_disease	type						
dy/dx	-0.020	0.042	0.006	-0.001						
se	0.008	0.005	0.002	0.004						
p	0.023	0.00	0.003	0.710						

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. The model is estimated via probit random effect, the upper table reports coefficients, se and p-value; while the bottom table reports the average marginal effects for each correspondent specification.

Appendices

.1 Appendix A

.1.1 Robustness check on the risk attitude measure

Following Bonsang and Dohmen (2015), we want to estimate whether our measure of risk attitude is a good predictor of financial exposure. Table A1 shows the results. We run a linear probability model.

We create a variable for stock ownership which is 1 if the respondent states to own stocks and 0 otherwise. We use the measure of financial risk attitude as it is presented in the questionnaire with the 4 scores, from not willing to take any financial risk to taking substantial financial risk.

We control for age, years of education, being in couple, having a chronic disease and being working or retired. We include the full set of country dummies. In column (I) we include the linear and the squared term for age, while in column (II) we include dummies for age groups.
Results in table A1 suggest that risk attitude is a good predictor of the probability of owning stocks: respondents who state to be willing to take from average to substantial financial risk have higher probability of stock ownership, with respect to those who reply not to be willing to take financial risk. This evidence is in line with the findings of Bonsang and Dohmen (2015).

.1.2 Subsample Analysis

In this section we proceed with further analysis to evaluate the robustness of our findings and the degree to which they are driven by particular subgroups within the overall 50-75 sample. We adjust the p-values for the coefficients of potentially correlated variables (age, numeracy and health indicators) following the Holm-Bonferroni's correction for multiple testing.

Firstly, we attempt to provide further insights on the different factors influencing risk attitude that may depend on whether the respondent is still at a working age or not. To do so, we split the sample between individuals that, at the time of the first interview, are aged 50-64, from those aged 65-75. The choice of the threshold is due to the fact that in most of the countries examined, reaching 65 years of age is the requirement for statutory retirement.

We estimate the same random effects probit model illustrated in previous sections separately for each sub-sample. Table A3 and A4 report the marginal effects and standard errors for the 50-64 and for the 65-75 groups, respectively. Not surprisingly the age effect is much smaller in size and often no longer significant when the two subgroups are considered separately: this drop is due to the smaller range of variation in the age variable in the sub samples. In particular, for the sub group 65-75 age is not significant when we control for health measured via self perceived health or via the Poterba Venti Wise Index.

By contrast, the significance level and the magnitude of the effects associated to all health-related indicators are fairly similar, pointing to a comparable impact of health deterioration across age groups. Most notably, income and years of education decrease both groups' risk aversion. Both cohorts are affected by receiving a pension, while only older cohorts's risk tolerance is affected by not being working. Finally, for the young group low numeracy skills increase risk aversion and being single increases risk tolerance.

Another important issue to consider relates to the link between risk attitude and gender. The literature has consistently pointed out that risk attitudes tend to differ substantially between men and women (Dohmen et al. (2011) and Borghans et al. (2009)), with females usually more reluctant to take risks. Our main specification confirms this empirical regularity.

In order to further investigate possible differences in the determinants of risk aversion across genders, we run separate analyses for men and women. Results are reported in table A5 and A6. It is worth noticing that the impact of age is greater for men and almost never significant for women. This seems to suggest that ageing is affecting relatively less women's risk attitude and that the age effect for men is not attenuated by life-related events. To give a sense of the magnitude, when controlling for a new disease for example (column (I) in both tables), the effect of age over 10 years is about 4.2 percentage points for males (table A5) and 1.2 percentage points for females (A6). Furthermore, for female, when controlling for self perceived health the age effect is the same of column (I), while it is not significant in the other health specifications.

As for the time varying controls, being a pension recipient only affects female risk attitude, whereas permanent income and education are still negatively correlated with risk aversion for both groups. In line with the estimates on the full sample, risk aversion increases with health deterioration even if we consider the two genders separately. Poor cognitive skills, as proxied by numeracy, positively affect male risk aversion while they have no significant impact on female risk attitude, when controlling for health too.

In conclusion, there exist differences between male and female, mainly related to the effect of age, pension and cognitive skills. Overall, the effect of age is less nuanced by life related events for men with respect to women.

Table A1: **Linear probability model for stock ownership**

Dep. variable:	**Stock_ownership**
Risk attitude	
Not willing to take financial risk	(base)
Average financial risk	1.950***
	(0.1556)
Above average financial risk	3.092***
	(0.0920)
Substantial financial risk	2.008***
	(0.0438)
age	0.149
	(0.1115)
age^2	-0.010
	(0.0354)
years_educ	0.116***
	(0.0055)
couple	0.927***
	(0.0585)
household_size	-0.200***
	(0.0269)
chronic	-0.120***
	(0.0145)
working	0.438***
	(0.0659)
retired	0.217***
	(0.0656)
constant	-4.793***
	(0.1370)
Country Dummy	Yes
N	55900

NOTE: The dependent variable 1 if individual owns stocks, and 0 otherwise. The model is estimated via linear probability model. Standard errors are in parenthesis, p-value: * p<0.05, ** p<0.01, *** p<0.001

Table A2: **Summary statistics**

Variable	**Stat**	**Wave 2**	**Wave4**	**Wave5**	**Total.**
risk attitude	mean	0.685	0.759	0.748	0.741
	sd	0.464	0.427	0.433	0.437
age	mean	62.025	61.546	65.100	63.403
	sd	6.835	7.155	7.370	7.410
female	mean	0.530	0.564	0.553	0.553
	sd	0.499	0.495	0.497	0.497
married	mean	0.698	0.719	0.691	0.701
	sd	0.459	0.449	0.461	0.457
widow	mean	0.123	0.093	0.124	0.113
	sd	0.328	0.291	0.330	0.317
household_size	mean	2.193	2.231	2.109	2.164
	sd	1.032	1.013	0.967	0.995
working	mean	0.366	0.374	0.283	0.327
	sd	0.481	0.484	0.450	0.469
retired	mean	0.579	0.586	0.676	0.630
	sd	0.493	0.492	0.467	0.482
years_educ	mean	11.547	11.008	11.190	11.189
	sd	4.294	4.282	4.297	4.295
numeracy	mean	0.129	0.141	0.137	0 .137
	sd	0.335	0.348	0.340	0.343
p.income	mean	38536.44	34447.89	35824.53	35830.28
	sd	34043.98	72971.13	62575.31	62568.38
num disease	mean	0.879	0.944	1.126	1.024
	sd	0.954	1.032	1.069	1.043
minor	mean	0.704	0.689	0.903	0.799
	sd	0.784	0.773	0.851	0.821
major	mean	0.185	0.266	0.234	0.236
	sd	0.445	0.538	0.506	0.508
self_perceived_health	mean	0.277	0.378	0 .366	0.355
	sd	0.447	0.484	0.481	0.478
health_index	mean	2.750	2.965	3.070	2.981
	sd	1.378	1.427	1.402	1.411
	N	9217	17931	27073	54221

NOTE: This table provides mean and standard deviation (sd) for each variable of interest of the dataset by wave and in total.

Table A3: **Model for financial risk attitude (sub sample: 50-64)**

Dep: risk_attitude	(Baseline)	(I)	(II)	(III)	(IV)	(V)
num_disease		0.007*				
		(0.0027)				
self_perceived_health			0.045***			0.035***
			(0.0055)			(0.0068)
health_index				0.012***		
				(0.0017)		
minor_disease					0.012***	
					(0.0030)	
major_disease					0.008	
					(0.0056)	
health_index1						0.006*
						(0.0024)
log_pincome	-0.135***	-0.134***	-0.130***	-0.130***	-0.132***	-0.129***
	(0.0069)	(0.0067)	(0.0068)	(0.0073)	(0.0058)	(0.0071)
not working	-0.007	-0.003	-0.007	-0.004	-0.003	-0.005
	(0.0145)	(0.0117)	(0.0112)	(0.0138)	(0.0134)	(0.0141)
pension	0.066**	0.058**	0.056**	0.052**	0.056**	0.051**
	(0.0185)	(0.0172)	(0.0169)	(0.0187)	(0.0179)	(0.0165)
numeracy	0.025	0.025*	0.022*	0.023	0.025*	0.022*
	(0.0130)	(0.0117)	(0.0110)	(0.0139)	(0.0123)	(0.0110)
years_educ	-0.010***	-0.010***	-0.010***	-0.010***	-0.010***	-0.010***
	(0.0007)	(0.0006)	(0.0008)	(0.0007)	(0.0008)	(0.0008)
household_size	-0.004	-0.004	-0.003	-0.004	-0.003	-0.004
	(0.0027)	(0.0028)	(0.0027)	(0.0030)	(0.0028)	(0.0032)
single	-0.034***	-0.033***	-0.034***	-0.032***	-0.033***	-0.032***
	(0.0082)	(0.0084)	(0.0075)	(0.0082)	(0.0077)	(0.0086)
widow	0.014	0.014	0.015	0.015	0.015	0.015
	(0.0120)	(0.0117)	(0.0116)	(0.0109)	(0.0124)	(0.0136)
female	0.105***	0.105***	0.106***	0.104***	0.105***	0.105***
	(0.0050)	(0.0054)	(0.0049)	(0.0047)	(0.0048)	(0.0057)
type	0.006	0.007	0.006	0.006	0.007	0.006
	(0.0071)	(0.0066)	(0.0074)	(0.0075)	(0.0076)	(0.0074)
age	0.022***	0.023**	0.025**	0.023**	0.023**	0.024**
	(0.0066)	(0.0072)	(0.0078)	(0.0083)	(0.0074)	(0.0071)
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
N	35502	35425	35502	35422	35502	35422

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. Col (Baseline) reports the average marginal effects for age following the specification of Table 6 column (III) for the sub sample. The model is estimated via probit random effect, columns report average marginal effects for each correspondent specification. Standard errors are in parenthesis, p-value: * $p<0.05$, ** $p<0.01$, *** $p<0.001$. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table A4: **Model for financial risk attitude (sub sample: 65-75)**

Dep: risk_attitude	(Baseline)	(I)	(II)	(III)	(IV)	(V)
num_disease		0.011**				
		(0.0033)				
self_perceived_health			0.034***			0.020**
			(0.0068)			(0.0073)
health_index				0.013***		
				(0.0019)		
minor_disease					0.010*	
					(0.0043)	
major_disease					0.014*	
					(0.0062)	
health_index						0.009**
						(0.0030)
log_pincome	-0.124***	-0.121***	-0.120***	-0.118***	-0.121***	-0.118***
	(0.0070)	(0.0068)	(0.0068)	(0.0048)	(0.0078)	(0.0057)
pension	0.073*	0.066*	0.070*	0.069	0.068*	0.069
	(0.0370)	(0.0299)	(0.0329)	(0.0385)	(0.0335)	(0.0352)
not working	0.030*	0.029*	0.027	0.027*	0.028	0.026
	(0.0136)	(0.0142)	(0.0159)	(0.0130)	(0.0155)	(0.0148)
numeracy	0.009	0.010	0.007	0.008	0.010	0.007
	(0.0119)	(0.0125)	(0.0135)	(0.0106)	(0.0124)	(0.0128)
years_edu	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***
	(0.0009)	(0.0008)	(0.0007)	(0.0008)	(0.0008)	(0.0008)
female	0.082***	0.082***	0.081***	0.079***	0.082***	0.080***
	(0.0062)	(0.0061)	(0.0059)	(0.0065)	(0.0066)	(0.0059)
household_size	-0.007	-0.007	-0.007	-0.007	-0.007	-0.008
	(0.0048)	(0.0061)	(0.0046)	(0.0051)	(0.0063)	(0.0054)
single	-0.012	-0.011	-0.013	-0.013	-0.012	-0.013
	(0.0117)	(0.0117)	(0.0096)	(0.0122)	(0.0114)	(0.0115)
widow	0.001	0.001	0.002	0.001	0.000	0.001
	(0.0113)	(0.0118)	(0.0112)	(0.0109)	(0.0105)	(0.0098)
type	0.017*	0.019**	0.017*	0.017*	0.019*	0.017*
	(0.0082)	(0.0070)	(0.0073)	(0.0075)	(0.0077)	(0.0078)
age	0.020*	0.018*	0.017	0.015	0.017*	0.015
	(0.0087)	(0.0090)	(0.0091)	(0.0094)	(0.0082)	(0.0079)
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
N	20058	20027	20058	20027	20058	20027

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. Col (Baseline) reports the average marginal effects for age following the specification of Table 6 column (III) for the sub sample. The model is estimated via probit random effect, columns report average marginal effects for each correspondent specification. Standard errors are in parenthesis, p-value:* p<0.05, ** p<0.01, *** p<0.001. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table A5: **Model for financial risk attitude (sub sample: male)**

Dep: risk_attitude	(Baseline)	(I)	(II)	(III)	(IV)	(V)
num_disease		0.009**				
		(0.0033)				
self_perceived_health			0.040***			0.027**
			(0.0071)			(0.0095)
health_index				0.014***		
				(0.0025)		
minor_diseases					0.011*	
					(0.0049)	
major_diseases					0.015**	
					(0.0057)	
health_index1						0.008*
						(0.0034)
log_pincome	-0.151***	-0.150***	-0.147***	-0.147***	-0.149***	-0.146***
	(0.0087)	(0.0111)	(0.0094)	(0.0096)	(0.0086)	(0.0099)
pension	0.004	-0.006	-0.001	-0.012	-0.007	-0.011
	(0.0300)	(0.0282)	(0.0346)	(0.0283)	(0.0239)	(0.0274)
not working	0.032	0.037*	0.030	0.036	0.036	0.035
	(0.0232)	(0.0225)	(0.0273)	(0.0214)	(0.0198)	(0.0190)
numeracy	0.041**	0.041**	0.037**	0.039**	0.041*	0.037*
	(0.0162)	(0.0147)	(0.0143)	(0.0144)	(0.0177)	(0.0164)
years_educ	-0.013***	-0.013***	-0.013***	-0.013***	-0.013***	-0.013***
	(0.0008)	(0.0009)	(0.0011)	(0.0008)	(0.0007)	(0.0008)
household_size	-0.008*	-0.008*	-0.008	-0.008*	-0.008*	-0.008*
	(0.0039)	(0.0040)	(0.0045)	(0.0032)	(0.0035)	(0.0037)
single	-0.037***	-0.035**	-0.037***	-0.036***	-0.036**	-0.036**
	(0.0104)	(0.0126)	(0.0103)	(0.0095)	(0.0110)	(0.0104)
widow	0.060**	0.059**	0.061***	0.060***	0.060**	0.060**
	(0.0198)	(0.0183)	(0.0142)	(0.0148)	(0.0178)	(0.0211)
type	0.018*	0.019**	0.017**	0.018**	0.019**	0.018***
	(0.0073)	(0.0056)	(0.0054)	(0.0056)	(0.0058)	(0.0051)
age	0.043***	0.042***	0.043***	0.042***	0.042***	0.043***
	(0.0078)	(0.0070)	(0.0076)	(0.0082)	(0.0076)	(0.0070)
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
N	22837	22797	22837	22797	22837	22797

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. Col (Baseline) reports the average marginal effects for age following the specification of Table 6 column (III) for the sub sample. The model is estimated via probit random effect, columns report average marginal effects for each correspondent specification. Standard errors are in parenthesis, p-value: * $p<0.05$, ** $p<0.01$, *** $p<0.001$. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table A6: **Model for financial risk attitude (sub sample: female)**

Dep: risk_attitude	(Baseline)	(I)	(II)	(III)	(IV)	(V)
num_disease		0.009***				
		(0.0027)				
self_perceived_health			0.041***			0.032***
			(0.0063)			(0.0068)
health_index				0.011***		
				(0.0017)		
minor_disease					0.013***	
					(0.0030)	
major_disease					0.004	
					(0.0053)	
health_index1						0.006**
						(0.0022)
log_pincome	-0.111***	-0.109***	-0.106***	-0.106***	-0.108***	-0.105***
	(0.0060)	(0.0047)	(0.0056)	(0.0057)	(0.0058)	(0.0060)
pension	0.066***	0.059***	0.061***	0.060**	0.060***	0.059***
	(0.0186)	(0.0139)	(0.0135)	(0.0183)	(0.0167)	(0.0158)
not working	-0.005	-0.003	-0.008	-0.007	-0.004	-0.007
	(0.0122)	(0.0107)	(0.0092)	(0.0119)	(0.0109)	(0.0110)
numeracy	0.018*	0.018	0.016	0.016	0.018	0.016
	(0.0092)	(0.0108)	(0.0093)	(0.0100)	(0.0111)	(0.0093)
years_educ	-0.008***	-0.008***	-0.007***	-0.007***	-0.008***	-0.007***
	(0.0007)	(0.0008)	(0.0008)	(0.0006)	(0.0007)	(0.0008)
household_size	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.0031)	(0.0033)	(0.0037)	(0.0039)	(0.0039)	(0.0036)
single	-0.024**	-0.023**	-0.023**	-0.022**	-0.023**	-0.022*
	(0.0086)	(0.0086)	(0.0078)	(0.0073)	(0.0082)	(0.0092)
widow	0.006	0.006	0.006	0.006	0.005	0.006
	(0.0109)	(0.0093)	(0.0085)	(0.0078)	(0.0076)	(0.0091)
type	0.001	0.003	0.002	0.002	0.002	0.002
	(0.0048)	(0.0043)	(0.0054)	(0.0048)	(0.0044)	(0.0057)
age	0.012	0.012*	0.012*	0.010	0.011	0.011
	(0.0068)	(0.0061)	(0.0056)	(0.0073)	(0.0069)	(0.0062)
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes
N	26850	26802	26850	26799	26850	26799

NOTE: The dependent variable is 1 if the individual is risk averse and 0 otherwise. Age has been rescaled [age=(age -50)/100], so that 1 year more accounts for +0.10. Col (Baseline) reports the average marginal effects for age following the specification of Table 6 column (III) for the sub sample. The model is estimated via probit random effect, columns report average marginal effects for each correspondent specification. Standard errors are in parenthesis, p-value: * p<0.05, ** p<0.01, *** p<0.001. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Chapter 2

An Empirical Analysis of Health-Dependent Utility on SHARE data

2.1 Introduction

For many western economies one of the great challenges of the XXI century is the increasing share of older people as a result of two significant changes in demographic variables: a reduced birth rate and an increased longevity. Both these demographic trends generate concern about the sustainability of the welfare system, particularly pensions, but the latter is associated to a relevant risk of insufficient public and private resources caused an increase of the number of years with potential health deterioration.

The standard framework dealing with insurance models or models which describe welfare interventions is based on the assumption that utility is not dependent on the health status of individuals. But, if health can shape the utility function, generating state dependence, this has implications on several aspects such as the choice of the optimal insurance level or the optimal amount of savings for the future periods in a life-cycle savings model.

If the utility of individuals depends directly on the level of their health, than the marginal utility of consumption varies as health changes. In particular, the marginal utility to consume will reflect the utility changes due to changes in the amount of goods which might be complements to "good health", for example leisure goods. On the other hand, some goods could be substitutes for good health, for example private house services, which might be appreciated more in poor health conditions. The literature refers to the first example as a case of "negative state dependence" (marginal utility to consume decreases) and to the second example as "positive state dependence" (marginal utility to consume increases). Figure 2.1 reports a graphical representation of the state dependence pattern, as suggested by Finkelstein et al. (2013).

This brief introduction intends to stress that the effect of health on utility is relevant, and that the sign of health state dependence is a priori unknown, making it necessary to resort to the empirical evidence. Indeed, a vast literature has analyzed empirically the effect of health on the marginal utility of consumption: Lillard and Weiss (1997) ans Edwards (2008) have focused on older cohorts in the US and provided evidence of the existence of positive state dependence, while Evans and Viscusi (1991), Sloan et al. (1998),Viscusi and Evans (1990) and Finkelstein et al. (2013) conclude that there is no relationship or even a negative relationship, implying that marginal utility to consume decline as health deteriorates. A recent study by Kools and Knoef (2019) has provided evidence of positive state dependence on European data using an equivalence scale approach. They estimate how much extra or less income is needed to maintain the same level of financial well-being after a health shock.

Understanding the health effect on the marginal utility to consume in the late part of the life-cycle is also particularly important for policy. With increasing older cohorts living longer, knowledge of the shape of the utility in case of health deterioration is fundamental for the implementation of important welfare programs such as long-term care and health care provision to the elderly, or reforms related to annuity or health insurance markets. It also points towards the importance of considering that the marginal utility of consumption at older ages might be different from the one at the earlier stages of the life cycle - highlighting that individuals do not equate the expected marginal utility of consumption across states, as it is usually describe in life-cycle models (Brown et al., 2016).

Furthermore, as stressed by several authors (Norton (2000), Callegaro and Pasini (2007) and Carrino et al. (2018)), Europe is facing and increasing unmet demand for long-term care by older individuals, this contributes to underline that it is fundamental to understand how people value consumption in the adverse health state and their demand for further assistance.

Although we can assume that the public insurance in Europe is close to be universal, since in most countries the health care is publicly provided, there is still the necessity to cope with part of the unmet demand generated by the increasing need for long-term care. This leaves space for the private insurance market to protect against these events.

This study aims at testing the hypothesis of health state dependence, on a panel of European countries. We exploit data from the Survey of Health Ageing and Retirement in Europe (SHARE) which is composed by individuals aged 50+ from 12 different countries. The survey provides a rich set of information related to the individuals and the households as well. The dimensions which are investigated are health, working and retirement situation, life satisfaction, income and a large set of questions about savings, the individual network, cognition and more. The survey is longitudinal so this allows us to have repeated information for each respondent: we exploit wave from 1 to 7 that span from 2004 to 2017, more than a decade. Furthermore, some partner's respondents are interviewed when present and when they allow: thus, we are able to retrieve information at couple's level. The advantage of using the SHARE data is that we have different health measures, such as the presence of severe diseases, mobility difficulties and mental decline.

In this chapter we show evidence of positive state dependence when health is measured in terms of physical decline, negative state dependence emerges for mental decline. In other words: physical decline translates into greater value into future resources, in the sense that people value more the marginal utility of consumption when sick, whereas cognitive deterioration demands less future resources at least for Europe, this being in line with the evidence of Brown et al. (2016) for US.

One possible explanation might be that individuals value more future resources when physically impaired since they need them to adapt to the new state in order to enjoy life as before, while when they are cognitively impaired future resources are not as worth as before, since the disease prevents from living life as before.

An important finding of our work is that there exist important differences between male and female when couples are taken into account. In particular, men seem to be more affected than women by changes in the health of their partner.

Although we do not know whether the differences in health state dependence are driven by differences in the consumption basket, since SHARE does not collect the full set of information on budget shares, we were able to stress that different health deterioration paths (physical versus cognitive) make individuals value resources for the future in a different way. This calls for policies able to meet the increasing demand for long-term care such as nursing homes, when cognitive deterioration arises.

We suggest that couples are different from singles in changing in marginal utility to consume when sick, but also that males and females within couples react differently to the partner's health deterioration. This supports that within couple's health is not perfectly assorted, as documented by some scholars (Banks et al. (2013) and Davillas and Pudney (2017)). Relevant to our study, the health shock of one partner has not the same symmetric effect as the health shock of the other partner. Our result aligns with the one of the aforementioned literature and, to our knowledge, this work is the first that tries to link the health state dependence literature with the couple's health situation.

The rest of the paper proceeds as follows: section 2.2 describes the existing literature and the theoretical framework (section 2.3), section 2.4 presents the empirical strategy, section 2.5 the dataset and its variables, section 2.6 provides the results. Section 2.7 shows the results for the model with individuals in couples and section 2.8 further analyses. Finally, section 2.9 concludes.

2.2 Literature

Following the influential contribution of Grossman (1972), many authors have assumed that health enters the utility function and influences the consumption decision and the demand for goods : individuals are endowed with a stock of health that depreciates over time but can also increase with specific investments. Hence health-enhancing goods may be preferred, and also dynamic decisions would take account of health outcomes.

Finkelstein et al. (2013) have implemented a theoretical model where utility depends on the choice of non-health consumption and health service. The deterioration of health has a direct effect on the level of utility and an indirect effect on the marginal utility of consumption. While there is consensus on the negative sign of the direct effect of health on the marginal utility of consumption, since we expect that as health deteriorates, a decrease in health will cause a decrease the individual's utility; the indirect effect of health has been discussed and modelled by different scholars, but it is still under debate (Finkelstein et al., 2009).

With respect to this last point, Viscusi and Evans (1990) and Evans and Viscusi (1991) were among the firsts to claim that if health is able to change the slope of the utility function, it can also affect the marginal utility to consume. Whether this change goes in a positive or negative direction does not emerge from their studies.

To provide an example, individuals who face sickness might decide to decrease their consumption of leisure goods such as vacation, travels, or social events since now their cost to participate is higher than in the healthy state, that is, those goods are complements to good health. In such a scenario, the marginal utility of consumption decreases, and it is a case of negative state dependence with respect to health. On the other hand, some goods such as private health care assistance and catered meals are substitutes for good health, and these goods might be viewed as more beneficial when the agent is in the sickness state. In that case, the marginal utility to consume increases and utility exhibits a positive state dependence.

As Finkelstein et al. (2013) have shown, if there is negative state dependence, becoming ill causes a greater loss in consumption for wealthy people rather than low income people. If utility shows a positive state dependence, the opposite is true. Figure 2.1 shows a graphical representation of these relationships.

Recently, Grable and Lytton (2001a) has developed a theoretical model concerning life cycle savings when health declines. The author pointed out that when utility shows state dependence, the marginal utility can vary over the life cycle: it can be very low at the very end of life, when health deterioration is high, and conversely it can increase from 60 to 75 years old where we suppose that the health status could be stable. Thus, as individuals face health risks as time goes by, they might save to transfer consumption when the marginal utility is higher.

Different methodologies have been implemented measures of the health state dependence. Finkelstein et al. (2009) classified them into two main approaches. The first one exploits the individual's demand and variation of resources across states (health/unhealthy), while the second looks at variation of subjective well-being due to health shocks in individuals with different incomes.

Concerning the first approach, Lillard and Weiss (1997) developed a structural model in which the marginal utility of consumption varies with health, focusing on individuals who were exposed to the different health shocks and expected health shocks and comparing their consumption profiles. Their results suggested an increase in marginal utility to consume of 55%.

Regarding the second approach, Sloan et al. (1998),Viscusi and Evans (1990) implemented a strategy to estimate the compensating differentials to exposure to a hypothetical health risk and investigated the differences in compensation among income levels. Evidence was mixed: from no state dependence (Evans and Viscusi, 1991) to negative state dependence (Sloan et al. (1998),Viscusi and Evans (1990)). Also, the magnitude varied significantly, highlighting that different assumptions about the curvature of the utility function lead to different results in terms of magnitude.

Within the second approach is the one by Finkelstein et al. (2013). Empirically, they find evidence of a decrease in the marginal utility to consume of about 10% to 25%, stressing that the magnitude has to be taken carefully. According to their analysis, their findings are not driven by medical expenditure, and so the decrease in marginal utility to consume reduces the optimal share of earnings saved for retirement by about 3% to 5%. Also, the optimal share of expenditure reimbursed by insurance lowers from 20% to 45%, according to the authors.

Recently, Kools and Knoef (2019) focused on European countries and addressed the analysis of the health state dependence with an equivalence scale approach. They used information from the domain of living standards and income adequacy, and built a measure of financial well-being. They aimed at quantifying the amount of income required to compensate an individual after the onset of a new disease. In their results, the authors obtained evidence of positive state dependence and motivated their findings as the results of population heterogeneity in Europe with respect to the US case. Differences in consumption patterns and transportation contribute to explaining the positive sign of the health state dependence. Their evidences are not driven by medical expenditure, but they claim for further research on consumption patterns to confirm their findings.

Another stream of the literature has focused on the marginal utility to consume and how it is distributed among the population. Brown et al. (2016) documented a significant heterogeneity in health state dependence across individuals when different health disabilities are presented. They documented evidence of negative state dependence when cognitive impairment occurs and positive state dependence when physical health deteriorates.

The empirical results are, overall, mixed and not entirely explored for the European case (apart from the recent analysis of Kools and Knoef (2019), which only looks at the financial well-being variation of individuals), which leaves space for further analysis.

All of the approaches previously cited focus on empirical models of health state dependence of utility at individual level. This approach follows the unitary model; however, individual's utility might depend not only on their own preferences over health but also on the partner's preferences.

Collective models have highlighted the importance of household decisions with respect to individual's choices driven by the unitary model ((Chiappori et al., 1988), (Chiappori, 1992), (Chiappori and Mazzocco, 2017)). Household members have their personal preferences and they might disagree on an optimal decision. Collective models take this into account and develop a framework where each member's utility is present. In the collective framework, each household maximizes a weighted sum of individuals' utilities subject to a household budget constraint. Although this case considers egotistic preferences, it provides a solution also under "caring" preferences, meaning when the partner's utility also takes into account also the spouse's utility. For example, husband and wife can value their own utility as well as their spouse's (Chiappori et al., 1988). Furthermore, in the context of a couple welfare function, the shape of the function is not a priori determined: it can be the aggregation of both individuals utility, as in the utilitarian approach; or it can be the minimum between the two individuals' utilities. We take this as a starting point and extend the analysis of state dependence with a specific focus on the couple's perspective.

As some scholars have suggested, individuals living in couple have a different time horizon than singles, and may result in a different pattern from the predictions of the life cycle (Hurd, 1999). There is evidence that singles are more likely to spend their savings in the out-of-pocket-expenditures, while for couples, when one partner passes away, savings drop sharply (De Nardi et al., 2016). Furthermore, singles and couples experience differences in health trajectories (Lillard and Panis (1996), Monden (2007), Kiecolt-Glaser and Newton (2001), Robles et al. (2014)): usually singles men and women tend to experience more years in pain with respect to couples. Mortality rates are also different: married men tend to live longer with respect to single or divorced men (Hu and Goldman (1990), Zick and Smith (1986), Lillard and Waite (1995)). All these elements emphasize that there exist differences between singles and couples and, in addition, those differences can generate different economic outcomes.

Another well-known aspect of the couple's perspective is the marital sorting, which harks back to Becker (1973) and was recently explored by Charles et al. (2013): individuals tend to marry those who are similar to them. Therefore, we might expect healthy individuals to marry healthy ones, and unhealthy to marry the unhealthy partners.

Also, because couples share the same lifestyle, a couple's health status might be correlated over time (Banks et al. (2013)). For example, individuals who smoke are more likely to have a smoking partner, which can contribute to increasing risk of cardiovascular diseases. At the same time, an individual's utility might account for their partner's health when assessing individual happiness. However, the correlation within couples' health is not perfectly symmetric (Davillas and Pudney (2017)).

Nevertheless, if we assume that health enters the utility function, couples and singles can differ in their level of utility. As individuals age, their chance of getting sick increases,and couples can find as caregiver their partner, whereas singles cannot. Furthermore, the other partner can provide financial support in case that sickness causes unemployment or income loss of the spouse (Hess, 2004).

Formal and informal care are an important source of consumption and home production. This implies that these services matter when considering the marginal utility of consumption. In the literature, (Norton, 2000) reports that when long-term care is needed, also the life expectancy shortens and so the marginal utility of the individual might change. When the caregiver is the healthy partner, studies have showed that this has important effects on the partner's health (Van Houtven et al. (2010), Do et al. (2015), Gaugler et al. (2009)).

Furthermore, Carrino et al. (2018) documented the existence of an important unmet demand for long-term care in Europe. Criteria for eligibility for long-term care vary among countries, and in some cases also within countries (in Italy and Belgium for example). Lacks of eligibility leaves space for the informal care provided within the family. All of this must be taken into consideration when evaluating the marginal utility of consumption for individuals in sick condition.

This literature review highlights the necessity to explore the couple's dimension when testing for the state dependence. Several aspects are involved and might explain different patterns of couples versus singles.

2.3 The model

In this chapter, we investigate the hypothesis of health state dependence of utility on a panel of European countries. In order to do that, we are going to look at variation of subjective well-being due to health shocks in individuals with different levels of income. Our empirical model is based on the theoretical model presented by Finkelstein et al. (2013). The parameter and the magnitude of the health state dependence are key to interpret the empirical results. Thus, we report the theoretical model below in order to show the exact derivation of the health state dependence parameter and the computation of its magnitude.

Let us consider a two periods model where individuals choose their path of consumption and allocate between non-health consumption and health services. In the first period, we assume that all the individuals are healthy (S=0) and with a probability p an individual can become sick (S=1). Individuals preferences allow for intertemporal elasticity of substitution and risk aversion to vary separately (Attanasio and Weber (1989) and Epstein and Zin (1991)).

The lifetime utility is the following:

$$U = \left(\frac{1}{1-\gamma}\right)\left(C_1^{1-\theta} + \frac{1}{1+\delta}(1-\gamma)E_1[U_2])^{(1-\theta)/(1-\gamma)}\right)^{(1-\gamma)/(1-\theta)} \tag{2.1}$$

In the first period, individuals consume C_1 and maximize the second period utility $E_1[U_2]$. γ is the coefficient of relative risk aversion, $1-\theta$ is the elasticity of intertemporal substitution, and δ is the discount rate. Both γ and $1-\theta$ are ≥ 0.

Second period utility is stochastic from the first period since the future health state is unknown, it is given by:

$$U_2 = (1+\varphi_1 S)\frac{1}{1-\gamma}C_2^{1-\gamma} + S\Psi(H) \tag{2.2}$$

C_2 is the second-period non health consumption, H is the health service consumption and S is the sickness indicator. For an individual in good health, the second period utility is a CRRA utility function. For a sick individual, sickness multiplies the marginal utility of consumption by $1+\varphi_1$. Empirical analysis will allow estimation of the measure of φ_1. Furthermore, only individuals in poor health consume health service H.

In this model, all individuals are insured with respect to health, and the insurance is financed with a fraction τ of their permanent income Y. Individuals must satisfy the following budget constraint:

$$Y(1-\tau) = C_1 + \frac{1}{1+r}\left(C_2 + (1-b)H\right) \tag{2.3}$$

where r is the real interest rate and b the fraction of second period health expenditures (with $0 \leq b \leq 1$). The authors solve the model backward. If the individual is healthy in the second state, then $W = (1+r)(Y(1-\tau)-C_1)$ and:

$$U_{2,S=0} = \frac{1}{1-\gamma}W^{1-\gamma} \tag{2.4}$$

If an individual is sick, then she needs to maximize non-health and health consumption by solving:

$$\begin{aligned}\max_{C_2,H} U_2(C_2,H) = \max_{C_2,H}(1+\varphi_1 S)\frac{1}{1-\gamma}C_2^{1-\gamma} + \varphi_2\frac{1}{1-\gamma}H^{1-\gamma} \\ \text{subject to:} \quad C_2 + (1-b)H = W\end{aligned} \tag{2.5}$$

This maximization leads to the following results:

$$C_2 = \frac{W}{(1+\varphi_2^{1/\gamma}(1+\varphi_1)^{-1/\gamma}(1-b)^{1-1/\gamma}} \tag{2.6}$$

and

$$H = \frac{\varphi_2^{1/\gamma}(1+\varphi_1)^{-1/\gamma}(1-b)^{-1/\gamma}W}{1+\varphi_2^{1/\gamma}(1+\varphi_1)^{-1/\gamma}(1-b)^{1-1/\gamma}} \tag{2.7}$$

By substituting 2.6 and 2.7 into the utility in the second period we obtain utility as a function of wealth:

$$U_{2,S=1} = \frac{1}{1-\gamma}(1+\varphi_1)\left(1+(1+\varphi_1)^{-1/\gamma}(1-b)^{1-1/\gamma}\varphi_2^{1/\gamma}\right)W^{1-\gamma} \tag{2.8}$$

Finkelstein et al. (2013) calculate the expected second-period utility as the weighted average of equations 2.4 and 2.8 and use the budget constraint to solve for C_1 and W as a function of permanent income Y. The result shows that the optimal second period income wealth is proportional to permanent income such that $W = wY$. By substituting this result into equations 2.4 and 2.8, it brings to the indirect utility $v(Y, S)$ which is for the healthy:

$$v(Y,0) = \frac{1}{1-\gamma}(wY)^{1-\gamma} \tag{2.9}$$

and for the unhealthy:

$$v(Y,1) = \frac{1}{1-\gamma}(1+\varphi_1)(1+\varphi_2^{1/\gamma}(1+\varphi_1)^{-1/\gamma}(1-b)^{1-1/\gamma})^{\gamma}(wY)^{1-\gamma} \tag{2.10}$$

These results can be translated into a nonlinear regression as it follows:

$$v = \beta_1 SxY^{\beta_2} + \beta_3 Y^{\beta_2} + \eta \tag{2.11}$$

where S is the health sick state and Y is the permanent income; and which returns the parameter estimates:

$$\begin{aligned} \beta_1 = (1+\varphi_1)(1+\varphi_2^{1/\gamma}(1+\varphi_1)^{-1/\gamma}(1-b)^{1-1/\gamma})^{\gamma}\frac{w^{1-\gamma}}{1-\gamma} - \frac{w^{1-\gamma}}{1-\gamma} \\ \beta_2 = 1-\gamma \quad \text{and} \quad \beta_3 = \frac{w^{1-\gamma}}{1-\gamma} \end{aligned} \tag{2.12}$$

We are interested in the ratio of one additional unit of income in the sick state with respect to the healthy state (β_1) over the income of the utility in the good health state (β_3), which is:

$$\beta_1/\beta_3 = (1+\varphi_1)(1+\varphi_2^{1/\gamma}(1+\varphi_1)^{-1/\gamma}(1-b)^{1-1/\gamma})^{\gamma} - 1 \tag{2.13}$$

After some simple substitution, we yield to the expression used to compute state dependence:

$$(1+\varphi_1) = \frac{\beta_1/\beta_3 + 1}{(1+m(1-b))^{\gamma}} \tag{2.14}$$

where $m = H/C_2$ represents the fraction of health services over non-health consumption, b is the fraction of health expenditure covered by the insurance, and γ is the relative risk aversion. The reason why we include the full model derivation is that we want to stress that the coefficient of the health state dependence is theoretically grounded, as well as its magnitude.

2.4 Empirical Strategy

We proceed by presenting a strategy to assess the presence of state dependence with respect to health on a panel of European countries. We start by adopting the specification used by Finkelstein et al. (2013) which is particularly suitable given the nature of our dataset. Furthermore as shown in the theoretical model in section 2.3, the specification allows us to test directly the sign and magnitude of the health state dependence.

We focus on retired people as seen in Finkelstein et al. (2013), we decide not to include workers, since we want to avoid a health shock's first-order effect on income. In this analysis, we exploit the variation in subjective well-being due to adverse health events that are likely to occur as people get older. Through this analysis we are also able to compare our results for Europe with the findings from authors examining the US context. A comparison analysis is useful for several reasons: individuals in US and Europe have shown different patterns in budget spending at older ages (Banks et al. (2016)) and also have different health care systems. The US system is mostly private supported (private insurance is compulsory except for those age 65 and above); whereas, the European primary health care services are provided to all citizens free of charge and supported via public expenditure.

Following Finkelstein et al. (2013) we implement a two-steps procedure. The first step is a linear OLS fixed effect regression where utility is measured through happiness (a binary variable, see section 2.5.1 for details) as a function of health ($NumDisease_{it}$), permanent income interacted with health ($NumDisease_{it} * Log(pincome_i)$, a set of individual characteristics and an individual fixed effect (θ_i). We take a linear link $g()$ function, which is increasing mapping from latent utility to the proxy equation 2.11.

Happiness is considered to be a good proxy able to capture the main features of the utility, and it has extensively used in the subjective well-being literature (Frey and Stutzer, 2001).

The second step is needed to retrieve the effect of permanent income which is absorbed by the individual effect in the first step. In the second step, the estimated fixed effect is regressed on permanent income and a set of controls; including some additional explanatory variables in order not to confound the effect of permanent income on happiness with demographics that are correlated with permanent income in the equation 2.15.

$$Happy_{it} = g(\beta_4 NumDisease_{it} + \beta_1 NumDisease_{it} * \text{Log}(pincome_i) + \gamma_1 Controls_{it} + \theta_i) \quad (2.15)$$

$$\hat{\theta}_i = \beta_3 \text{Log}(pincome_i) + \gamma_2 Controls_{it} + \epsilon_{it} \quad (2.16)$$

Where i refers to the individual and t to time.

In equation 2.15, happiness (*Happy*) is a proxy of utility, number of disease (*NumDisease*) is a measure of health status; permanent income (*Log(pincome)*) represents a proxy for consumption; finally θ is the individual fixed effect. To detect the presence of health state dependence, we look at the coefficient of the interaction term (β_1). We recall that $\beta_2 = 1 - \gamma$ and it is set equal to 1.
To compute the magnitude of the state dependence, meaning the variation in the marginal utility of consumption after a health event, we exploit also the coefficient of permanent income (β_3). The ratio β_1/β_3 provides an upper bound of the magnitude of the state dependence. We do not have any prior expectation about the sign of the state dependence, nor the magnitude, since, as we

discussed above, there might be either an increase or decrease in the marginal utility to consume, after a health event.

Since we acknowledge the existence of differences in health trajectories between the US and Europe (Banks et al., 2006), we want to exploit other measures of health that account not only for severe acute health conditions, but also for the set of difficulties in mobility that lead people to poor health status. Thus, we measure health not only via chronic diseases but also in terns of mobility difficulties, which we will explain in detail in section 2.5.2.

Another aspect of health deterioration involves the cognitive decline that usually occurs at older ages. With that in mind, we also measure such health shocks as low verbal fluency or low memory skills. Further details are provided in section 2.5.2. Our analysis investigates not only the role of an acute shock, but also the effect of physical and mental deterioration that occurs for a longer period and leads the individual to a state of poor health.

To assess the sensitivity of our results, we implement a one step random effect analysis to allow for variability between groups and exploit the fact that with our short panel such as the one we have, we do not have a great source of within individual variability. We set up the following model:

$$\begin{aligned} Happy\_it = g(&\beta_4 Health_{it} + \beta_1 Health_{it} * \text{Log}(pincome)_i \\ &+\beta_3 \text{Log}(pincome)_i + \mathbf{\Gamma} Controls_{it} + \theta_i) \end{aligned} \tag{2.17}$$

Successively, we run a Probit Fixed Effect analysis to account for nonlinear effect of health on the probability of being happy.

Following (Finkelstein et al., 2013), we require two assumptions to interpret the test for the state dependence.

The first assumption implies that the imposed mapping g(.) and the true mapping from the Von Neumann-Morgenstern utility to the utility proxy cannot vary with health by permanent income. This means that there may be errors in our g(.) map from latent utility to proxy utility, but the error cannot vary systematically with health by permanent income. We required that a change in the true utility associated with a given change in health must map into the same change in our utility proxy at different permanent income levels. To validate this assumption, we present results for different classes of approaches, such as OLS and Fixed Effect Probit (for the latter method we report the results for the analysis with cognitive decline), to investigate the potential miss-specifications of g(.) .

The second assumption requires that there are no omitted determinants of utility that vary with health differentially by permanent income. In the baseline specification, we apply the fixed effect model that takes into account the presence of unobserved heterogeneity, ruling out the problem of time invariant omitted variables. With respect to the random effect model, the interaction terms we exploit try to capture this problem. Furthermore, we have a relatively short panel that does not have a great source of within variability.

Finally, we control for bootstrapped standard errors at the individual level and also we compute household clustered robust standard errors: results do not change overall.

2.5 Data

This study uses data from the Survey of Health and Retirement in Europe (SHARE). The survey is done through a computer-assisted personal interview and conducted a face to face using a laptop.

SHARE started in 2004 and it is conducted every two years. The survey gathers information regarding health, wealth, working situation, retirement, and socioeconomic status of individuals aged from 50 and above.

The sample is representative at the country older age population level. All respondents who were interviewed several times are part of the longitudinal sample. For every wave, new individuals are interviewed, in part to maintain the 50+ age composition and in part to compensate for the attrition that influences the sample. Furthermore, if the household composition changes, the new partner is eligible for interview, regardless of age.

The questionnaire is submitted to the head of the household and to the partner as well but not for every couple. For those individuals for whom we have information at each partner's level, we are able to conduct an analysis at the couple level. The survey does not include those who are hospitalized, incarcerated, in a nursing home, and who do not speak the country of residence language. SHARE pursued an ex-ante harmonization: the questionnaire is translated into the national languages (in some countries more than one language).

There are now up to 7 waves available. Among those, wave 3 and 7 are retrospective and focus on an individual's life history, in contrast with regular waves that collect information about an individual's current situation.

The survey focuses on several aspects of the individual dimension. SHARE questionnaire starts asking information about demographic characteristics and family composition and social networks, then explores the physical and mental health situation, and then moves to the financial matters such as income, wealth, housing, consumption, assets and activities.

With this great variety of information, SHARE is one of the best European datasets that enables researchers from sociology, economics, gerontology, and demography to produce meaningful analysis on the European population of aged 50+.

For this work, we exploit all the waves of the survey: wave from 1 to 7, which span from 2004 to 2017. During this decade, the original sample of countries enlarged and reached up to 140,000 respondents in wave 7. For our purpose we consider 12 countries out of the 28 ones that participated: Austria, Belgium, Switzerland, Germany, Sweden, Denmark, the Netherlands, Spain, Italy, France, Luxembourg, and Israel.

This choice is due to several reasons: first, we want to focus on those individuals who respond to the survey several times, and for which we have repeated information about income since it is our proxy to measure consumption.

Second, we select countries that have some features in common so we could follow the Esping-Andersen (1990) classification of welfare systems and cluster countries based on their social security regimes. Following the economic and sociological literature, we acknowledge that Eastern and Central-Eastern countries cannot be classified under the Esping-Andersen (1990) definition (Fenger, 2007). Although the original design of the sociologist taught that the post-communist countries were in a transition to a welfare system such as those of western countries, there is evidence of a lack of accomplishment in various sectors. For example, following Soede et al. (2004), unemployment benefits are low and with a shorter duration than in western countries, pension benefits are below European averages , tax rates are quite moderate, finally and health care systems, disability, and child benefits are heterogeneous among Eastern countries compared to Western ones. Some countries faced a crisis after the fall of the communist system and in some others the privatization increased.

For these reasons, we decide not to include those countries in the sample, as there exists a great heterogeneity between Eastern and Western countries among the ageing population. Moreover, we also decide to exclude Greece and Portugal since those countries were severely affected by the financial crisis and their welfare systems were drastically revised. Accounting for those exclusion, we are left with 62450 individuals for an average of 3 waves each.

Finally, we focus on retired males over 60 and females over 55. For men, we want to avoid individuals who exit the labor market due to bad health status. For women, we select a sample from age 55 since they tend to be younger than their partner on average.

2.5.1 The happiness measure

The proxy used for utility is happiness measured through a subjective well-being question that was introduced in each wave starting from wave 2. As fundamental assumption, we suppose that the proxy is a true measure of the latent Von Neumann-Morgenstern utility as in Finkelstein et al. (2013). Our measure is based on the following question of the survey:

How often, on balance, do you look back on your life with a sense of happiness?
1. *Often*
2. *Sometimes*
3. *Rarely*
4. *Never*

We define a dummy variable that is 1 if the respondent answered *"often"* or *"sometimes"* and zero otherwise. This dichotomization leads to loss of information, in particular for those that reports "rarely"; however it is hard to say how close "rarely" and "sometimes" are in this context, which is why we prefer a sharper characterization Each individual was asked this question in each wave they participate, thus giving us the possibility to evaluate changes in happiness as time goes by.

Although the happiness measure has some drawbacks, (Benjamin et al. (2012))[1] it has been shown that it is a good predictor of hypothetical choice (Finkelstein et al., 2013).

Furthermore, an extensive literature provides evidence of the use of happiness as a good proxy for the Von Morgensten Utility approach (Frey and Stutzer (2002), Di Tella et al. (2001) and Hirschauer et al. (2015)).

In our sample, around 89% of the individuals reported to be "happy", as we code the variable. Figure 2.2 displays the distribution of happiness by age per marital status and gender. Starting from the figure on the left, it can be seen that there are differences between couples and singles. On average,singles are less happy than individuals in couples. This is constant over time, however, after age 75, the average values for singles converge towards the couples' ones.

An alternative measure for utility could be the CASP indicator, which has been used in the literature of subjective well-being. This measure involves four dimensions: control (C), autonomy(A), self-realization (S), and pleasure (P). CASP is scaled from 12 to 48, with higher values indicating a better quality of life. It has been used by scholars such as and Hyde et al. (2003) and Di Novi et al. (2015).

[1] The authors find that life satisfaction has a better predicted power of choice with respect to happiness. Also, financial well-being can play a role, as exploited by Kools and Knoef (2019), which is not directly captured through our question

Looking at the graphical comparison between happiness and CASP in Figure 2.2, it is evident that the two measures behave in the same way. There is a decline in happiness with age, but it is on average relatively small for both measures (about 3% for happiness and 7% for CASP). We proceed by focusing our analysis on the measure of happiness, and we then replicate the analysis with the CASP variable, which is available in the Appendix .1. Results hold with this alternative measure.

We could not compare genders from ages 55–59 since we selected only females in that range. Looking at the differences between males and females from age 65 onwards, there is evidence that females report to be less happy compared to males. This feature persists over time and creates even greater discrepancy around age 80 and on.

Overall, these descriptive statistics suggest that the average level of happiness for European is in line with that of the US population, at least for older ages, even though some non-negligible heterogeneity emerges by marital status and by gender: individuals in couples report on average greater values of happiness with respect to singles, while males report on average greater values of happiness with respect to females.

2.5.2 The health measures

In order to measure health, we use different proxies which give more (less) weight to the different dimensions of well-being: we want to focus not only on the physical health status but also on the mental health status. The increase in the number of pathologies related to the brain such as dementia or Alzheimer, which have their roots (or manifest themselves) in cognitive decline at older ages is attracting a lot of attention. Much of the debate is on the possibility of carrying out early detection and early prevention of these conditions. Some symptoms of cognitive decline have been found at the early stage of older ages for smokers (Sabia et al., 2012) and we will follow this literature. We therefore claim that it is essential to measure health not only via physical health but also through the cognitive condition. We now first introduce the measure of physica,l and then cognitive, health status.

The first measure we exploit is the number of relevant diseases which are: cancer, stroke, hypertension, lung disease, heart disease, arthritis and diabetes. The set of these diseases has been largely examined in the labour economics literature (Trevisan and Zantomio (2016)), health and ageing (Smith (1999)), and more. Table 2 reports the distribution of severe diseases by gender and overall: a sizeable fraction of individuals (39%) reports to have no relevant disease, more than one third instead has at least one disease, and only 17% at least two diseases. The prevalence of individuals with three diseases is low at about 6%. Sicker individuals (with at least four diseases) are negligible in terms of percentage. Overall, the percentage of individuals that are affected by more than 1 disease is less than one third, this suggesting that the individuals in the sample are less sick compared with individuals in the sample of Finkelstein et al. (2013), where each individual had 2 diseases on average.

Another health measure we used is an index for mobility which includes several aspects of daily living. This choice was driven by the fact that mobility is a good indicator of individual health status., Additionally, differences in health patterns exist between Europeans and Americans (Banks et al. (2006)), such that we believe that other measures can be representative of the health condition. We exploit five indicators of experienced difficulties in that domain, specifically experiencing difficulties in getting up from the chair (*diffchair*), climbing one flight or several flights of the stairs (*diffclimb1* and *diffclimb2*), having difficulties in walking (*diffwalk*), stooping, kneeling and crouching (*diffstoop*). This index can capture difficulties in daily activities and can be a good proxy for health status. In Table 3, we report the distribution of these measures by genders: women experience more difficulties than men as the number of limitations increases. This evidence is in line with the distribution of the number of diseases. From three to five difficulties in mobility, gender distribution differs from 20% to 40%, and it is worse for women.

Concerning a health measure aimed at capturing the mental condition, we focus on two components: memory and verbal fluency. We also could have used other information about cognition but the large number of missing values prevented us from doing that. Therefore, we focus on two different questions: one asking to recall a list of 10 words previously heard (memory measure) and the other asking to name as many animals as possible in one minute of time (verbal fluency). These might appear simple tasks; however, there is a percentage of the sample that shows difficulties in that respect.

The first cognition measure is having a low memory: we code with 1 individuals who were able to recall at maximum 4 words out of 10. From Table 4, it emerges that two thirds of the sample have low memory skills, since around 60% could not remember more than 4 words, men more than women are the more affected. When considering the verbal fluency instead, we code 1 those who were able to report maximum 10 animals in one minute and 0 otherwise. From Table 4 the bottom part, 10% of respondents show low verbal fluency and men and women are equally split in both high and low.

The set of these three health proxies will let us to compare health dimensions across the same specification and to assess whether some of them are able to better explain the effect of health deterioration on utility.

2.5.3 The permanent income measure

We use permanent income as a proxy for consumption because this information is usually scarce in the surveys. Furthermore, the SHARE survey was precisely designed to focus on information about earnings and wealth, rather than on consumption. We exploit information about income at the household level, as this data is provided also via an imputation technique to treat missing values. Focusing on the household's income allowed us to attribute a source of earning for each partner of the house, even for those unemployed or otherwise not working such as home-makers.

Information about budget shares is notoriously scarce, and the permanent income hypothesis still holds. As it has been previously implemented by other authors in this literature such as Lillard and Weiss (1997), permanent income is considered to be a good proxy for consumption. Another example of permanent income measure has been used by Brunello et al. (2017) using the SHARE data. We begin by following the same approach of (Finkelstein et al., 2013) and we consider household income, which was reported in each wave, weighting each household income over the household size, following the OECD 97 adjustment coefficients.

We also add the 5% of financial wealth to the income measure in order to account for the fact that older people might exploit their savings once they are out of the labor force. Financial wealth includes all assets, stocks, and bonds, but does not include non-financial wealth such as the value of the house or cars.

We then average the amount for each individual based on the number of income observations we had available. On average, there are three waves for each respondent.

2.5.4 Descriptive Statistics

Table 1 displays the summary statistics for the variables of interest. We have about 62450 respondents who were interviewed three times on average. The sample is composed of retired individuals aged 55 for women and 60 for men to 86 years old. The average age is 70. About 9% of the female population is still working. We include them since we are going to exploit couple's health situation and we are aware that female partners tend to be younger than their partner, hence might not yet be retired. Females represent 64% of the sample. On average, individuals spent 10,5 years in education. Two-thirds of the sample lives in couple, while the remaining one-third is single.

Regarding happiness as a proxy for utility, 89% of the sample reports to be happy. This is in line with the statistics of Finkelstein et al. (2013). Permanent income is an average measure of household income plus 5% of the financial wealth. The average permanent income is about 24000€, with a high standard deviation, as expected.

As for health, the average number of severe diseases is one. When looking at the distribution the most frequent diseases are hypertension (40%), arthritis (14%) and diabetes (13%). Also, heart diseases are commonly reported (11%). Another measure of health is given by the mobility difficulties index which is on average 1 on a scale up to 5. In that respect, the most common difficulties are those difficulties in stooping, kneeling, and couching (31%), climbing several flights of stairs (27%) and getting up from a chair (19%).

Figures 2.4 and 2.5 show the distribution of the number of diseases and mobility index by income level for single individuals and couples, and for gender. Regarding the number of diseases, in Figure 2.4, on the left it appears that low-income singles as well as high-income singles are sicker than low/high - income couples. In contrast, observing the middle income category, singles are slightly better off than couples. On the right, the main differences between men and women are at low-income level, where women appear as ill as men. As income increases, however, females are better off.

Focusing on the mobility index, from Figure 2.5 on the left, singles experiences more difficulties than couples at every income level, and women are worse off compared to men on the right side. This evidence underlines that singles and women are more exposed to sickness than couples as well as women when compared with men.

Finally, concerning mental health, we report two measures of low memory skills and low verbal fluency. The former is more spread in the sample, with 60% of the respondents being affected by low memory : an understandable result considering the average respondent was aged 70. In contrast, only 10% of the individuals surveyed is scored as having low verbal fluency.

2.6 Results

Tables 5 and 6 display results of the model in equation 2.15 and 2.16. We control for age, age squared, household size, being single, female, years of education, and wave fixed effect. In the tables, we report bootstrapped standard errors at the individual level. We also run analyses with clustered standard errors at the household level: results do not change.

We recall that the sign of the health state dependence is given by β_1, which gives evidence of whether the marginal utility of consumption varies with health decline; whereas, the magnitude of the state dependence is given by the ratio β_1/β_3. The model is estimated via OLS fixed effect.

Table 5 reports the analysis for health measured via number of relevant diseases: in column (I) the sign of β_4 is negative as expected, implying a decrease in happiness as the individual gets sick, thus, for someone with the average income (since permanent income is demeaned), an increase in one disease leads to a decline of about 5.7 % in the probability of being happy. The coefficient of β_3 in column (II) is positive as we expected around 0.03, this means that for a 10% increase in permanent income there is a 3 percentage point higher probability that the respondent reports being happy.

Regarding our coefficient of interest, β_1, it is around 0.006 : the sign is positive and suggests the presence of positive state dependence. This means that as health deteriorates, the marginal utility of consumption increases. The significance level is at 1%. To compute the magnitude of the state dependence, we proceed by calculating the ratio β_1/β_3. We consider a one within-person standard deviation increase in the number of relevant diseases ($\sigma = 0.45$) and find that it is associated with a 11.5% increase in the marginal utility to consume. Marginal utility increases from 0.03 for a healthy individual to 0.04 for a person with one disease, to 0.05 with two diseases, to 0.06 with three diseases (only 7% of the sample).

This result goes in the opposite direction with respect to the findings of Finkelstein et al. (2013), who found negative state dependence. Their analysis suggested a decline of about 11% for an individual shifting from being healthy to a one standard deviation increase in the number of severe diseases.

The difference between the results on US data with our findings suggests the existence of different patterns on the two continents. One of the underlying mechanisms associated with this finding of an increase in marginal utility to consume could be that individuals enjoy more some goods such as health assistance or domestic help in the sick state, rather than in the healthy state. However, because of lack of information about consumption baskets, we are unable to corroborate this hypothesis. Another explanation might be that people hit by physical diseases need more resources to buy health care services or to adapt their home, again we do not have this budget shares information to validate this argument.

Another representation is provided by the graph in Figure 2.6 of the results for relevant diseases. As can be seen, when health deteriorates, the large drop in happiness is experienced by individuals with low level of permanent income when compared to the high level.

Concerning mobility difficulties in column (III) and (IV), looking at β_4: as mobility difficulties arises, results show a decrease in the probability of being happy of about 3.9% . Here, as well as in the previous estimates, the sign of β_3 is positive and of the same magnitude as for number of diseases.

Our key coefficient β_1 it is about 0.008. This implies a ratio β_1/β_3 of 3.3%, meaning that for a one within person standard deviation increase in mobility difficulties ($\sigma = 0.65$), the marginal utility of consumption increases around 2%. For an individual with no difficulty who has a marginal utility of about 0.03, it increases to 0.05 with one difficulty, to 0.07 with two impediments. The size of these variations is modest but consistent with the onset of difficult mobility conditions that do not have a strong impact as the onset of a disease.

These first findings suggest that older people place greater value on future resources when physical health is affected, rather than when they are healthy. One potential explanation is that being sick involves future expenditures, both medical and non-medical, to adapt to life in the unhealthy state.

In Table 6 we focus on cognitive decline. Overall, results suggest evidence of negative state dependence. We compute both the fixed effect and the probit fixed effect analysis, following Finkelstein et al. (2013). We proceed by commenting only on the results for the probit fixed effect since they are the only ones statistically significant. We report the marginal effects in the table.

From column (III) it is possible to see that an increase in memory loss leads to a coefficient of β_1 of -7.3%. This result indicates a decrease in the marginal utility and it can be explained through a decline in the enjoyability of goods such as travel or leisure, given that the mental impairment precludes living life as before. However as mentioned above, we do not have enough information to confirm this explanation.

When it comes to the magnitude of the state dependence, one within-person standard deviation increase in low memory ($\sigma = 0.29$) decreases the marginal utility to consume of about 22%.

Looking at the estimates for low verbal fluency, column (IV) reports the marginal effects for the analysis. An increment in low verbal fluency skills leads to a decrease in the marginal utility of about 0.043. The magnitude of the state dependence given by the ratio β_1/β_3 is about 13% for one standard deviation increase in low verbal fluency ($\sigma = 0.17$). Again, this result confirms a different path for marginal utility when mental health worsens with respect to physical health.

To summarize this first set of results: we find evidence of both positive and negative state dependence on a panel of European retirees. With respect to physical deterioration, we find that as the number of severe diseases increases, individuals experience an increase in the marginal utility to consume of about 11%, for an increase in mobility impairments the increase is instead about 3.3%. With reference to mental deterioration, decline in memory reports a decrease in marginal utility of 22%, while worsened verbal fluency implies a drop of around 13%.

The size of these effects is different both in terms of sign and magnitude. Concerning the sign, as previously mentioned, it is possible that when physical decline occurs, people need more resources to adapt their life to the previous state, while when cognitive decline occurs, individuals' marginal utility declines since the unhealthy state prevents living life as before. With respect to the magnitude of the state dependence, we found heterogeneity in the size of the effects that might be due to different health measures applied. Nevertheless, the magnitude is in line with results found in the literature (Finkelstein et al. (2013) and Kools and Knoef (2019)).

These findings further indicate the presence of heterogeneity in the marginal utility to consume as health drops. Different health trajectories and impairments may cause different results in terms of state dependence. This evidence shed some light in favor of the previous work of Brown et al. (2016), who found both evidence of increase and decrease in the marginal utility to consume after bad health events.

2.7 Extension: the analysis for individuals living in couple

As previously mentioned in section 2.3, when analyzing the health state dependence, the family arrangement matters. Couples have a different time horizon than singles and they might disagree in the optimal decisions problem to consume, save and other life cycle choice (Chiappori et al. (1988) and Chiappori (1992)).

Couples are most likely to share a common lifestyle and the same household habitat. Health and economic outcomes are more likely to be correlated within couples, since they are exposed to the same environment (Banks et al., 2013). Furthermore, the health status of one partner can influence the other one in terms of health and economic decisions.

In this section, we focus on the subsample of respondents for whom we have information for both partners. As a first step, we want to ensure that within the health of partners is not perfectly correlated. Table 7 reports the distribution of the health status of men in couple and their respective spouse both for non-working and working spouse. From the upper table, it is possible to see that 7.85% of men in good health have a spouse in a bad health status (i.e., with at least one severe disease) and around 78.5% of men in bad health situations have a spouse in good health. Concerning the couples where the female is still working (only around 3% of the sample), the same pattern is confirmed. Hence, we are confident that the health status is not perfectly symmetric within couples.

To our knowledge in the literature of health state dependence there is no special focus on couples. We do not provide a fully worked model of the interplay between members of the couple and how they might take decisions in a strategic framework (for example). However, we consider explicitly the interaction in terms of altruistic behavior. Of course, the empirical strategy that we implement is a first attempt of measuring the health state dependence in this contest, but it is far from being the extension of a theoretical model for the couples' health state dependence.

We proceed by assuming that individuals in couple have "altruistic" preferences and care about their partner's health status. This implies that partner's health enters the utility function of the individual; this is an attempt to empirically approximate the effect on the partner's on the utility. Thus, we include the spouse's health in the specification of Finkelstein et al. (2013). In our setting, the individual's happiness depends not only on the personal health deterioration, but also on the spouse's one. The state dependence is now composed of both individual's health interacted with permanent income as well as spouse's health interacted with permanent income. The model we estimate is the following:

$$\begin{aligned} Happy\_it = g(&\beta_4 Health_{it} + \beta_1 Health_{it} * \text{Log}(pincome)_i + \beta_3 \text{Log}(pincome)_i \\ &\beta_5 Health\_spouse_{it} + \beta_6 Health\_spouse_{it} * \text{Log}(pincome)_i \\ &+\mathbf{\Gamma} Controls_{it} + \theta_i) \end{aligned} \tag{2.18}$$

We set up a one-step random effect model to allow for variability between couples: we are left with around 17 thousand couples that were interviewed for an average of three waves and a half. The number of interviews is relatively small so that the variability is limited. For these reasons, we set up a random effect model controlling for demographic characteristics, country, and the time dummies. We measure spouse's health via the number of relevant diseases, mobility index or cognitive decline and control for the spouse's age and working situation if the spouse is female.

To evaluate potential differences between male and female partners' perspectives, we run a first set of estimates from males and attach the female partner's information. We then repeat the analysis for females.

We expect to find different effects of the partner's health on the utility of the individual, since the literature has already suggested that there exist gender differences in the late part of life with respect to health decline (women live longer but suffer more) and to the financial situation (De Nardi et al. (2016)).

We expect the coefficients of spouse's health to be negatively correlated with happiness, since partner's sickness causes a dis-utility on the other partner's utility. The idea is that since the individual care about her partner, she experience a loss in utility if the other is in bad health status.

Regarding the interaction of the partner's health with permanent income, we do not have any prior expectation on the sign of the coefficient. In principle, the partner's health might affect the other partner's marginal utility in different ways. For example, when one partner getting sick, she might require more resources to keep up with the previous lifestyle, so the marginal utility of the other partner might increase given that the resources are pooled together. On the contrary, since the sickness of one partner might preclude the other partner from enjoying leisure activities, for example, because she has to help take care of the spouse or the house more than before. This situation might generate a decrease in the marginal utility of consumption. A priori we do not know which of the effects will prevail.

In the following sections we present the sub sample of couples and the results obtained for this analysis.

2.7.1 Characteristics of the subsample

First, we focus now on those male individuals living in a couple for which we also have information for their partners, since both partners in the couple were interviewed. We recall that for our sample, male individuals are retired, because we do not want to have a health effect on labor supply, which would likely effect the budget constraint. The spouses are aged between 55 to 86. We allow female partners to be slightly younger than the male partner since it is quite common. The spouse sample is not entirely composed by retired women: since we include females from 55 years old, part of them is still working (3% in the estimating sample), we control for this characteristic in the analysis. We have about 35 thousand observations and 17 thousand couples. The average number of interviews is 3.7 out of 7.

At a first glance, our sample reveals differences in health decline between individuals living in couple and alone. From Table 9, it appears that single females have on average a greater number of relevant diseases and mobility difficulties than females in couple, while single men are slightly worse off in mobility difficulties compared to men in couple. This suggests that there are differences in health deterioration based on the marital status.

Table 10 reports the descriptive statistics for health status in this subsample. In examining partners' health, females seem to be slightly sicker than males in terms of difficulties in mobility, while male partners are worse off concerning relevant diseases.

From the summary statistics, we know that the female partners are to some extent sicker than the men, so we expect that the partner's health will negatively affect men's utility. About the sign of the interaction of spouse's health with permanent income, we do not have any prior expectations, since both positive and negative effects might occur, as explained in the previous section.

2.7.2 Results for the analysis of couple

Table from 11 to 12 show the results of equation 2.18 for number of relevant diseases and mobility index. Results are coefficients of the random effect model.

Starting from Table 11, in column (I) we consider the health of the male partner only, then in column (II) we add the spouse's health as well as its interaction with permanent income. As we can see, the effect of spouse's health is negatively correlated with happiness, while the coefficient interacted with permanent income is positive and significant. This result indicates that as health of both partners deteriorates, there is an increase in the marginal utility to consume. One explanation can be that when both partners are in the sick state, they benefit more from some goods related to health such as private assistance; although this is only a speculative hypothesis because we lack data to confirm it.

We compute the same analysis measuring health via mobility difficulties in columns (III) and (IV). Interestingly, the sign of the state dependence is negative for men, whereas for the spouse's result is positive, although both are not significant. This result suggests caution in claiming the existence of a spouse's effect on the marginal utility to consume.

In Table 12, we run the same specification but from the female partner perspective. Here, what it is interesting to stress is that when the male partner's health is considered its effect is insignificant. In contrast, in column (II), there is still a positive and significant effect of the female health and of health interacted. The magnitude of the state dependence is about 58% ($\sigma = 0.445$). We are cautious about the magnitude, since we considered a subsample, but we are confident that the results confirm the presence of positive state dependence.

We proceed by running the same analysis with health measured through cognitive decline in Tables 13 and 14. Starting from the male perspective, in Table 13 we find no statistically significant evidence for low memory skills (column (II)), while looking at column (IV) there is a negative and significant effect of the spouse's cognitive decline interacted with permanent income when cognition is measured via low verbal fluency. This suggests the presence of a spouse's health effect, which translates into a negative state dependence of about 22% for a one standard deviation increase ($\sigma = 0.162$) in the spouse's low verbal fluency. This result confirms the effect of cognitive decline on the marginal utility that we found in the baseline analysis for cognitive decline, where the effect was between 13% and 22%. This result supports the hypothesis that when mental problems arise, individuals value consumption less in the future states because cognitive diseases prevent them from enjoying life as before. As for the female perspective earlier, in Table 14, we do not find any statistically significant effect of the partner's mental health on females' utility. This result supports the presence of heterogeneity in the effect of bad health status within couples.

Differences in the marginal utility within couples are consistent with different patterns in consumption and savings as health declines. We found that men in couple are influenced in their marginal utility when the partner gets sick, while it is not the same when considering the female partner's perspective. This is an interesting result and we believe that further research is needed to confirm these findings. For example, it would be interesting to analyze what happen to the marginal utility if the partner passes away and whether this also has any effect on the wealth and savings of the survivor.

2.8 Sensitivity Analysis

2.8.1 Welfare models and long-term care insurance

In this analysis we take advantage of the countries variation in terms of welfare states that is present in the SHARE dataset.

Different welfare systems can provide different levels of social protection to individuals and this may imply different levels of health state dependence of utility. Our analysis assesses whether there are relevant welfare system effects that may affect individual's utility between healthy and sick condition.

In the European framework, several approaches have been used to group countries, from the Esping-Andersen (1990) classification of the three welfare states to the health care systems approach of Atella et al. (2012). None of the cited studies focused on the dimension of long-term care (henceforth LTC) spending, which varies among countries and it is fundamental when considering health shocks in late life. Carrino et al. (2018) demonstrate that there is a great unmet demand for formal long-term care in Europe, with tailored requirements on a country basis, and also differences in eligibility to the programs within country regions.

In our analysis, we proceed by focusing on the degree of expenditure for LTC both public and private per country. We focus on this aspect since we want to group countries not only on the basis of basic health care services, but also to consider the heterogeneity in terms of support for LTC that has been documented by Brugiavini et al. (2017). To do this, we define three groups of countries based on the public spending on long-term care (health and social components) in 2014 as a % of GDP, according to the OECD Health Statistics 2019. We select Sweden, Denmark and the Netherlands as "high spending countries", with more than 2% of GDP spending for LTC. We group Germany, Austria, France, Luxembourg, Belgium and Switzerland as "medium spending countries" with a share of expenditure between 1% and 1.9% of their GDP. Finally, Italy, Spain and Israel are considered "low spending countries" with less than 1% of GDP expenditure.

We proceed by re-estimating the baseline analysis by groups of countries based on our classification. In Tables 15 and 16 we report the results. As we can see, when measuring health via cognitive decline in Table 16, the marginal utility of consumption decreases as cognitive decline arises in each of the three groups, but with differences among groups in the magnitude of the health state dependence. For declining memory, low spending countries experience the greatest drop in marginal utility, suggesting that when the countries coverage for LTC is low, people's marginal utility of consumption is worse off after mental health decline compared to high and medium spending countries. For verbal fluency decline, people in medium spending countries experience the greatest drop in the marginal utility to consume, followed by people in low spending countries. These results suggest the existence of differences in health state dependence of utility when controlling for countries differences in LTC spending. This evidence reflects different coverage and degree of protection, which translates into different declines in terms of marginal utility after a mental health shock.

As pointed out by Bolin et al. (2008), using SHARE data, about one third of the respondents state to receive informal care, with a strong north-south gradient. Northern countries have the highest rate compared to Southern ones. As a second exercise, we are interested in controlling for the possibility that the respondent in our sample is subject to long-term care needs, since this will extensively change her life.

To do that, we start by creating a proxy for receiving long-term care. Since informal care is endogenous, we exploit information of eligibility to public care assistance as documented by Carrino et al. (2018). In particular, we are able to exploit information on individual-country eligibility to the programs.[2]

In the following analysis, we build a control function approach à la Wooldridge (2015) where we

[2]Thanks to the courtesy of the authors Carrino et al. (2018) who provided us this information on our SHARE sample

model receiving care as a function of eligibility to LTC, plus a set of controls.

$$\mathrm{P}(Received\_Care_{iw} = 1|\boldsymbol{x}_{iw}, c_i) = \Phi(\gamma_1 Eligibility_{iw} + \boldsymbol{\Gamma}\boldsymbol{x}_{iw} + c_i). \tag{2.19}$$

We get the generalized residuals from equation (2.19); then, we estimate the model in equation (2.15) including the generalized residuals and the raw indicator *Received_Care* among the regressors.

Results in Table 17 show that when accounting for formal care received the sign of the state dependence is still positive and statistically significant (column (I)). We run the specification via random effect in column (III) and find that there is presence of positive state dependence and it is statistically significant. The effect of receiving care is positive although not significant. Overall, we can confirm our result of positive state dependence when health is measured via physical diseases.

2.8.2 Analysis controlling for out-of-pocket expenditure

In this section, following Kools and Knoef (2019), we consider the fact that in some European countries part of the medical expenditures are not covered by the welfare system but it paid directly by the consumers. With that in mind, this might lead our results of positive state dependence to be driven by out-of-pocket expenditures, for this reason we run further analysis controlling for the presence of out-of-pocket.

In the survey, questions about health consumption were introduced from the first wave, but these questions were moved to the drop-off questionnaire in wave 4. Thus, we cannot use wave 4 in this estimate since we do not have imputation values for this wave. Furthermore, we need to stress that the non-response rate was high for these questions, so the use of imputations is fundamental to be able to use these variables.

We proceed by re-estimating the model in 2.15 and 2.16 including a control variable for the amount of out of pocket expenditure of the individual. We use the variable in logarithm terms since it is an expenditure measure and it is more tractable with that transformation. Table 18 displays the estimates. We report only the case for health via number of diseases. Results are confirmed, there is evidence of positive state dependence, Furthermore, the coefficients of medical expenditure are significant and negatively correlated with happiness. The overall magnitude of the state dependence is about 36%, yielding a one within-person standard deviation increase in severe diseases to a rise of 16% in the marginal utility to consume. With respect to the baseline analysis with number of diseases, where the magnitude of the state dependence was about 10%, we found a greater magnitude when out-of-pocket is included. Nevertheless, we are cautious in comparing those results since the sample of this latter analysis is a subsample of the main analysis. Furthermore, given the heterogeneity in the coverage of medical expenditure among European countries, we claim that the magnitude of our result, when accounting for out-of-pocket might be an overestimation of the “true" state dependence magnitude.

In conclusion, we confirm that the presence of private medical expenditure does not change the sign of our main findings, but we are careful about the magnitude of the state dependence.

2.8.3 Analysis with alternative health measures

We assess the sensitivity of our analysis by re-running the baseline model with alternative health measures: limitation with activities of daily living (ADL) and limitation with instrumental activities of daily living (IADL), the Poterba Venti Wise Index and the minor-major approach.

ADL and IADL are extensively used in the literature and considered to be a good proxy for the health status of the individual. ADL scores from 1 to 6 limitations while IADL up to 9 limitations.

In Table 19 we report the results where we estimate the baseline model with ADL in column (I) and (II) and IADL in column (III) and (IV). The coefficients of interest are statistically significant. In both cases, the sign of the interaction of health with permanent income is negative, suggesting a negative state dependence result.

Another health measures that has been exploited in the literature of health economics is the Poterba Venti Wise index by Poterba et al. (2017). This index exploits a set of 20 indicators using principal component analysis. In Table 20 we compute the baseline model using the index and the results confirmed the positive state dependence presence for the model estimated via random effects.

We focus on the distinction between minor and major health conditions and we divide the set of 7 severe diseases into the 2 categories. We consider diabetes, hypertension and arthritis as minor diseases since they can be treated via medication and kept under control. We group cancer, stroke, heart and lung disease as major diseases, since these are in principle more dangerous, severe and some of them sudden (such as cancer and stroke, heart attack, ischemia and more).
Results, which are reported in Table 21, suggest that only major diseases have a strongly and significant effect on utility. An increase in one major disease causes a drop in happiness of about 0,8% , while the state dependence is positive with a coefficient of about 0,08 and suggests a marginal utility of consumption increase of about 28%. This result confirms the presence of positive state dependence of physical disease as was seen in Table 5. It is interesting to note that the results are driven only by major conditions, whereas minor conditions are not statistically significant and do not impact on the marginal utility to consume. This is consistent with the fact that major conditions are a stronger health shock compared to minor diseases, and thus they have a greater impact on the individual's utility.

2.9 Conclusion

This paper investigates the presence of health state dependence in Europe. We follow the framework of Finkelstein et al. (2013) and extend their approach with a particular a focus on individuals living in couple. We also use different health measures to account not only for physical deterioration but also for cognitive decline, that generally occurs at older ages. The baseline analysis confirms the presence of positive state dependence for physical diseases, meaning that when health deteriorates, the marginal utility to consume increases of about 11.5%. With respect to mental decline, we find evidence of negative state dependence: the marginal utility to consume decreases of about 13% to 22% as cognition skills deteriorate. This result suggest the need for policies able to meet increasing demand for long-term care when cognitive deterioration arises.

These results of different health state dependencies based on the physical or mental decline are interesting and suggest heterogeneity in the marginal utility to consume. To be more clear, when the physical issues arise, people value more in future resources since they necessitate more wealth in the sick state to keep up with the previous living standards. When cognition decline occurs, people are less willing to value wealth in the future state because mental impairment prevents them from living life as before.

This study is the first that tries to combine health state dependence with a focus on couples. We base this analysis starting from the literature about altruistic preferences, we take into consideration that the utility of individuals living in couple might be affected by the health status of the respective partner. We also consider that the health status might be correlated for individuals in the couples, but we are reassured by the fact that in our sample health is not fully correlated within partners.

Focusing on couples, we extend the empirical model of Finkelstein et al. (2013), by adding the spouse's health in the model specification. We found that the female partner's health has a significant effect on the male individual's utility and has a positive and significant effect on the marginal utility to consume. When focusing on females, the male partner's health is not significantly correlated with the female's utility, and does not affect the state dependence. Differences within couples are present, although we are not able to exhaustively disentangle the effects. Further research is needed to confirm these results.

We run a series of sensitivity analyses which confirmed the nature of our findings. These results contribute to underlining that European countries face a different scenarios when dealing with health state dependence compared with the US, for whom the evidence suggests negative state dependence. We provide a possible explanation to understand what drives these differences, but we think that there is a need for more information about consumption and budget shares to deepen this question.

In conclusion, this work highlights the necessity of implementing models with health state dependent utility in order to assess the optimal amount of life-cycle saving and insurance levels. Furthermore, the role of couples must be considered when evaluating health effects on the marginal utility to consume.

Tables and figures

Figure 2.1: **Health State Dependent Utility Framework**

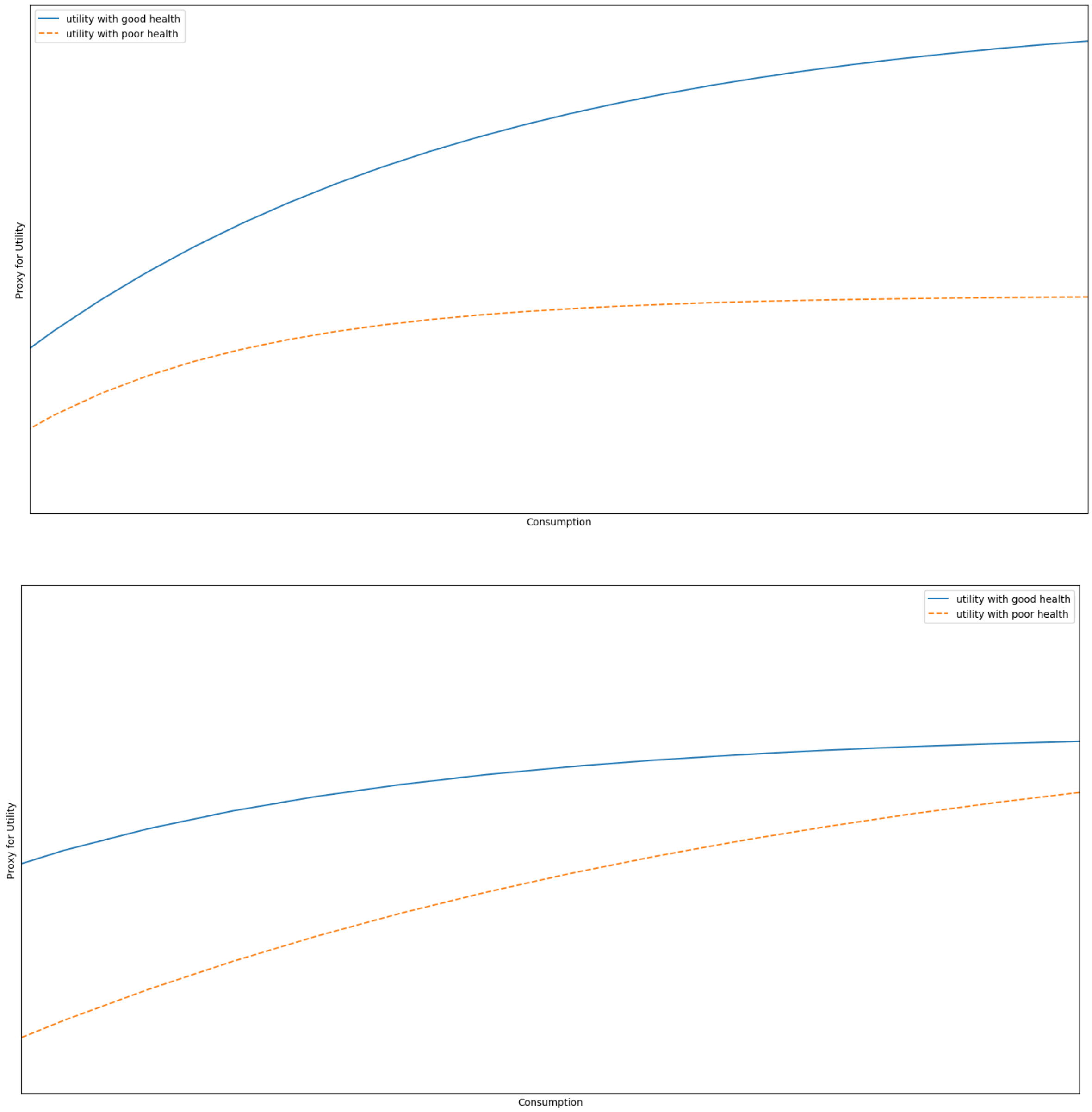


Table 1: **Summary statistics**

Variable	Mean	Std. Dev.	Min.	Max.	N. Obs
happy	0.892	0.31	0	1	138772
casp	38.066	6.169	12	48	138772
age	69.542	8.084	55	86	138772
female	0.639	0.48	0	1	138772
couple	0.727	0.446	0	1	138772
single	0.273	0.446	0	1	138772
income	24.076	35.591	0	4.724.612	138772
years education	10.537	4.575	0	35	138772
number of disease	0.956	1.005	0	7	138772
cancer	0.057	0.232	0	1	138772
arthritis	0.144	0.351	0	1	138561
hypertension	0.401	0.49	0	1	138772
lung disease	0.065	0.247	0	1	138772
heart disease	0.118	0.322	0	1	138772
stroke	0.038	0.192	0	1	138772
diabetes	0.133	0.339	0	1	138772
mobility index	1.01	1.433	0	5	138772
diffchair	0.189	0.391	0	1	138730
diffclimb1	0.128	0.334	0	1	138730
diffclimb2	0.272	0.445	0	1	138456
diffwalk	0.107	0.309	0	1	138730
diffstoop	0.314	0.464	0	1	138730
sphus	3.118	1.059	1	5	138772

NOTE: N of individuals is about 62450 and the average number of interviews per respondents is around 3

Figure 2.2: **Average values of happiness and CASP by age**

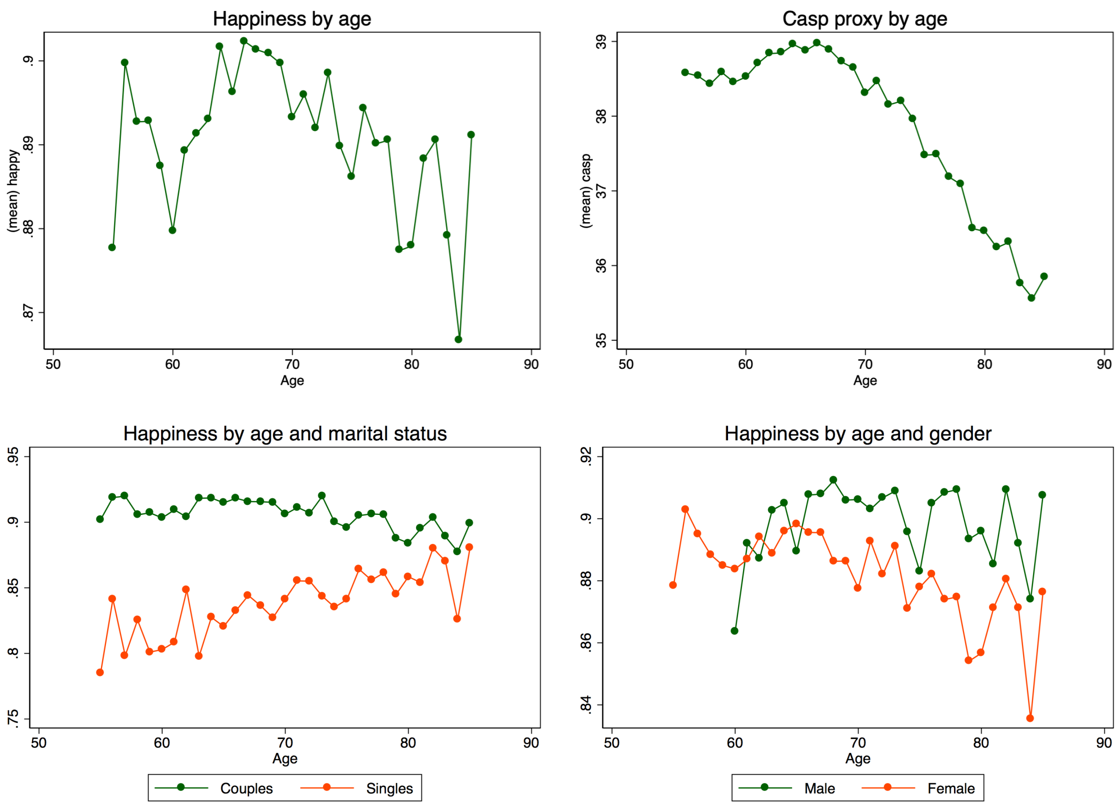


Table 2: **Distribution of number of diseases by gender**

number of disease	Male	Female	Total
0	17,115	37,919	55,034
	31.10%	68.90%	100.00%
	34.17 %	42.76%	39.66
1	18,610	30,499	49,109
	37.90 %	62.10%	100.00%
	37.15%	34.39%	35.39
2	9,778	13,889	23,667
	41.31%	58.69%	100.00%
	19.52 %	15.66%	17.05
3	3,416	4,825	8,241
	41.45%	58.55%	100.00%
	6.82%	5.44%	5.94
4	942	1,253	2,195
	42.92%	57.08%	100.00%
	1.88%	1.41%	1.58
5	204	255	459
	44.44%	55.56%	100.00%
	0.41%	0.29%	0.33
6	26	36	62
	41.94%	58.06%	100.00%
	0.05%	0.04%	0.04
7	4	1	5
	80.00%	20.00%	100.00%
	0.01%	0.00%	0.00
Total	50,095	88,677	138,772
	36.10%	63.90%	100.00%
	100.00%	100.00%	100.00%

NOTE: For each number of diseases the second row refers to the row percentage, while the third row to the column percentage.

Table 3: **Distribution of mobility index by gender**

mobility index	Male	Female	Total
0	30,024	46,822	76,846
	39.07%	60.93%	100.00%
	59.93%	52.80%	55.38 %
1	8,570	15,727	24,297
	35.27%	64.73%	100.00%
	17.11%	17.74%	17.51%
2	4,950	10,552	15,502
	31.93%	68.07%	100.00%
	9.88%	11.90%	11.17%
3	2,846	6,906	9,752
	29.18%	70.82%	100.00%
	5.68%	7.79%	7.03%
4	1,855	4,460%	6,315
	29.37%	70.63%	100.00%
	3.70%	5.03%	4.55%
5	1,850	4,210	6,060%
	30.53%	69.47%	100.00%
	3.69%	4.75%	4.37%
Total	50,095	88,677	138,772
	36.10%	63.90%	100.00%
	100.00%	100.00%	100.00%

NOTE: For each mobility index the second row refers to the row percentage, while the third row to the column percentage.

Table 4: **Distribution of cognitive measures by gender**

Memory	Male	Female	Total
High	14,449	38,456	52,905
	27.31%	72.69%	100.00%
	29.79%	44.47%	39.19%
Low	34,058	48,027%	82,085
	41.49%	58.51%	100.00%
	70.21%	55.53%	60.81%
Total	48,507	86,483	134,990
	35.93%	64.07%	100.00%
	100.00%	100.00%	100.00%
Verbal Fluency	Male	Female	Total
High	37,798	66,787	104,585
	36.14%	63.86%	100.00%
	90.51%	90.41%	90.45%
Low	3,961%	7,082	11,043
	35.87%	64.13%	100.00%
	9.49%	9.59%	9.55%
Total	41,759	73,869	115,628
	36.11%	63.89%	100.00%
	100.00%	100.00%	100.00%

NOTE: For each measure the second row refers to the row percentage, while the third row to the column percentage.

Figure 2.3: **Health measures averages by age**

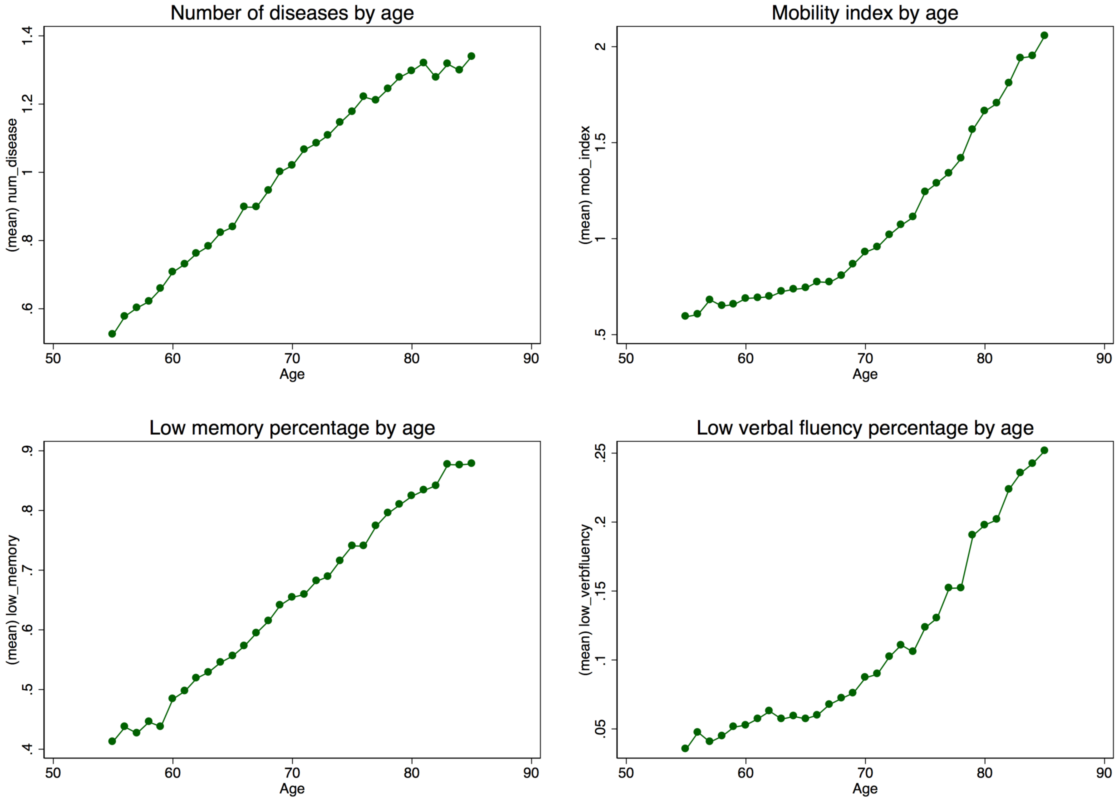


Figure 2.4: **Average number of diseases by marital status (left) or gender (right)**

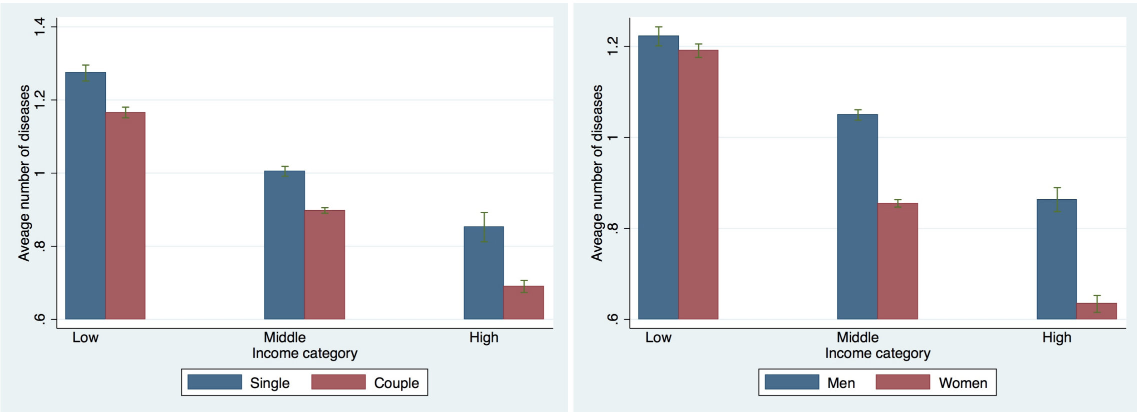
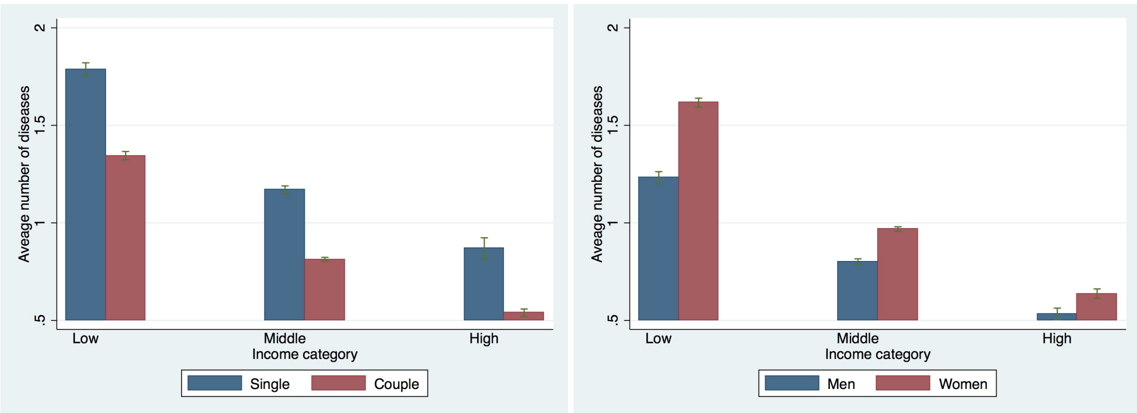


Figure 2.5: **Average mobility difficulties by marital status (left) or gender (right)**



NOTE: Figures from 2.4 to 2.5 show the prevalence of the number of relevant diseases and mobility difficulties, for individuals in couple or singles and for genders.

Table 5: **Analysis of happiness: baseline model results**

Dep. var: Happy	(I) FE	(II) OLS	(III) FE	(IV) OLS
num_disease (β_4)	-0.006***			
	(0.0014)			
num_disease*log_pincome (β_1)	0.006***			
	(0.0020)			
mobility_index (β_4)			-0.008***	
			(0.0009)	
mobility_index*log_pincome (β_1)			0.001	
			(0.0016)	
log_pincome (β_3)		0.026***		0.030***
		(0.0014)		(0.0014)
age	0.002	-0.000	0.000	-0.000
	(0.0036)	(0.0018)	(0.0036)	(0.0018)
age^2	0.000	-0.000	0.000	-0.000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
household size	-0.000	-0.002	0.000	-0.002
	(0.0027)	(0.0017)	(0.0030)	(0.0017)
single	-0.015**	-0.048***	-0.014**	-0.048***
	(0.0073)	(0.0030)	(0.0059)	(0.0030)
female		0.001		0.004*
		(0.0020)		(0.0020)
years education		0.003***		0.003***
		(0.0002)		(0.0002)
constant	0.896***	-0.029***	0.898***	-0.029***
	(0.0020)	(0.0032)	(0.0015)	(0.0032)
R-squared	0.667	0.051	0.667	0.054
N. obs.	138772	138772	139069	139069

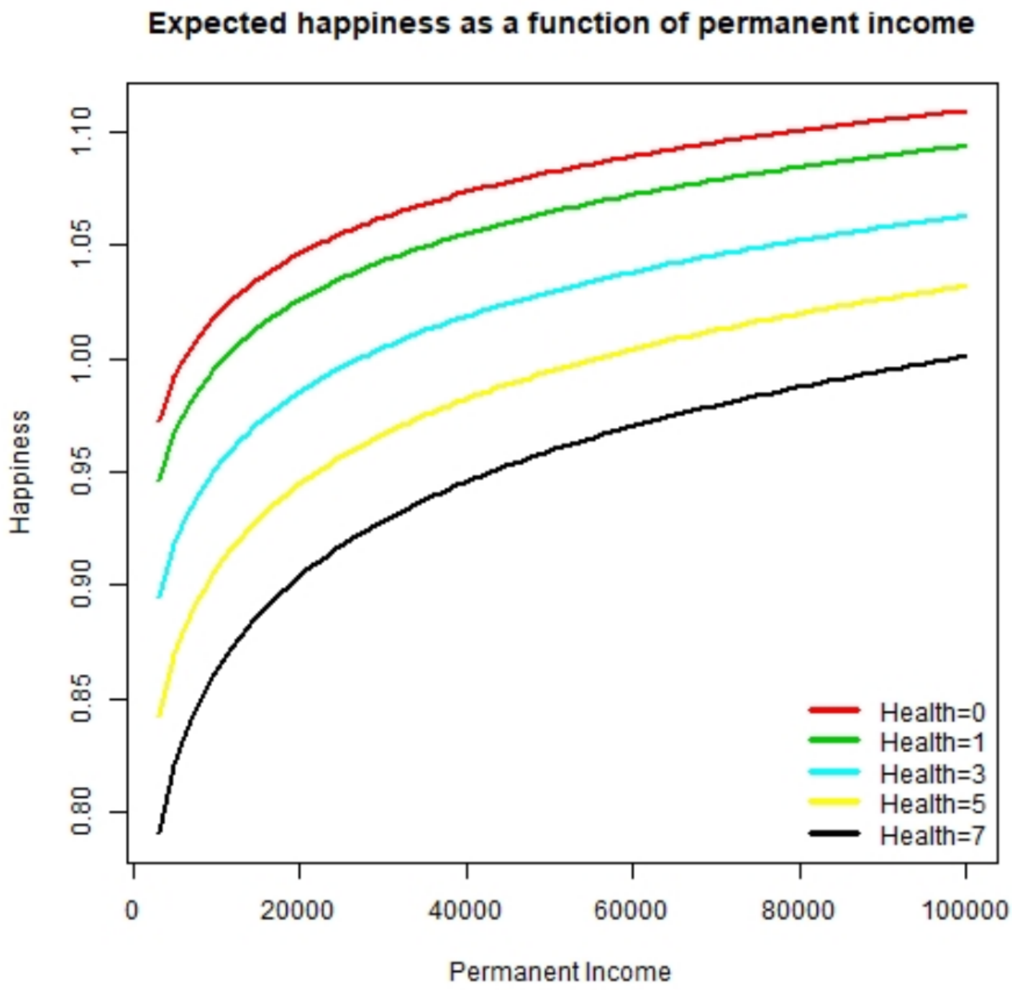
NOTE: The dependent variable is a dummy for happiness. Health is measured via number of diseases or mobility index. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 6: **Analysis of happiness: health measured via cognitive decline**

Dep. var: happy	(I) (FE)	(II) (OLS)	(III) (PROBIT)	(IV) (FE)	(V) (OLS)	(VI) (PROBIT)
low_memory (β_4)	0.001		0.336***			
	(0.0025)		(0.0005)			
low_memory*log_pincome (β_1)	-0.001		-0.073***			
	(0.0033)		(0.0030)			
low_verbfluency (β_4)				-0.024***		0.399***
				(0.0063)		(0.0050)
low_verbfluency*log_pincome (β_1)				-0.006		-0.050***
				(0.0077)		(0.0056)
log_pincome (β_3)		0.034***	0.094***		0.035***	0.063***
		(0.0014)	(0.0027)		(0.0015)	(0.0025)
age	0.003	-0.002	0.001	0.003	-0.003	0.038***
	(0.0036)	(0.0019)	(0.0019)	(0.0043)	(0.0020)	(0.0032)
age^2	0.000	-0.000	-0.000**	0.000	-0.000	-0.000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
household size	-0.002	0.000	-0.011***	-0.002	0.001	-0.003
	(0.0031)	(0.0016)	(0.0015)	(0.0036)	(0.0017)	(0.0027)
single	-0.016**	-0.048***	-0.022***	-0.019**	-0.044***	-0.029***
	(0.0069)	(0.0030)	(0.0027)	(0.0080)	(0.0032)	(0.0049)
constant	0.891***	-0.031***		0.890***	-0.029***	
	(0.0017)	(0.0031)		(0.0014)	(0.0033)	
R-squared	0.000	0.062		0.001	0.061	
N.obs.	134990	134990	134990	115940	115940	115940

NOTE: Reported coefficients for the linear model and marginal effects for the probit model. The dependent variable is a dummy for happiness. Health is measured via low memory and low verbal fluency. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Figure 2.6: Expected happiness on permanent income as health deteriorates



NOTE: Health varies from 0 for a healthy individual to 7 for an individual with all the set of severe diseases considered

Table 7: Distribution of the health status of spouses and partners

	Female partner		
Male Partner	**Good health**	**Bad Health**	Total
Good Health	28,646	2,441	31,087
	92.15%	7.85%	100.00%
Bad Health	2,540	697	3,237
	78.47%	21.53%	100.00%
Total	31,186	3,138	34,324
	90.86%	9.14%	100.00%
With working partner			
Male Partner	**Good health**	**Bad Health**	Total
Good Health	891	17	908
	98.13%	1.87%	100.00%
Bad Health	66	2	68
	97.06%	2.94%	100.00%
Total	957	19	976
	98.05%	1.95%	100.00%

NOTE: Distribution of the health status for men in couple with respect to their spouse, both for non-working and working spouse. Bad health is measured with at least one severe disease. The percentages refer to the distribution of the row

Table 8: **Summary statistics**

Variable	Mean	Std. Dev.	Min.	Max.	N
number of diseases	1.073	1.03	0	7	35300
mobility index	0.856	1.342	0	5	35300
average income	22.984	30.886	0	2.989.168	35300
age	72.082	6.407	60	86	35300
household size	2.21	0.601	2	10	35300
years education	10.531	4.732	0	35	35300
Spouse					
age spouse	68.903	6.802	55	85	35300
years educ spouse	9.997	4.367	0	25	35300
happy spouse	0.908	0.289	0	1	35300
cancer spouse	0.054	0.225	0	1	35300
stroke spouse	0.029	0.167	0	1	35300
diabetes spouse	0.119	0.324	0	1	35300
lung disease spouse	0.051	0.22	0	1	35300
arthritis spouse	0.173	0.378	0	1	35300
heart disease spouse	0.085	0.278	0	1	35300
hypertension spouse	0.409	0.492	0	1	35300
number disease spouse	0.918	0.98	0	6	35300
mobility index spouse	1.05	1.431	0	5	35300

Table 9: **Health measures for individuals in couples and singles**

Number of diseases				
		Male	Female	Total
Couple	mean	1.062	0.832	0.927
	sd	1.025	0.949	0.988
	N.obs	47,485	67,826	115,311
Single	mean	1.108	1.051	1.063
	sd	1.054	1.055	1.055
	N.obs	9,605	33,670	43,275
Total	mean	1.069	0.905	0.964
	sd	1.030	0.991	1.008
	N.obs	57,090	101,496	158,586
Mobility index				
		Male	Female	Total
Couple	mean	0.831	0.935	0.892
	sd	1.315	1.363	1.344
	N.obs	47,618	68,000	115,618
Single		1.067	1.401	1.327
	sd	1.484	1.614	1.592
	N.obs	9,621	33,762	43,383
Total	mean	0.871	1.090	1.011
	sd	1.348	1.467	1.429
	N.obs	57,239	101,762	159,001

Table 10: **Health measures for individuals in couples**

Number of diseases		
	Male	Female
mean	1,076	0,943
sd	1,035	0,990
N.obs	32,405	32,405
Mobility index		
mean	0,861	1,076
sd	1,338	1,438
N.obs	32,405	32,405

Table 11: **Analysis of happiness, males in a couple**

Dep Var: Happy	(I) RE	(II) RE	(III) RE	(IV) RE
num_disease (β_4)	-0.013***	-0.012***		
	(0.0017)	(0.0017)		
num_disease*log_pincome (β_1)	0.004*	0.003		
	(0.0024)	(0.0022)		
num_disease_spouse (β_5)		-0.005**		
		(0.0019)		
num_disease_spouse*log_pincome (β_6)		0.003*		
		(0.0017)		
mobility_index (β_4)			-0.015***	-0.014***
			(0.0015)	(0.0015)
mobility_index*log_pincome (β_1)			-0.000	-0.001
			(0.0017)	(0.0020)
mobility_index_spouse (β_4)				-0.008***
				(0.0013)
mobility_index_spouse*log_pincome (β_6)				0.000
				(0.0015)
log_pincome (β_3)	0.010**	0.007*	0.013***	0.012***
	(0.0043)	(0.0041)	(0.0035)	(0.0033)
age	0.002	0.003	-0.003	-0.003
	(0.0051)	(0.0046)	(0.0053)	(0.0051)
age^2	-0.000	-0.000	0.000	0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
age_spouse	-0.000	-0.000	-0.000	-0.000
	(0.0005)	(0.0006)	(0.0005)	(0.0004)
working_spouse	-0.014	-0.015	-0.014	-0.015
	(0.0098)	(0.0096)	(0.0096)	(0.0096)
household size	-0.007***	-0.007**	-0.007*	-0.007**
	(0.0026)	(0.0031)	(0.0037)	(0.0035)
years education	0.002***	0.002***	0.002***	0.001***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
constant	0.891***	0.896***	0.891***	0.901***
	(0.0132)	(0.0118)	(0.0138)	(0.0127)
N.obs.	35451	35451	35526	35522

NOTE: The dependent variable is a dummy for happiness. Health is measured via number of diseases or mobility index. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 12: **Analysis of happiness, females in a couple**

Dep Var: Happy	(I) RE	(II) RE	(III) RE	(IV) RE
num_disease (β_4)	-0.099***	-0.089***		
	(0.0278)	(0.0270)		
num_disease*log_pincome (β_1)	0.009***	0.008***		
	(0.0027)	(0.0028)		
num_disease_spouse (β_5)		-0.039*		
		(0.0226)		
num_disease_spouse*log_pincome (β_6)		0.003		
		(0.0023)		
mobility_index (β_4)			-0.035*	-0.030
			(0.0186)	(0.0202)
mobility_index*log_pincome (β_1)			0.002	0.001
			(0.0019)	(0.0021)
mobility_index_spouse (β_5)				-0.004
				(0.0190)
mobility_index_spouse*log_pincome (β_6)				-0.001
				(0.0020)
log_pincome (β_3)	0.010**	0.006	0.014***	0.013***
	(0.0041)	(0.0041)	(0.0035)	(0.0035)
age	0.009*	0.009*	0.005	0.005
	(0.0047)	(0.0049)	(0.0052)	(0.0051)
age^2	-0.000*	-0.000*	-0.000	-0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
household size	0.001	0.001	0.001	0.001
	(0.0035)	(0.0039)	(0.0030)	(0.0029)
years education	0.003***	0.003***	0.003***	0.003***
	(0.0004)	(0.0005)	(0.0004)	(0.0005)
constant	0.459***	0.477***	0.537***	0.553***
	(0.1659)	(0.1754)	(0.1712)	(0.1835)
N.obs.	32516	32516	32584	32584

NOTE: The dependent variable is a dummy for happiness. Health is measured via number of diseases or mobility index. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 13: **Analysis of happiness: health measured via cognitive decline, males in a couple**

Dep Var: Happy	(I)	(II)	(III)	(IV)
	RE	RE	RE	RE
low_memory (β_4)	-0.014***	-0.014***		
	(0.0034)	(0.0032)		
low_memory*log_pincome (β_1)	0.005	0.005		
	(0.0044)	(0.0047)		
low_memory_spouse (β_5)		-0.002		
		(0.0038)		
low_memory_spouse*log_pincome (β_6)		0.003		
		(0.0041)		
low_verbfluency (β_4)			-0.045***	-0.038***
			(0.0093)	(0.0076)
low_verbfluency*log_pincome (β_1)			0.001	0.004
			(0.0100)	(0.0091)
low_verbfluency_spouse (β_5)				-0.047***
				(0.0071)
low_verbfluency_spouse*log_pincome (β_6)				-0.024**
				(0.0094)
log_pincome (β_3)	0.011***	0.010**	0.016***	0.017***
	(0.0041)	(0.0048)	(0.0033)	(0.0037)
age	0.003	0.003	0.002	0.001
	(0.0059)	(0.0053)	(0.0049)	(0.0061)
age^2	-0.000	-0.000	-0.000	-0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
age_spouse	-0.000	-0.000	-0.000	-0.000
	(0.0005)	(0.0004)	(0.0005)	(0.0005)
working_spouse	-0.007	-0.007	-0.005	-0.005
	(0.0058)	(0.0063)	(0.0063)	(0.0064)
household size	-0.008**	-0.008**	-0.007*	-0.007*
	(0.0038)	(0.0036)	(0.0036)	(0.0041)
years education	0.002***	0.002***	0.001***	0.001***
	(0.0004)	(0.0005)	(0.0004)	(0.0004)
constant	0.889***	0.891***	0.891***	0.896***
	(0.0112)	(0.0137)	(0.0106)	(0.0158)
N.obs.	34218	34218	29592	29592

NOTE: The dependent variable is a dummy for happiness. Health is measured via low memory skills and low verbal fluency. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 14: **Analysis of happiness: health measured via cognitive decline, females in a couple**

Dep Var: Happy	(I) RE	(II) RE	(III) RE	(IV) RE
low_memory (β_4)	-0.020	-0.019		
	(0.0552)	(0.0510)		
low_memory*log_pincome (β_1)	0.001	0.001		
	(0.0055)	(0.0051)		
low_memory_spouse (β_5)		-0.002		
		(0.0489)		
low_memory_spouse*log_pincome (β_6)		-0.000		
		(0.0048)		
low_verbfluency (β_4)			-0.052	-0.056
			(0.0770)	(0.0829)
low_verbfluency*log_pincome (β_1)			-0.001	0.000
			(0.0082)	(0.0088)
low_verbfluency_spouse (β_5)				0.046
				(0.0893)
low_verbfluency_spouse*log_pincome (β_6)				-0.006
				(0.0093)
log_pincome (β_3)	0.018***	0.018***	0.019***	0.019***
	(0.0054)	(0.0047)	(0.0040)	(0.0031)
age	0.005	0.005	0.006	0.006
	(0.0047)	(0.0037)	(0.0044)	(0.0051)
age^2	-0.000	-0.000	-0.000	-0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
household size	-0.002	-0.002	-0.001	-0.001
	(0.0039)	(0.0037)	(0.0033)	(0.0035)
years education	0.003***	0.003***	0.003***	0.002***
	(0.0005)	(0.0006)	(0.0005)	(0.0005)
constant	0.525***	0.526***	0.449***	0.460***
	(0.1656)	(0.1321)	(0.1525)	(0.1730)
N. obs.	34142	34142	29626	29626

NOTE: The dependent variable is a dummy for happiness. Health is measured via low memory skills and low verbal fluency. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard error are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 15: **Happiness analysis by group of countries by LTC spending**

Dep. var: Happy	(I) FE	(II) OLS	(III) FE	(IV) OLS
High Spending Countries				
num_disease	-0.003			
	(0.0047)			
num_disease*log_pincome	0.001			
	(0.0079)			
mobility_index			-0.004	
			(0.0032)	
mobility_index*log_pincome			0.007	
			(0.0049)	
log_pincome		0.017***		0.012***
		(0.0038)		(0.0038)
R-squared	0.762	0.019	0.762	0.017
N	29474	29474	29501	29501
Medium Spending Countries				
num_disease	-0.003			
	(0.0027)			
num_disease*log_pincome	0.000			
	(0.0029)			
mobility_index			-0.008***	
			(0.0019)	
mobility_index*log_pincome			0.002	
			(0.0028)	
log_pincome		0.029***		0.025***
		(0.0020)		(0.0020)
R-squared	0.651	0.030	0.650	0.027
N	70671	70671	70887	70887
Low Spending Countries				
num_disease	-0.008*			
	(0.0043)			
num_disease*log_pincome	0.008*			
	(0.0047)			
mobility_index			-0.014***	
			(0.0029)	
mobility_index*log_pincome			-0.004	
			(0.0025)	
log_pincome		0.005*		0.016***
		(0.0029)		(0.0029)
R-squared	0.630	0.147	0.629	0.156
N	38627	38627	38681	38681

NOTE: The dependent variable is a dummy for happiness. Health is measured via number of diseases and mobility index. Permanent income (*pincome*) is a proxy for consumption. Demographic controls and wave dummies apply. The group of countries "high spending countries" are Sweden, Denmark and the Netherlands, "medium spending countries" are Germany, Austria, France, Luxembourg, Belgium and Switzerland; "low spending countries" are Italy, Spain and Israel. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 16: **Happiness analysis with health measured via cognitive decline by groups of countries by LTC spending**

Dep. var: happy	(I) (FE)	(II) (OLS)	(III) (PROBIT)	(IV) (FE)	(V) (OLS)	(VI) (PROBIT)
High spenders						
low_memory	0.008		0.254***			
	(0.0055)		(0.0033)			
low_memory*log_pincome	-0.007		-0.219***			
	(0.0098)		(0.0056)			
low_verbal fluency				-0.018		0.285***
				(0.0151)		(0.0131)
low_verbal fluency*log_pincome				0.054		-0.283***
				(0.0338)		(0.0275)
log_pincome		0.021***	0.226***		0.015***	0.327***
		(0.0037)	(0.0053)		(0.0038)	(0.0054)
R-squared	0.768	0.022		0.880	0.026	
N	29031	29031	29031	26205	26205	26205
Medium Spending Countries						
low_memory	-0.003		0.336***			
	(0.0036)		(0.0009)			
low_memory*log_pincome	0.002		-0.119***			
	(0.0038)		(0.0035			
low_verbal fluency				-0.015		0.407***
				(0.0112)		(0.0093)
low_verbal fluency*log_pincome				-0.015		-0.173***
				(0.0142)		(0.0109)
log_pincome		0.028***	0.141***		0.031***	0.179***
		(0.0019)	(0.0024)		(0.0020)	(0.0033)
R-squared	0.659	0.030		0.808	0.033	
N	69212	69212	69212	58873	58873	58873
Low spenders						
low_memory	0.004		0.260***			
	(0.0063)		(0.0017)			
low_memory*log_pincome	-0.000		0.119***			
	(0.0090)		(0.0053)			
low_verbal fluency				-0.046***		0.255***
				(0.0122)		(0.0083)
low_verbal fluency*log_pincome				-0.022*		0.177***
				(0.0130)		(0.0078)
log_pincome		0.016***	-0.109***		0.021***	-0.193***
		(0.0029)	(0.0052)		(0.0033)	(0.0046)
R-squared	0.660	0.166		0.817	0.106	
N	36747	36747	36747	30862	30862	30862

NOTE: The dependent variable is a dummy for happiness. Health is measured via low memory skills and low verbal fluency. Permanent income (*pincome*) is a proxy for consumption. Demographic controls and wave dummies apply. The group of countries “high spending countries" are Sweden, Denmark and the Netherlands, “medium spending countries" are Germany, Austria, France, Luxembourg, Belgium and Switzerland; “low spending countries“ are Italy, Spain and Israel. Bootstrapped standard error are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 17: **Happiness analysis controlling for formal care recipiency**

Dep Var: Happy	(I) (FE)	(II) (OLS)	(III) (RE)
num_disease (β_4)	-0.054**		-0.078***
	(0.0239)		(0.0119)
num_disease*log_pincome (β_1)	0.005**		0.006***
	(0.0024)		(0.0012)
log_pincome (β_3)		0.029***	0.029***
		(0.0015)	(0.0016)
received formal care	0.011	-0.058***	-0.005
	(0.0363)	(0.0221)	(0.0233)
age	-0.001	0.002	0.002
	(0.0041)	(0.0020)	(0.0022)
age^2	0.000	-0.000	-0.000
	(0.0000)	(0.0000)	(0.0000)
household size	-0.002	0.000	-0.002
	(0.0035)	(0.0017)	(0.0016)
single	-0.020**	-0.043***	-0.061***
	(0.0093)	(0.0032)	(0.0030)
female		0.001	
		(0.0023)	
years education		0.003***	
		(0.0002)	
residual	-0.008	0.011	-0.007
	(0.0133)	(0.0080)	(0.0083)
constant	0.914***	-0.383***	0.547***
	(0.1459)	(0.0728)	(0.0835)
R-squared	0.815	0.026	
N.obs.	119102	119102	119102

NOTE: The dependent variable is a dummy for happiness. Health is measured via number of diseases. Permanent income (*pincome*) is a proxy for consumption. We control for being a (in)formal care recipient. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 18: **Happiness analysis controlling for out of pocket expenditures**

Dep. var: happy	(FE)	(OLS)
num_disease (β_4)	-0.090***	
	(0.0238)	
num_disease*log_pincome (β_1)	0.009***	
	(0.0024)	
log_pincome (β_3)		0.025***
		(0.0014)
oop	-0.000	-0.000***
	(0.0000)	(0.0000)
age	-0.002	0.004*
	(0.0034)	(0.0020)
age^2	0.000	-0.000**
	(0.0000)	(0.0000)
household size	-0.002	0.000
	(0.0033)	(0.0017)
single	-0.014*	-0.048***
	(0.0085)	(0.0031)
female		0.003
		(0.0023)
years education		0.003***
		(0.0002)
constant	0.941***	-0.384***
	(0.1238)	(0.0716)
R-squared	0.857	0.025
N.obs.	113695	113695

NOTE: The dependent variable is a dummy for happiness. Health is measured via number of diseases. Permanent income (*pincome*) is a proxy for consumption. Log_oop is a measure for out of pocket expenditure. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 19: **Happiness analysis: ADL and IADL as measures of health**

Dep Var: Happy	(I) FE	(II) OLS	(III) FE	(IV) OLS
adl (β_4)	0.044**			
	(0.0210)			
adl*log_pincome (β_1)	-0.006**			
	(0.0022)			
iadl (β_4)			0.025	
			(0.0154)	
iadl*log_pincome (β_1)			-0.003**	
			(0.0016)	
log_pincome (β_3)		0.033***		0.033***
		(0.0013)		(0.0013)
age	0.000	-0.000	-0.001	0.000
	(0.0031)	(0.0018)	(0.0037)	(0.0018)
age^2	0.000	-0.000*	0.000	-0.000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
household size	0.000	-0.002	0.000	-0.002
	(0.0036)	(0.0016)	(0.0030)	(0.0016)
single	-0.014*	-0.049***	-0.014*	-0.049***
	(0.0071)	(0.0029)	(0.0075)	(0.0029)
female		0.001		0.002
		(0.0022)		(0.0022)
years education		0.003***		0.003***
		(0.0002)		(0.0002)
constant	0.718***	-0.200***	0.754***	-0.215***
	(0.1289)	(0.0667)	(0.1546)	(0.0666)
R-squared	0.668	0.058	0.668	0.058
N.obs.	139069	139069	139069	139069

NOTE: The dependent variable is a dummy for happiness. Health is measured via adl and iadl. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 20: **Happiness analysis: the Poterba Venti Wise index as a measure of health**

Dep Var: Happy	(I) FE	(II) OLS	(III) RE	(IV) POLS
index (β_4)	-0.009***		-0.022***	-0.023***
	(0.0016)		(0.0009)	(0.0009)
index*log_pincome (β_1)	0.003		0.006***	0.007***
	(0.0021)		(0.0011)	(0.0011)
log_pincome (β_3)		0.028***	0.007**	0.005
		(0.0017)	(0.0034)	(0.0034)
age	0.008	-0.006***	-0.001	-0.001
	(0.0058)	(0.0022)	(0.0023)	(0.0023)
age^2	0.000	-0.000***	0.000	0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
household size	0.000	-0.001	0.003	0.004**
	(0.0040)	(0.0019)	(0.0020)	(0.0020)
single	-0.022**	-0.038***	-0.057***	-0.057***
	(0.0089)	(0.0035)	(0.0036)	(0.0036)
constant	0.904***	-0.013***	0.931***	0.935***
	(0.0061)	(0.0036)	(0.0114)	(0.0115)
R-squared	0.001	0.190		0.043
N.obs.	96122	96122	96122	96122

NOTE: The dependent variable is a dummy for happiness. Health is measured via Poterba Venti Wise index. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table 21: **Happiness analysis: minor and major diseases as health measures**

Dep Var: Happy	(I) FE	(II) OLS
minors	-0.004	
	(0.0025)	
majors	-0.008***	
	(0.0028)	
minors*log_pincome	0.004	
	(0.0034)	
majors*log_pincome	0.008**	
	(0.0035)	
log_pincome		0.028***
		(0.0014)
age	0.002	-0.001
	(0.0035)	(0.0018)
age^2	0.000	-0.000
	(0.0000)	(0.0000)
household size	0.000	-0.002
	(0.0031)	(0.0017)
single	-0.015**	-0.049***
	(0.0071)	(0.0030)
female		0.001
		(0.0020)
years education		0.003***
		(0.0002)
constant	0.895***	-0.029***
	(0.0020)	(0.0032)
R-squared	0.668	0.053
N.obs.	139069	139069

NOTE: The dependent variable is a dummy for happiness. Health is measured via minor and major diseases. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Appendices

.1 Appendix A

.1.1 Baseline analysis with CASP indicator as proxy for utility

Table A1: **Analysis with CASP as dependent variable**

Dep Var: CASP	(I) FE	(II) OLS	(III) FE	(IV) OLS
num_disease (β_4)	-0.415***			
	(0.0237)			
num_disease*log_pincome (β_1)	0.205***			
	(0.0303)			
mobility_index (β_4)			-0.682***	
			(0.0185)	
mobility_index*log_pincome (β_1)			0.114***	
			(0.0234)	
log_pincome (β_3)		1.837***		1.832***
		(0.0367)		(0.0351)
age	0.851***	-0.264***	0.712***	-0.238***
	(0.0394)	(0.0395)	(0.0508)	(0.0378)
age^2	-0.006***	0.002***	-0.005***	0.001***
	(0.0003)	(0.0003)	(0.0004)	(0.0003)
household size	-0.124***	-0.318***	-0.106**	-0.317***
	(0.0426)	(0.0376)	(0.0513)	(0.0364)
single	-0.275***	-0.910***	-0.267**	-0.806***
	(0.0711)	(0.0673)	(0.1067)	(0.0645)
female		-0.441***		-0.191***
		(0.0407)		(0.0387)
years education		0.123***		0.111***
		(0.0057)		(0.0054)
constant	38.471***	-1.046***	38.742***	-1.079***
	(0.0276)	(0.0734)	(0.0260)	(0.0703)
R-squared	0.647	0.139	0.611	0.144
N.obs.	140871	140871	140972	140972

NOTE: The dependent variable is the CASP variable for utility. Health is measured via number of diseases and mobility index. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Table A2: **Analysis with CASP as dependent variable**

Dep Var: CASP	(I) FE	(II) OLS	(III) FE	(IV) OLS
low_memory (β_4)	-0.301***			
	(0.0330)			
low_memory*log_pincome (β_1)	0.126***			
	(0.0414)			
low_verbfluency (β_4)			-0.990***	
			(0.0841)	
low_verbfluency*log_pincome (β_1)			0.004	
			(0.1160)	
log_pincome (β_3)		1.979***		2.111***
		(0.0335)		(0.0345)
age	0.823***	-0.286***	0.814***	-0.306***
	(0.0478)	(0.0385)	(0.0597)	(0.0400)
age^2	-0.006***	0.002***	-0.006***	0.002***
	(0.0003)	(0.0003)	(0.0004)	(0.0003)
household size	-0.134***	-0.298***	-0.133***	-0.306***
	(0.0388)	(0.0338)	(0.0437)	(0.0350)
single	-0.270***	-0.919***	-0.257***	-0.896***
	(0.1037)	(0.0634)	(0.0968)	(0.0659)
female		-0.463***		-0.419***
		(0.0497)		(0.0515)
years education		0.119***		0.119***
		(0.0053)		(0.0055)
constant	38.286***	-1.000***	38.156***	-1.090***
	(0.0356)	(0.0696)	(0.0279)	(0.0715)
R-squared	0.660	0.149	0.780	0.160
N	139689	139689	121634	121634

NOTE: The dependent variable is the CASP variable for utility. Health is measured via low memory and low verbal fluency. Permanent income (*pincome*) is a proxy for consumption. Wave dummies apply. Bootstrapped standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01

Chapter 3

Risk and patience attitude in different domains: evidence from the ELSA study

3.1 Introduction

Preferences towards risk and time preferences are a relevant dimension of individual's decision making and play an important role in microeconomic models. However, in standard life cycle models, these parameters are assumed constant as part of the Bernoulli utility function. This is in contrast with the empirical literature, which points out different features of heterogeneity of risk preferences and also suggests the possibility that they depend on demographics and time (Schildberg-Hörisch, 2018). In the same way, some scholars tested empirically the stability of time preferences and found that for some individuals, these preferences may change over time (Meier and Sprenger, 2015).

This paper takes these findings as a starting point and focuses on preferences towards risk and patience in different domains: in a general domain called "general matters", but also in financial matters and health matters. Understanding whether agents exhibit different attitudes concerning risk and patience in these domains is crucial to be able to better design welfare policies such as, for example, pension reforms or demand for health care. Furthermore, this would suggest that not only preferences change over time as already established, but also that there exist heterogeneous preferences according to the domain that affects an individual's life.

Whether preferences change over time and circumstances has been investigated by several scholars in the empirical literature. Some authors found differences in risk attitude based on gender (Dohmen et al., 2011), educational attainment (Outreville, 2013) or socioeconomic status (Shaw, 1996). Dohmen et al. (2010) and Bonsang and Dohmen (2015) emphasized the role of cognitive abilities in influencing risk preferences, while Sunde and Dohmen (2016) provide evidence on the role played by the ageing process. Recently, Banks et al. (2019a) focused on the effects of life events such as losing job, retirement, becoming widow or having a health shock at older ages and found evidence that these events contribute to explain part of the changes in risk attitudes attributed to age.

In a companion literature, time preferences (patience) and their stability over time and age have been studied empirically. Mischel and Shoda (1989) found correlations between time preferences elicited through experiments and the level of education. Meier and Sprenger (2010) highlighted this type of association in the financial domain. In a parallel research venue, personality traits and time preferences were explored by Mischel (1968) and Ross and Nisbett (1991). However, as suggested by Frederick et al. (2002), the literature lacks longitudinal analysis to be able to draw conclusion about the stability of time preferences.

Another interesting aspect of preferences is that they are usually captured by one parameter of the utility function, and furthermore the parameter is independent of life circumstances at any time of the life cycle. We investigate whether this is the case or if in fact there may be different components that contribute to form individual preferences, such as financial and health preferences. We argue whether certain sub-components matter more than others, say financial over health attitude for example. In a broader perspective, health and financial attitudes, both in terms of risk and time preferences, have an impact on life cycle decision such as consumption, savings and leisure. Health preferences may affect your labor supply and your consumption of health services, while financial preferences influence the optimal level of life cycle savings and consumption.

In this analysis, we question the assumption of the single parameter specification of preferences by exploiting information about risk and time attitudes in the health and in the financial domain, that are available in the English Longitudinal Survey of Ageing (ELSA)[1]. The survey focuses on the older population aged from 50 and over in England.

For our purpose we exploit six questions about risk and time attitudes in different domains that were introduced in the self-completion questionnaire in 2016 (wave 8). About 6000 individuals replied to the questions. With such a great variety of questions, along with socio-economic information, we can to address several aspects of the elicited preferences.

In this study, we focus on three important aspects of the elicited risk attitudes and patience attitudes. First, we investigate the cross-correlation of these measures – meaning that we look at the responses at individual level and try to assess the degree of "coherency " across domains for each individual. While there is no presumption that an individual who is very risk averse in one domain (say health) should also avoid financial risks, or that the association should go the other way, it seems useful to see whether older people tend to have a coherent pattern of preferences vis-à-vis risk and patience. Second, we investigate whether gender differences (or other socioeconomic differences) were present in answers to the key-questions and which of the individual characteristics was useful in determining the willingness to take risks. For this second point, we implement a multinomial logit analysis, which enables us to identify the source of individual heterogeneity in the sample. As a final step, we address the predictive power of those measures in behavioral choices, by selecting a set of behaviors that are classified as "risky" in the literature (smoking, drinking, borrowing, investing in assets)[2].

This study is the first to exploit information about both risk and patience in different domains on a sample representative of the 50+ population in England. Previous studies had some limitations: either because they were based on small samples or because they lacked exhaustive information about the socioeconomic status of the individual and the household. Furthermore, we can address in a novel way both the potential sources of heterogeneity in risk attitudes in different domains and how these are reflected in behavioral patterns, such as activities which have an impact on health

[1] see Banks et al. (2019b)

[2] This test is the so-called "external validity" test, it looks at the extent to which the measures associate with, and are able to predict, a range of field behaviors, as described by Galizzi et al. (2016). This approach has been implemented also by several scholars such as Mitchell (1999), Reynolds (2006) and Harrison et al. (2018).

outcomes or economic outcomes.

To summarize our findings, for cross-correlation there is evidence of positive correlation in risk measures (pairwise correlation) as a sign that they are generally moving in the same direction. Risk aversion in the health domain is positively associated to risk aversion in the financial domain and to risk aversion in general, and the same applies for patience measures. When looking at cross-correlation between risk and patience, it emerges that greater risk patience in the financial domain is negatively correlated with risk in finances, suggesting that individuals who place more value on the future in financial terms tend to be less willing to take financial risks. Important differences emerge in all these checks between genders.

Turning to the nature of the willingness to take risks, we describe the data by allowing for the presence of different sub population groups in the distribution of the answers and relate these to some underlying explanatory variable. In particular age and female have significant effects on the outcome measure, risk attitude. In addition, we find differences in the determinants that affect each subgroup, suggesting a potential source of the groups' heterogeneity.

As to the behavioral predictions, there are significant results of association between behaviors and preferences, in particular with smoking, drinking, savings and investment decisions. Overall, increasing willingness to take financial risks is often associated with engaging in risky behaviors. Whereas, increasing "general" patience attitude decreases the chance of drinking, borrowing or investing in risky assets.

In conclusion, our work provides original insights on a set of risk and patience attitudes, which covers different contexts. We are the first to exploit this information on a survey representative of the older population in England. Our findings confirm some of the previous results proposed by the literature.

The rest of the paper proceeds as follows: section 3.2 presents the theoretical background and the state of the literature, section 3.3 introduces the dataset and the key variables, section 3.5.1 provides descriptive statistics, section 3.4 the identification strategy and section 3.5 the results. Finally, section 3.6 concludes.

3.2 The basic model and the literature

Standard models of life-cycle consumption and leisure decisions assume that utility functions are additive and separable over time; and also that the parameters describing preferences over risk and time are typically fixed and independently set. A typical specification of the consumer's problem assumes that the individual lives for T periods and she has to maximize the present discounted value of the following future utility:

$$max \sum_{t=0}^{T-1} \frac{u(c_t)}{(1+\delta)} \tag{3.1}$$

where the utility function takes as argument consumption expenditures in several periods. The δ-parameter represents preference for time, δ takes values in the interval (0,1), and it can be thought of as a measure of the individuals' impatience. If δ tends to zero then the individual is highly patient and values the future such as the present; instead, if δ tends to one the individual is more impatient and values the future consumption less than the present one. The period-utility function is often assumed of the isoelastic form, that is the constant relevant risk aversion (CRRA):

$$U(c_t) = \frac{c^{1-\gamma}}{1-\gamma}$$

Where the γ-parameter indicates the relative risk aversion after Arrow (1971) and Pratt (1964) , this parameter is assumed to be constant and to be positive, but different from 1.

Given this specification the individual maximizes her utility, subject to a budget constraint, and the well-known result is that individuals do consumption-smoothing and that the level of consumption is related to lifetime resources and not to current income.

Based on this starting model, micro-founded models typically assume that risk and time preference parameters do not change over time. These models usually assume that each individual displays the same parameter no matter at which point of the life cycle she is, thus, different individual time horizons at each age. Furthermore, this approach fixes parameters independently from life circumstances such as employment or health shocks, as well as individual characteristics as trust or personal characteristics.

However, the empirical literature has already pointed out the possibility that risk and time preferences are more complex than previously thought (Schildberg-Hörisch, 2018). Several approaches have been implemented, and they might be classified into two main strategies. The first aims at eliciting preferences through survey-based questionnaires where, through direct and indirect questions the individual is asked to reveal choices about risk and time attitudes. The second approach instead pursues the same objective via experiments, where the participants are asked to complete several tasks, such as playing lotteries for example. Since surveys are not incentive compatible, some scholars have argued about the reliability of replies for these questions. Also, experiments are costly and it is difficult to obtain a sample representative of the population. Below, we present some results of both approaches.

With respect to the first approach, Dohmen et al. (2011) exploited the German Socio-Economic Panel (SOEP) survey and shed light on the determinants for the willingness to take risks with a measure of risk attitude in "general". They were able to find that individual characteristics such as age, gender, height and parental background contribute to explaining differences in risk attitude.

Some scholars looked at risk preferences during the ageing process. Using a sample of German and Dutch individuals, Sunde and Dohmen (2016) documented that ageing is correlated with a decreasing attitude in willingness to take risks. Also it seems that a time preferences age pattern is present, but focusing on different outcomes. The same results was found by Dohmen et al. (2017). With respect to this last point, Huffman et al. (2017) focused on older individuals in US and were able to identify differences in time discounting preferences related to characteristics of particular importance to elderly, such as cognitive decline and a bequest motive. Finally, Schurer (2015) showed that after age 40 risk attitude changes differently across socio-economic groups: risk tolerance drops for low income groups and remains stable for all other groups.

Several studies have examined the connection between risk or time attitude with health (Gafni and Torrance (1984), Breyer and Fuchs (1982)). Breyer and Fuchs (1982) tried to elicit risk attitude in the health domain by asking individuals about their willingness to access medical treatment in health care and found that respondents are risk-seeking with respect to losses and risk averse towards gains. They observed that more educated individuals exhibit more risk-seeking behavior to gains and more risk aversion to losses, thus implying a nonlinear relationship between health and utility.

Bonin et al. (2007) looked at labour choice and risk preferences: they found that among those less willing to take risk, earning risks were very low, irrespective of the level of occupation, region, gender and working experience.

Another stream of the literature has explored the relationship between risks or time attitude and cognitive ability. Dohmen et al. (2010), using German data, provided evidence that people with greater cognitive ability take more risk in lotteries and exhibit more patience over the experiment time horizon. Recently, Bonsang and Dohmen (2015), exploiting the Survey of Health Ageing and Retirement in Europe (SHARE), established that part of the increase in risk aversion at older ages might be instead attributed to the decline in cognitive ability that occurs during the ageing process.

Thanks to the availability of a new world-based dataset, the Global Preference Survey (GPS), some evidence on world patterns on risk and time attitude have been observed. Falk et al. (2016) documented the validity of this dataset, which collects information about time and risk attitude on more than 70 countries. Falk et al. (2018) exploited this data and were able to reveal some important facts and results on the global population. For example, European and English speakers are more patient than the rest of the world, patience and risk taking are positively correlated as preferences, and at the individual level, attitudes vary by gender, age and cognition. When it comes to comparison among countries, between-country variation is considerable, but within-country variation is greater, suggesting that individual characteristics are even more crucial in explaining differences.

There is an important issue of "instability of preferences" addressed by Meier et al. (2018) who looked at the variation in people's emotions and look at whether this predicted changes in preferences: fluctuations in happiness, anger and fear affect risk and patience attitude, even when controlling for confounding factors or events. The role of personality traits on risk attitude was also pointed out by Jones et al. (2018).

Dealing with patience, some scholars found correlations between time preferences elicited through experiments and level of education (Mischel and Shoda, 1989), or financial domains (Meier and Sprenger, 2010). Also personality traits and time preferences have been explored by Mischel (1968), and Ross and Nisbett (1991). However, as suggested by Frederick et al. (2002), there is a lack of longitudinal analysis to be able to draw conclusions about the stability of time preferences, and not many studies have been produced using survey data on this point.

A recent stream of the literature has proposed “survey experiments": they combine survey questionnaires with experiments in order to collect not only preferences attitudes (through the standard questionnaire) and on the other hand, actual decision making. At this stage, ELSA does not include these experiments for the questions of interests. In wave 5, a lottery experiment was conducted: a future aim will be to match the participant replies to those experiments with the replies given in the self-completion questionnaire of wave 8, in order to evaluate the cross validity of the risk and patience attitudes measures.

Overall, the majority of these findings focus mainly on attitude towards risk or time in the “general" domain. To the best of our knowledge we are the first to model these preferences also in financial and health domains at the same time, through direct questions about these topics. Furthermore, except for one study of Galizzi et al. (2016) who exploited a relatively small sample of individuals in England (around 660 respondents), we are the first to investigate a larger sample of elderly (6000), which is representative of the English older population; and to examine different perspectives such as the cross validity and the behavioral prediction of these measures, as well as the heterogeneity of replies.

3.3 Data

In this chapter we make use of the English Longitudinal Study of Ageing which contains information about individuals aged 50 and above in England. The survey samples respondents starting from individuals that were previously interviewed in the Health Survey for England (HSE). To maintain a representative sample of the population aged 50 and over, new individuals were added in wave 3, 4, 6 and 7. Up to now, 18 thousand people participated.

The survey collects several information about different aspects of ageing: health, social care, retirement and pensions, social service and participation. It started in 2002 and it is conducted every two years.

Up to the present, 8 waves have been released out of 9 data collections. For the purpose of this analysis, we are interested in the information from wave 8, where questions about risk and patience attitudes in different domains were asked. In particular, these questions were asked in the self-completion questionnaire which was completed using paper and pencil. This further restricts our sample to individuals who provided valid answers to these questions. From the original sample that replied to wave 8, 13% did not answer to the self-completion part.

On top of this domain, we made use of information about socioeconomic characteristics from the previous waves, as well as health information from the last nurse interview for each respondent.

Furthermore, since new respondents aged 50-52 were not included in wave 8, such that the sample representativeness from age 50 is not perfect, we focus on respondents aged from 55 and above. Based on our restriction, we are left with 6000 of about 10000 respondents, for which we exploit information about savings, retirement, working situation, education, behaviors (drinking, smoking, exercising).

3.4 Empirical Analysis

In the literature review of section 3.2, we explained why it is relevant to empirically evaluate risk and time attitudes in different domains. However, there is no shared consensus on a general model which could support such an investigation. Therefore, we propose a set of estimates which can shed some light on the interesting patterns in the data.

A first objective of this chapter is to document preferences towards risk and patience taking into account different sources of heterogeneity within the sample.

An important feature of our data is that we can compare the "general" attitude to risk/time and different components of preferences. Hence, we carry out the cross validity of these measures: that is, we estimate the correlation between the different measures of risk/patience attitudes at the individual level. It should be mentioned that this is a specific type of cross validity, which has been adopted in this literature and validated by Dohmen et al. (2011) and Galizzi et al. (2016), and it does not follow the more traditional cross validity methodology adopted in statistics or econometrics.

A specific analysis of the data is carried out by looking at association tests such as the pairwise correlation, the Chi-squared, the Kendall, and the Spearman test. These tests provide the degree of dependence/association using pairwise comparison of two variables, different risk/patience measures and individual characteristics (being female/male) or between different risk and patience measures.

These tests enable a first exploratory analysis as well as association and dependence patterns but are only baseline statistical tools.

The statistical measures discussed above are mostly descriptive and do not lead themselves to a more structured choice model. Hence, focusing on the determinants of willingness to take risks, we model the outcome variable using a multinomial logit analysis.

In a final exercise, we test the behavioral predictions of risk and time attitude variables by setting up an econometric model which specifies how risky behaviors (such as drinking and smoking) depend on these variables.

The type of model specified for the behavioral prediction tests takes the form:

$$Behavior_i = \beta_0 + \beta_1 risk\_attitude_i + \beta_2 patience\_attitude_i + \Theta Controls_i + u_i \tag{3.2}$$

As stated before, we desire to identify which measures of risk or patience are able to predict the behavior of individuals, controlling for other confounders.

Since we can presume that attitude of "risk in general" is a more comprehensive measure that includes risk in other domains, that is, with a broad spectrum, it is interesting to analyze the effect of attitude towards "risk in general" as a separate factor with respect to attitudes towards "risk in finances" and the "health" domain. The same discussion applies to "patience in general" matters versus "patience in financial" and "health" matters.

3.5 Results

3.5.1 Descriptive Statistics

Table 1 reports the summary statistics for the variables of interests: we focus on individuals aged between 55 to 85 to avoid very old cohorts. The average respondent is 69 years old and 45% of the sample is composed of females; 25% of individuals are single.

For the education variables: 18% reports no education, 14% high education but below degree, 18% degree level, 3% has the foundation diploma (low education), 18% the higher diploma (mid low education) and 18% the advanced diploma (high education below degree). Finally, 14% states to have a foreign education. For the working situation: the majority is not working (72%), and a small percentage (12%) is working full time, while 15% part time.

Income is on average 28.500£ per individual (the standard deviation is 21.100£). Almost all the respondents (97%) report to save money and 65% has investments. A small share (10%) has still a mortgage.

In this chapter we are particularly interested in risky behaviors: only 8% currently smoke, while 57% declares drinking at least once or twice a week, and 16% of the sample does not exercise much. Finally, 34% is overweight and 25% is considered obese according to the BMI scale.

3.5.2 Analysis of the distributions of risk and patience attitude

As explained above, we carry out several exercises to understand the value of this new set of variables included in the ELSA study. It is useful to recall that “willingness to take risk" and patience span from 0 to 10 where zero is avoiding taking risks or being very impatient and 10 being fully prepared to take risk or being very patient.

The descriptive statistics in Table 1 suggest that when considering risk attitude, individuals appear to be concentrated more around a low level of willingness to take risks. In particular, the attitude of risk in financial domains is the variable with the lowest average score, namely 3.16. When turning the attention to patience, respondents report being quite patient (values above 6.5) with respect to patience in general and finances. Instead, with respect to health, they tend to be less patient (5.29 on average). Although these results provide a preliminary description of the risk preferences and patience, these are partial as they are simple unconditional summary statistics.

We control for the possibility that individuals systematically report the score 5 (the value in the middle of the scale) only because they do not know what to reply. Only around 200 observations over 6000 are affected by this problem. We also consider those who report the value 5 in four out of six questions of interests. Again, there are only a small percentage. Nevertheless, we report the distribution of the variables with and without these cases in tables from 2 to 4: the distributions do not change overall.

In Table 2 we look at “risk attitude in general terms”: it emerges that 64% of respondents answer a number between 0 and 5, meaning that they tend to avoid taking risk, while a very small share reports to be fully prepared to take risks (3%). When looking at the bottom of the table, where statistics about patience are shown, it can be seen that almost two-thirds of respondents (65%) report a number greater than 5, that is, people tend to be patient, with 40% being within 7 and 10.

The distribution of attitude towards finances is presented in Table 3: nearly 82% of replies are within the score 5, meaning that individuals avoid taking risks with reference to their finances; only a tiny percentage (6%) are quite prepared to take risks, and 0.70% answered that they are fully prepared to take risks. These results are in line with the literature findings on financial risk attitudes.

Finally, with respect to health: Table 4 reports the degree for which an individual is willing to take risk with respect to a treatment to improve health, here the distribution is concentrated in the area of "less willing to take risk", still around 40% present a score greater than 6 (more towards prepared to take risk). The interpretation of these patterns is not obvious: one could argue that older individuals are more willing to expose themselves to new health treatment because on average their health is worse than for younger cohorts, but it could just be that in general people are more prepared to face new treatments because they have an objective of "health capital" that they like to preserve. In the same way, when health is related to living for the moment or for the future, 46% declare to be more willing to live for the future, which seems in line with the willingness to expose themselves to medical treatment.

To provide a descriptive introduction to the analysis we report the cumulative distribution function (henceforth cdf) of the measures of interest, also combined with several individual characteristics. Figure 3.1 on the left reports the cdf of risk each domain: if we consider the probability of having a score below 4 (thus, towards not willing to take risks), financial risk attitude shows the highest probability, with 60% chance, while general and health risk attitude only 40% of chances.

Looking at Figure 3.1 on the right, we compare the cdf for patience attitudes, there is a probability of 60% of having a score below 6 (toward very patience), while for financial and general patience these chances are approximately below 40%. This evidence suggests different patterns among domains and also across measures.

Following on, we look at the cdf by educational attainment for each risk domains. From figure 3.2 it can be seen that low educated individuals (i.e. with at most elementary education) are those more risk averse in each domain considered; this evidence is particularly striking in the financial matters, where the probability of having a score below 4 (towards avoiding risk) is around 70%. The general and health risk have similar patterns by educational level, suggesting consistent replies with respect to these questions.

Figure 3.3 illustrates results for patience in different domains: highly educated individuals report to be by far the most patient in each domain, whereas, interestingly, low educated people are the most impatient in health matters with about 30% of chances of a score below 4 (towards being very impatient).

We proceed by checking whether there are differences in the cdf by age groups. We define three groups, those from age 55-64, from 65-74 and finally 75-85. In doing this, we compare those that are likely to be at work with those that are likely to be in the early retirement ages or late retirement part of life.

First, we focus on the risk attitudes in Figure 3.4: in each of the three cdf, the group 75-85 has higher chances of a score below 4, from 40% of probabilities for health and general risk, up to more than 60% of chances for financial risk. Between the groups aged 55-64 and 65-74 differences in the cdf are less pronounced, but the latter group appears to be less willing to take risks with respect to the former group. This evidence is in line with the main findings of the literature, where older people are less willing to take risks.

Finally, we move to Figure 3.5, where we concentrate on patience attitudes: groups 55-64 and 65-74 have a similar behaviors; instead, group 75-85 shows higher probability of a score below 4 (towards being more impatient) for the health domain. This result is interesting and suggests that older individuals are more likely to report to "live" for the moment in the health domain, which is in line with being in the late part of the life.

Through this preliminary analysis, we can confirm that there exists heterogeneity in replies among educational attainment and age groups. These characteristics have to be considered when analyzing the measures of interest.

3.5.3 Pairwise correlation analysis

Table 5 reports the pairwise correlation between the risk and patience attitude and the main variables of interests.

Starting from risk attitude in general matters, there is positive correlation both with financial and health risk attitude. We believe that risk attitude in general domain could comprehend risk attitude preferences in other domains, in such a way that there is a correlation, and furthermore, that the association goes towards the same direction – as we found a positive correlation.

General risk attitude is also positively correlated with patience in each domain: this implies that a greater willingness to take risks in general domain is in line with greater patience.

In contrast, financial risk is negatively correlated with financial patience such that individuals who are more risk tolerant appear to be more impatient, and positively correlated with health patience. This negative correlation is interesting: it is as if individuals who report to be more patient with their finances are also less prepared to take financial risks.

Health risk is positively correlated with patience in health: people who are more risk tolerant for health treatment are also more likely to report to live for the future.

In addition, age, being female, having no education, or a low level of education (low educ) and exercise rarely are all negatively correlated with taking risks in general, financial risk and health risk (even this last one not for low education). These correlations are in line with expectations and with the literature findings (Dohmen et al. (2011)).

Income, having risky assets or a mortgage are instead positively correlated with risk in general and with their finances, as well as having a high education or a degree. Having a foreign education is positively correlated with taking risk in general: this is consistent with the fact that migrants might be more risk tolerant since they move to find better economic opportunities, therefore, they might be more prepared to take risks.

Overall, this correlation matrix supports the literature findings of attitude towards risk and patience. In conclusion, we can state that these measures are correlated with each other. However, some measures are not statistically correlated within each other, for example, general patience and financial patience .

3.5.4 Association and correlation tests

At this stage, we have found some correlations through the pairwise correlation matrix, but we aim at deepening this aspect by running a series of further tests.

We proceed by setting up three statistical semiparametric tests: the Pearson Chi-Squared test, the Kendall "tau" test, and the Spearman's rank correlation test. Each of these tests could be computed only for couples of variables by construction, so we acknowledge its limitations.

We start with the Pearson Chi-Squared test and we focus on differences between genders, postulating how likely it is that gender and risk attitude and patience attitude are independent.

Table 6 shows that there exist significant differences between genders with respect to risk in general, financial and health. Also, there are differences in general patience and health patience attitude. These sets of evidence confirm the pairwise correlation previously found. Furthermore, it suggests that there are differences by gender in the distribution of answers.

Then, we proceed by focusing on the test of correlation following Kendall and Spearman rank correlation test. Kendall test looks at whether two variables are statistically dependent, while the Spearman's test analyzes the statistical dependence between the ranking of two variables. The null hypothesis of the Spearman's is of no correlation between the two variables of interest in the population.

Looking at Table 7, risk in general is significantly correlated with patience in general, in finances, in health, both for the Kendall and Spearman tests. Financial risk is correlated with patience in health. Risk attitude in health domain is significantly correlated with financial patience, patience in health, for both tests. These results suggest that there exist associations among attitude towards risk and patience, as we expect. These evidences shed some light on the degree of connection of these measures, although we are only able to compare pair of measures.

We have computed a set of simple but standard statistical correlation tests that enable to find cross validity of the risk and patience measures: by couple of measures, there is evidence of correlation. Furthermore, statistical differences exist in the distribution by gender.

Since we cannot compute a correlation test for each individual characteristic, we think that an econometric model might be interesting to find which elements are determinants in the willingness to take risks/be patient. The next section focuses on this point.

3.5.5 Analysis of the determinants of willingness to take risk

In this section, we focus on the determinants of willingness to take risks. First, we classify individuals based on their replies over financial and health risk attitudes. 50% of the individuals belongs to Group 1, they are individuals risk tolerant in both domains - meaning those that choose a value greater than 5 on the scale reply. 25% is in Group 2, they reply to be risk averse in finances (value less than or equal 4) and risk tolerant in health treatment (value greater or equal 5). 6% is in Group 3, they are risk averse in health treatment and risk tolerant with their finances. Finally, 17% of respondents answers to be very risk averse in both questions – meaning that they give a value less than or equal 4 in each reply, and we gather them in Group 4.

We are aware that this classification is arbitrary, but we made the first attempt to cluster respondents by their attitudes replies.

In our analysis, we are particularly interested in group 2 and 3, since those are the ones that exhibit different risk attitudes according to the specific domain considered. Following on Dohmen et al. (2011), we proceed by estimating the effect of exogenous personal characteristics such as gender, age, height and parental background on risk attitudes. Our aim is to check whether some of the group's heterogeneity is systematic, for example, gender differences might be at the core of differences in risk attitudes and thus in economic decisions.

Results are reported in Table 8: the dependent variable is the level of risk-taking attitude, the baseline category is Group 1, so those risk tolerant. Overall results suggest the presence of heterogeneity among groups, led by different personality traits. Group 2 is affected by age and height, while Group 3 is influenced by the mother and the father's education. Group 4 is affected by age, height, and gender. The signs of the characteristics are in line with expectations: being female and age are positively correlated with the increasing degree of risk aversion, this being in line with the literature finding (Dohmen et al., 2011). Higher mother education and being taller increases the risk intolerance as well. About height: the literature usually finds a positive effect of this variable, with taller individuals being more willing to take risks; however, since we consider only an older population, we think that there might be some cohort effects which our results might capture. Finally, higher father education decreases the risk aversion, this being in line with better-educated people being more risk tolerant.

The correlations reported are in line with the literature findings, and furthermore, they contribute to explain part of the individual's heterogeneity that is presented in the sample.

3.5.6 Behavioral prediction analyzes

In this section, we focus on several behavioral choices such as smoking, ever smoked, drinking, having debt, share of risky assets, and being self-employed and we assess the predictive power of the risk attitude and patience attitude measures[3]. To our knowledge, we are the first that are able to exploit this large set of measures to evaluate the behavioral prediction of these proxies.

We apply several linear specifications in order to disentangle the effect of general risk and patience measures from financial and health ones. In each table, we report in column (I) the analysis with "general" risk and patience attitude. In column (II), the financial and health domain measures for risk and patience, in column (IV), we consider all these three measures. We build a risk factor that is composed via factor analysis of financial risk attitude and health risk attitude, in order to gather the information in only one factor component. We repeat the same procedure for patience. In column (III) we run the specification of equation 3.2 with the risk and patience factors just obtained as regressors. In column (V) we also include the measures for general risk and patience.

If risk attitudes measures were perfectly correlated, then the standard models that assume that a single parameter captures risk attitude would be correct. Since the correlation is not perfect, it could be that some risk measures in specific domains are correlated with behaviors while others are not. The same applies for patience attitudes.

Table 9 shows the analysis for smoking behavior: starting from column (I) it seems that there is no effect of general risk attitude and patience on the probability of smoking, while financial risk attitude and patience in health domains are negatively correlated with the dependent variable (see column (II)). This suggests that as the willingness to take risks in the financial domain increases, individuals are less likely to smoke, as well as when patience in the health domains increases. Going forward, in column (III) and (V), it is interesting to notice that both measures of risk and patience attitude are negatively correlated with smoking. This suggests that as risk tolerance in health and finances increases, it is less likely to smoke. General risk attitude is not significant, suggesting that

[3] We are aware that risk and patience attitudes in health domain might be particularly related to life expectations questions. It might be interesting to explore this point in future research

other life domains are more relevant to explain the choice of smoking. Regarding being patience, in column (IV), all the three measures are significant but with different effects: increasing patience in the general domain improve the chances of smoking, while increasing patience in health and finances decrease it. This again suggests that a single parameter of patience preferences might not be able to fully explain the relationship between patience and smoking choice.

Table 10 reports the analysis with *ever smoked* as the dependent variable. Here it is interesting to note that in column (IV), general risk and financial risk are correlated with the dependent with different effects: increasing general risk improves the chance of having ever smoked, while increasing financial risk decreases it. Surprisingly, health risk has not significant effect as well as the factor risk in column (III) and (IV).

The next set of results concern being a regular drinker of alcohol: this risky behavior is harder to model, partly because the definition of "regular drinking" is less precise, partly because it is not obvious that one can think of drinking as a risky behavior. In Table 11, focusing on column (IV) where all the six patience and risk measures are accounted together: here none of them is significant except for general patience, which has a negative effect. The insignificant results suggest that none of the risk attitude affects the chance of drinking regularly, and results in column (V) confirm this evidence.

We then focus on financial choices as dependent variables. For holding debt, we report the results in Table 12: here only risk in the general domain is positively correlated with the probability of holding debts. This suggests that in this context, risk in general domain might capture the overall risk attitude. Regarding patience instead, both general and financial patience are associated with having debts, but the effect is positive for the first regressors and negative for the second one. Health patience has no significant impact.

We move to the analysis where the dependent variable is the share of risky assets over wealth in percentage points. Table 13 shows interesting results: financial risk it is positively associated and significant while general and health risk have no effect. In this analysis only financial risk matters while the other domains have no impact. Concerning patience, general patience is negatively correlated with the dependent, while financial patience is positively associated.

Finally, we analyze the context of labor choice and consider the probability of being self-employed. In Table 14 patience attitude is significant only for the health patience domain and at the 10% level. It seems that preferences for patience are not strongly related to the chance of being self-employed, while risk attitude in different domains is. Financial risk attitude has a stronger effect than general risk and health risk, implying heterogeneous effects in risk attitudes.

As a general point, in most of the specification considered the risk and patience measures are significant even with the control variables being significant: this an interesting result, which suggests that these attitude measures are able to capture part of the individual preferences, even when controlling for the standard individual characteristics.

Overall, we identify several results: (I) not only one risk/patience attitude measure is able to explain the chance of engaging in a behavior, but many measures matter. (II) When two risk or patience measures are significant, they might show opposite effects . (III) Health risk is less likely to be correlated with the behaviors. (IV) There is heterogeneity in the effect of the risk and patience measures depending on the behavior considered.

3.6 Conclusion

In this paper, we exploit survey data to investigate the relationship between risk or patience attitudes in different domains and individual characteristics. We also model how these parameters could affect the behavior of individuals. Our analysis focuses on older people aged at least 55. The sample is representative of the older population in England, drawn from the ELSA survey. Since questions about risk and patience attitudes are asked in wave 8 of ELSA, we make use of this specific wave and relate the variables of interest to several other characteristics of the individuals collected in the study.

We have several objectives: first we analyze the responses in different domains and look at the association and correlation of these measures among themselves (the cross validity of these measures), in a second exercise we try to capture which of the individual characteristics are determinants of the willingness to take risks. At this stage, we estimate a multinomial logit and account for the presence of heterogeneity. Finally, we analyze the behavioral prediction of these proxies in predicting behaviors such as smoking, drinking and borrowing in the financial market.

Our results suggest that there are different patterns in the data, hence confirming that risk attitudes cannot be captured by a simple, unique parameter in models of individual behavior. We find positive correlations among the risk measures as a sign that they generally move together; the same applies for patience measures. Greater risk tolerance and greater patience attitude do not always go towards the same direction: individuals that are more patient tend to be less risk tolerant in financial domains, as it is also found by studies on ageing and risk attitude. Age and patience are positively correlated, suggesting that older individuals tend to be more patient - and also less risk tolerant on average.

Exploiting a set of association tests, we found that men and women exhibit differences in the replies, as also found by the literature. When looking at the determinants of the willingness to take risks through the multinomial logit analysis, we are able to identify which of the individual characteristics affects each group considered in the sample. This result sheds some light regarding the kind of heterogeneity presented in the sample.

For the behavioral predictions, there are significant results of association between behaviors and preferences, in particular with smoking, savings and investment decisions. Some measures, such as general and financial risk attitudes, are correlated with different effects with the probability of engaging risky behaviors, while health risk attitude is unlikely to have an impact. Overall, there is heterogeneity in the effect of risk and patience attitude in the behaviors considered, both in the sign and the statistical significance.

These measures appear to be good predictors of individual choices and must be taken into consideration when designing new models. Elicited preferences via risk and patience attitude might be a good predictor of individuals' future choices.

A great strength of the ELSA is the rich set of available information. Unfortunately, the main questions of our interest were collected only recently in wave 8. To provide a more exhaustive analysis of risk and patience attitudes, it would be ideal to have further longitudinal replies and address whether the heterogeneity that we found is only a wave pattern or instead part of a more broader picture of individuals' preferences. The availability of repeated measures also would give us the opportunity to examine the temporal stability of preferences, which we are now unable to explore.

We believe that further research is needed to better understand the role of risk and patience attitudes, which lies at the core of the economic modeling and contributes to shaping welfare policies for present and future generations.

Tables and figures

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
age	68.658	7.459	55	85	5885
female	0.459	0.498	0	1	5885
degree	0.189	0.392	0	1	5885
foreign educ	0.143	0.35	0	1	5885
no educ	0.184	0.387	0	1	5885
high educ below degree	0.145	0.352	0	1	5885
middle education 3	0.092	0.288	0	1	5885
mid-low education	0.198	0.398	0	1	5885
low education	0.033	0.179	0	1	5885
single	0.257	0.437	0	1	5885
not working	0.729	0.445	0	1	5885
full time working	0.12	0.325	0	1	5885
part time working	0.151	0.358	0	1	5885
income	28.584	21.105	-9.371	300.946	5823
has investments	0.653	0.476	0	1	5823
has savings	0.971	0.168	0	1	5823
risky assets	0.657	0.475	0	1	5885
mortgagor	0.107	0.309	0	1	5885
smoker	0.089	0.285	0	1	5885
ever smoke	0.621	0.485	0	1	5885
drinker	0.577	0.494	0	1	5885
obese	0.254	0.435	0	1	5885
low exercise	0.168	0.373	0	1	5885
overweight	0.347	0.476	0	1	5885
Risk attitude					
General risk	4.586	2.598	0	10	5885
Financial risk	3.165	2.446	0	10	5885
Health risk	4.853	2.787	0	10	5885
Patience attitude					
General patience	6.555	2.414	0	10	5837
Financial patience	6.888	2.193	0	10	5640
Health patience	5.299	2.681	0	10	5715

Table 2: Distribution of risk and patience attitude in “general" matters

General risk	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Avoid taking risks	509	8.10	8.10	501	8.44	8.44
1	356	5.67	13.77	353	5.95	14.39
2	679	10.81	24.57	663	11.17	25.56
3	756	12.03	36.60	734	12.37	37.93
4	545	8.67	45.27	531	8.95	46.88
5	1,179	18.76	64.04	918	15.47	62.35
6	610	9.71	73.74	601	10.13	72.48
7	720	11.46	85.20	709	11.95	84.43
8	528	8.40	93.60	525	8.85	93.28
9	271	4.31	97.92	268	4.52	97.79
Fully prepared to take risks	131	2.08	100.00	131	2.21	100.00
Total	6,284	100.00		5,934	100.00	

General patience	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Very impatient	106	1.68	1.68	104	1.74	1.74
1	71	1.13	2.80	71	1.19	2.93
2	209	3.31	6.12	204	3.42	6.36
3	377	5.97	12.09	372	6.24	12.59
4	417	6.61	18.70	412	6.91	19.50
5	1,033	16.37	35.07	803	13.47	32.97
6	604	9.57	44.64	588	9.86	42.83
7	948	15.02	59.66	925	15.51	58.34
8	1,133	17.95	77.61	1,101	18.46	76.81
9	594	9.41	87.02	585	9.81	86.62
Very Patient	819	12.98	100.00	798	13.38	100.00
Total	6,311	100.00		5,963	100.00	

Table 3: Distribution of risk and patience attitude in financial matters

Financial risk	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Avoid taking risks	1,144	18.22	18.22	1,126	19.00	19.00
1	765	12.19	30.41	748	12.62	31.62
2	990	15.77	46.18	961	16.21	47.83
3	907	14.45	60.62	880	14.85	62.68
4	527	8.39	69.02	517	8.72	71.40
5	814	12.97	81.98	577	9.74	81.14
6	445	7.09	89.07	439	7.41	88.54
7	368	5.86	94.93	362	6.11	94.65
8	192	3.06	97.99	191	3.22	97.87
9	82	1.31	99.30	82	1.38	99.26
Fully prepared to take risks	44	0.70	100.00	44	0.74	100.00
Total	6,278	100.00		5,927	100.00	

Financial patience	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Very impatient	72	1.20	1.20	72	1.27	1.27
1	42	0.70	1.89	42	0.74	2.01
2	124	2.06	3.96	123	2.17	4.18
3	184	3.06	7.01	178	3.14	7.32
4	237	3.94	10.95	233	4.11	11.44
5	1,091	18.13	29.09	826	14.58	26.01
6	579	9.62	38.71	571	10.08	36.09
7	996	16.56	55.27	976	17.23	53.32
8	1,256	20.88	76.15	1,229	21.69	75.01
9	576	9.57	85.72	573	10.11	85.12
Very Patient	859	14.28	100.00	843	14.88	100.00
Total	6,016	100.00		5,666	100.00	

Table 4: Distribution of risk and patience attitude in health matters

Health risk	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Avoid taking risks	580	9.59	9.59	572	10.03	10.03
1	317	5.24	14.83	313	5.49	15.52
2	532	8.80	23.63	522	9.15	24.67
3	544	8.99	32.62	537	9.41	34.08
4	405	6.70	39.32	396	6.94	41.02
5	1,200	19.84	59.16	933	16.36	57.38
6	566	9.36	68.52	553	9.69	67.08
7	722	11.94	80.46	712	12.48	79.56
8	585	9.67	90.13	578	10.13	89.69
9	332	5.49	95.62	327	5.73	95.42
Fully prepared to take risks	265	4.38	100.00	261	4.58	100.00
Total	6,048	100.00		5,704	100.00	

Health patience	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Live for the moment	458	7.52	7.52	452	7.87	7.87
1	246	4.04	11.56	243	4.23	12.10
2	351	5.76	17.33	341	5.93	18.03
3	449	7.37	24.70	441	7.67	25.70
4	377	6.19	30.89	367	6.39	32.09
5	1,420	23.32	54.21	1,191	20.73	52.82
6	650	10.67	64.89	624	10.86	63.68
7	777	12.76	77.65	747	13.00	76.68
8	675	11.09	88.73	662	11.52	88.20
9	214	3.51	92.25	211	3.67	91.87
Live for the future	472	7.75	100.00	467	8.13	100.00
Total	6,089	100.00		5,746	100.00	

Figure 3.1: Cumulative distribution function of general, financial and health risk/patience attitude overall

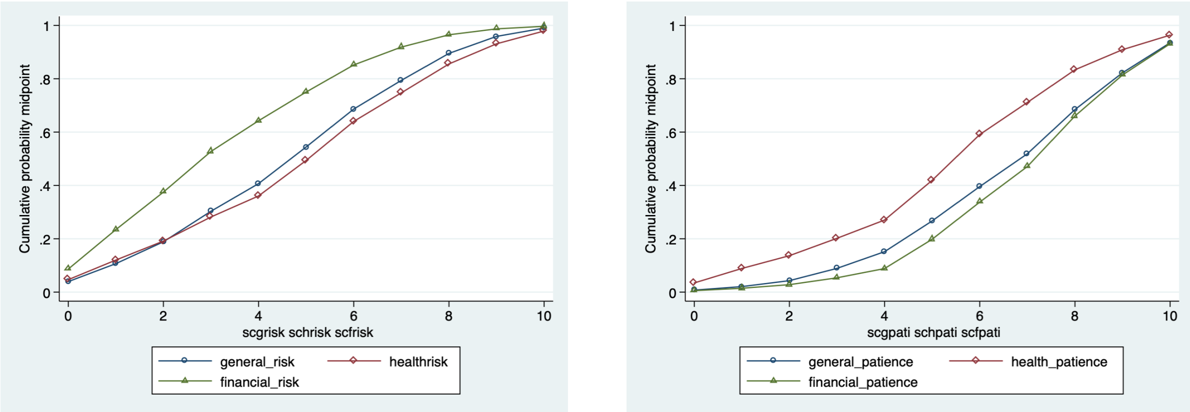


Figure 3.2: Cumulative distribution function of general, financial and health patience attitude by educational attainment

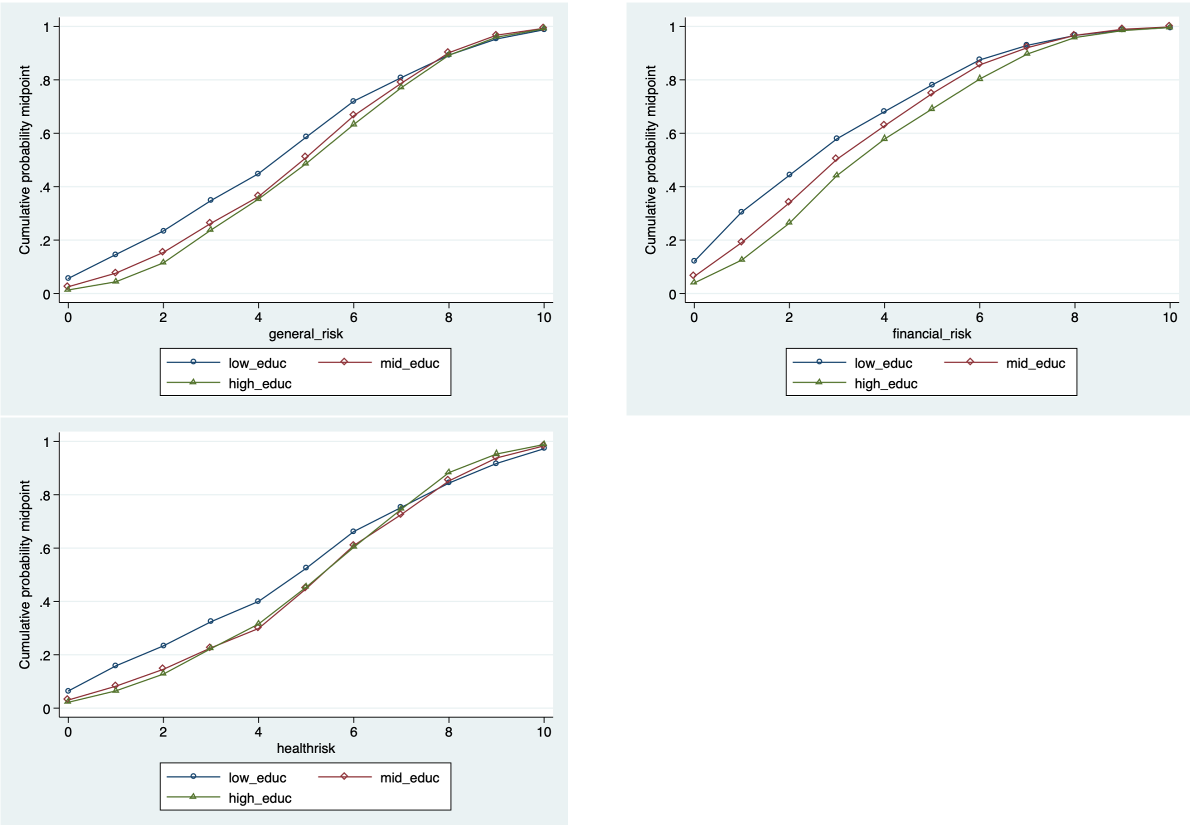


Figure 3.3: Cumulative distribution function of general, financial and health patience attitude by educational attainment

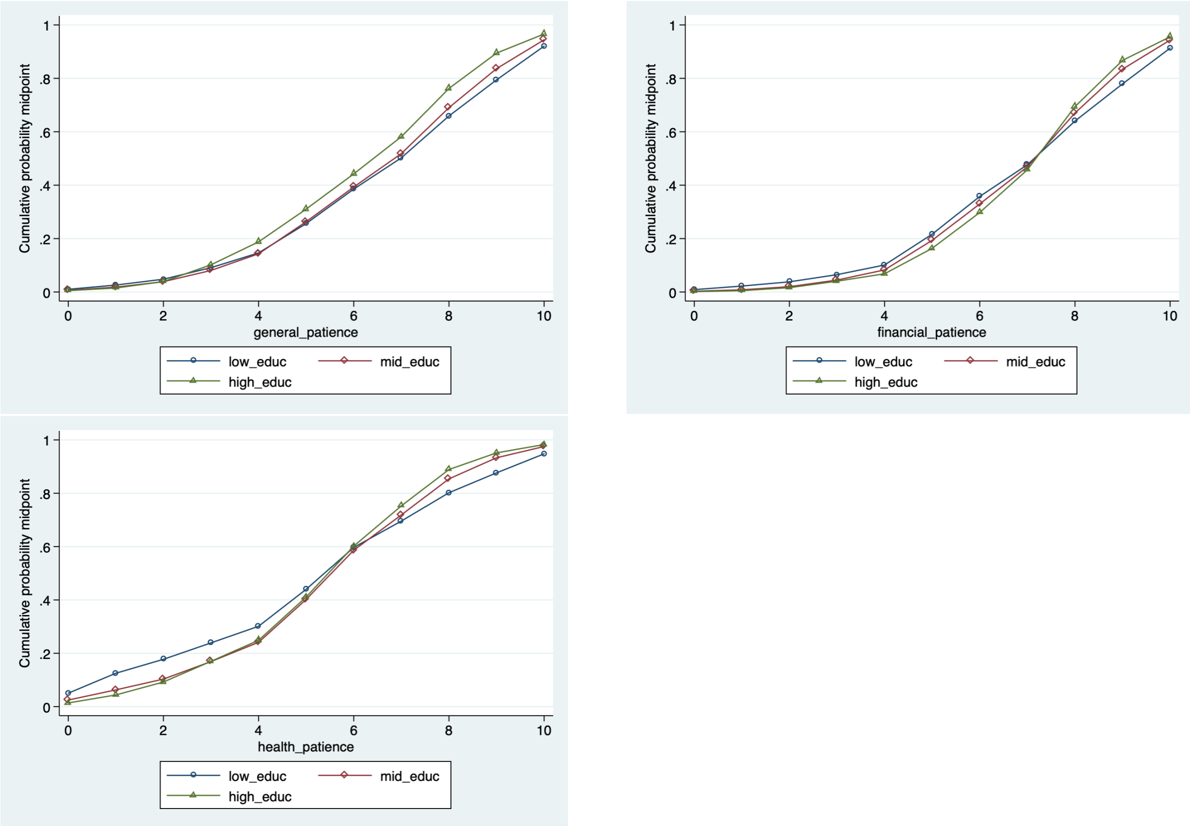


Figure 3.4: Cumulative distribution function of general, financial and health risk attitude by age groups

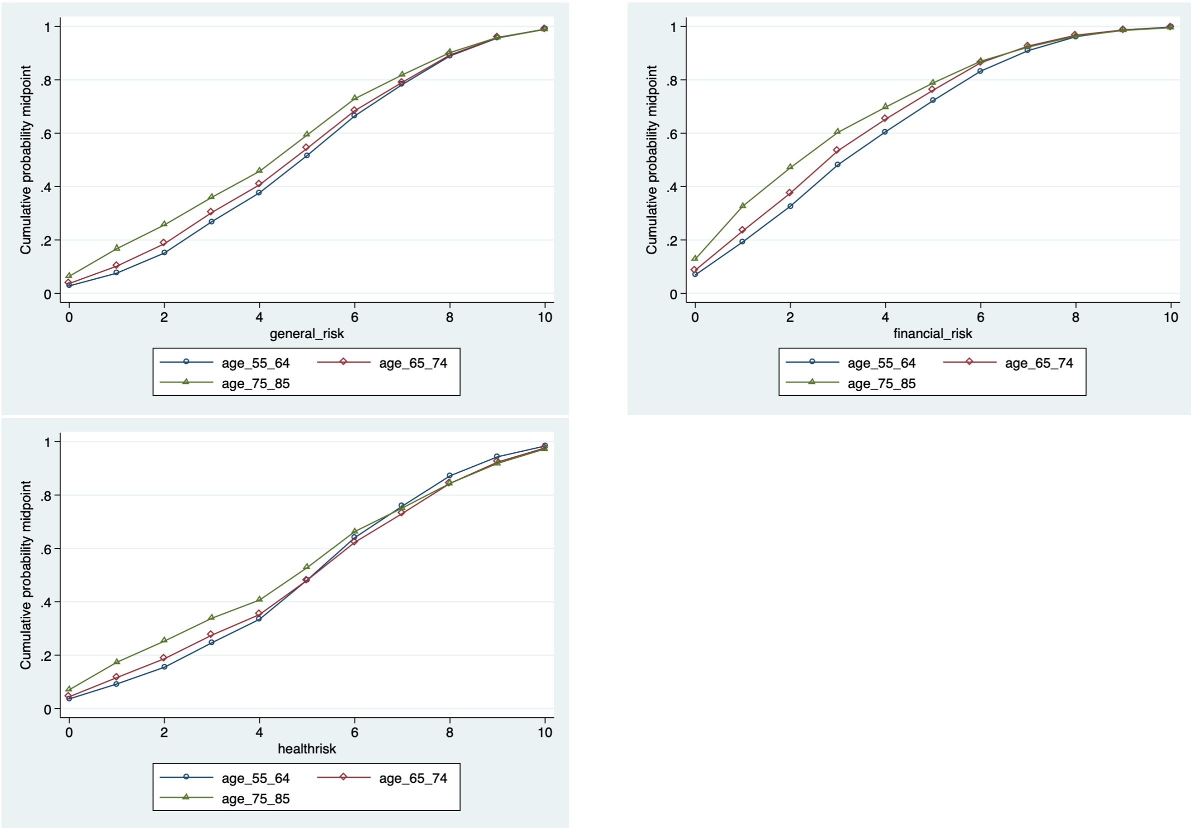


Figure 3.5: Cumulative distribution function of general, financial and health patience attitude by age groups

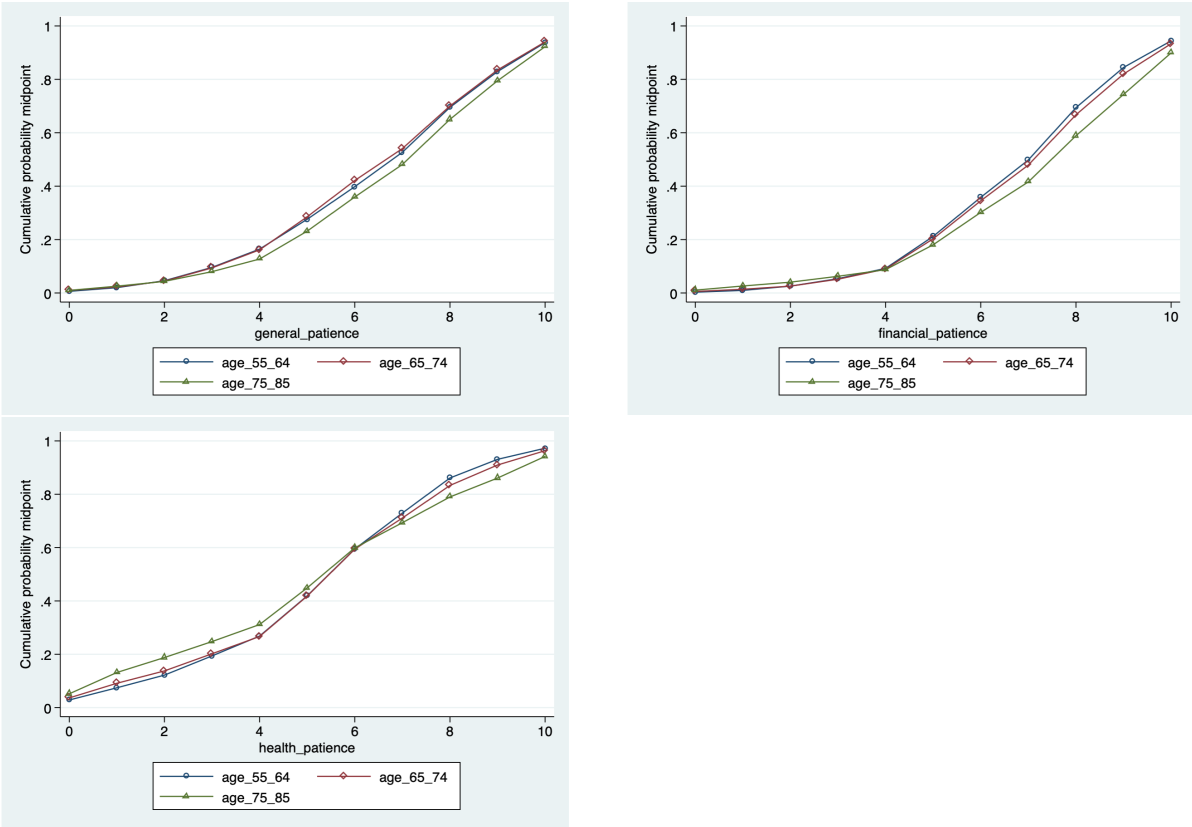


Table 5: **Pairwise correlation matrix**

	general_risk	general_patience	financial_risk	financial_patience	health_risk	health_patience
general_risk						
general_patience	+					
financial_risk	+					
financial_patience	+	+	—			
health_risk	+		+			
health_patience	+	+	+	+	+	
age	—	+	—	+	—	
female	—	+	—		—	—
total income	+	—	+	+	+	+
risky assets	+	—	+	+		+
mortgagor	+		+	—		
investments	+	—	+	+		+
savings				+		+
degree	+	—	+		+	
foreign educ	+					
no educ	—		—		—	
high educ below degree	+		+		+	+
middle educ					+	
low educ	—	+	—			

NOTE: Pairwise correlation matrix. The + or — indicate significant correlations at 95% Confidence Interval.

Table 6: **Pearson's χ^2 analysis for females vs males**

general_risk		female		
		0	1	Total
1		1,118	1,182	2,300
2		1,233	1,101	2,334
3		1,036	614	1,650
Total		3,387	2,897	6,284
Pearson	chi2(2) = 79.4508			Pr = 0.000
likelihood-ratio	chi2(2) = 80.1417			Pr = 0.000
financial_risk		0	1	Total
1		1,887	1,919	3,806
2		1,016	770	1,786
3		473	213	686
Total		3,376	2,902	6,278
Pearson	chi2(2) = 97.4626			Pr = 0.000
likelihood-ratio	chi2(2) = 99.4872			Pr = 0.000
health_risk		0	1	Total
1		1,012	961	1,973
2		1,182	989	2,171
3		1,072	832	1,904
Total		3,266	2,782	6,048
Pearson	chi2(2) = 10.0595			Pr = 0.007
likelihood-ratio	chi2(2) = 10.0571			Pr = 0.007
health_patience		0	1	Total
1		763	741	1,504
2		1,310	1,137	2,447
3		1,212	926	2,138
Total		3,285	2,804	6,089
Pearson	chi2(2) = 12.8948			Pr = 0.002
likelihood-ratio	chi2(2) = 12.8999			Pr = 0.002
general_patience		0	1	Total
1		468	295	763
2		1,184	870	2,054
3		1,743	1,751	3,494
Total		3,395	2,916	6,311
Pearson	chi2(2) = 51.1848			Pr = 0.000
likelihood-ratio	chi2(2) = 51.3869			Pr = 0.000

Table 7: **Kendall and Spearman's tests**

Number of obs =	6200
Spearman's rho =	-0.0080
Test of Ho:	financial_risk and general_patience are independent
Prob > $\|t\|$ =	0.5269
Number of obs =	5959
Spearman's rho =	-0.0022
Test of Ho:	financial_risk and financial_patience are independent
Prob > $\|t\|$ =	0.8630
Number of obs =	5958
Spearman's rho =	0.0899
Test of Ho:	financial_risk and health_patience are independent
Prob > $\|z\|$ =	0.0000
Number of obs =	5952
Kendall's tau-a =	0.0078
Kendall's tau-b =	0.0126
Kendall's score =	137461
SE of score =	128451.477 (corrected for ties)
Test of Ho:	health_risk and general_patience are independent
Prob > $\|z\|$ =	0.2846
Number of obs =	5716
Kendall's tau-a =	0.0247
Kendall's tau-b =	0.0420
Kendall's score =	403634
SE of score =	116563.013 (corrected for ties)
Test of Ho:	health_risk and financial_patience are independent
Prob > $\|z\|$ =	0.0005
Number of obs =	5853
Kendall's tau-a =	0.0507
Kendall's tau-b =	0.0769
Kendall's score =	869114
SE of score =	131653.826 (corrected for ties)
Test of Ho:	health_risk and health_patience are independent
Prob > $\|z\|$ =	0.0000
Number of obs =	5952
Spearman's rho =	0.0136
Test of Ho:	health_risk and general_patience are independent
Prob > $\|t\|$ =	0.2935
Number of obs =	5716
Spearman's rho =	0.0445
Test of Ho:	health_risk and financial_patience are independent
Prob > $\|t\|$ =	0.0008
Number of obs =	5853
Spearman's rho =	0.0844
Test of Ho:	health_risk and health_patience are independent
Prob > $\|t\|$ =	0.0000

Table 8: Determinants of willingness to take risk

Dep. var:	risk_attitude
group 2	
age	0.080
	(0.2981)
age^2	-0.022
	(0.0719)
female	0.139
	(0.0915)
father_educ	0.006
	(0.0167)
mother_educ	0.014
	(0.0200)
height	0.002
	(0.0020)
constant	-0.879*
	(0.4523)
group 3	
age	-0.519
	(0.4188)
age^2	0.152
	(0.0994)
female	0.214
	(0.1442)
father_educ	-0.058***
	(0.0209)
mother_educ	0.024
	(0.0248)
height	-0.001
	(0.0023)
constant	-1.187**
	(0.5724)
group 4	
age	-0.032
	(0.3152)
age^2	-0.001
	(0.0769)
female	0.292***
	(0.1006)
father_educ	0.021
	(0.0196)
mother_educ	-0.036
	(0.0238)
height	0.004**
	(0.0020)

constant	-1.409***
	(0.4624)
N	4740

NOTE: Multinomial logit analysis with clustered standard errors.

Table 9: **Behavioral prediction analysis for smoking behavior**

Dep Var : Smoke	(I)	(II)	(III)	(IV)	(V)
general_risk	-0.002			0.001	0.001
	(0.0023)			(0.0029)	(0.0028)
general_patience	0.002			0.007***	0.008***
	(0.0023)			(0.0025)	(0.0025)
financial_risk		-0.005*		-0.006**	
		(0.0027)		(0.0029)	
financial_patience		-0.003		-0.006**	
		(0.0029)		(0.0031)	
health_risk		-0.001		-0.002	
		(0.0022)		(0.0023)	
health_patience		-0.011***		-0.011***	
		(0.0024)		(0.0024)	
factor_risk			-0.015***		-0.018***
			(0.0056)		(0.0064)
factor_patience			-0.027***		-0.034***
			(0.0061)		(0.0065)
female	-0.011	-0.013	-0.011	-0.016	-0.015
	(0.0112)	(0.0116)	(0.0116)	(0.0118)	(0.0117)
single	0.079***	0.067***	0.069***	0.068***	0.069***
	(0.0138)	(0.0142)	(0.0140)	(0.0144)	(0.0144)
age	0.002	0.015	0.016	0.014	0.015
	(0.0317)	(0.0334)	(0.0333)	(0.0335)	(0.0334)
age^2	-0.014**	-0.017**	-0.017**	-0.017**	-0.017**
	(0.0074)	(0.0079)	(0.0079)	(0.0079)	(0.0079)
low_educ	-0.046	-0.048	-0.044	-0.047	-0.044
	(0.0332)	(0.0366)	(0.0353)	(0.0377)	(0.0372)
midlow_educ	-0.009	-0.014	-0.012	-0.017	-0.016
	(0.0740)	(0.0823)	(0.0796)	(0.0828)	(0.0811)
middlehigh_educ	-0.082***	-0.068***	-0.070***	-0.045***	-0.043***
	(0.0125)	(0.0109)	(0.0103)	(0.0135)	(0.0131)
highbelow_degree	-0.018	-0.015	-0.016	-0.016	-0.017
	(0.0125)	(0.0128)	(0.0129)	(0.0129)	(0.0130)
foreign_educ	0.013	0.009	0.009	0.011	0.010
	(0.0167)	(0.0160)	(0.0161)	(0.0164)	(0.0165)
noeduc	0.082***	0.076***	0.074***	0.076***	0.075***
	(0.0170)	(0.0180)	(0.0181)	(0.0181)	(0.0182)
constant	0.121***	0.214***	0.107***	0.195***	0.052
	(0.0350)	(0.0412)	(0.0320)	(0.0422)	(0.0355)
R-squared	0.035	0.043	0.040	0.045	0.044
N	5498	4888	4888	4830	4830

*Cluster standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01*

Table 10: **Behavioral prediction analysis for ever smoked**

Dep Var : Ever Smoked	(I)	(II)	(III)	(IV)	(V)
general_risk	0.003			0.007*	0.006
	(0.0031)			(0.0041)	(0.0040)
general_patience	-0.011***			-0.010**	-0.010**
	(0.0034)			(0.0039)	(0.0038)
financial_risk		-0.005		-0.008*	
		(0.0040)		(0.0045)	
financial_patience		-0.012***		-0.008*	
		(0.0039)		(0.0043)	
health_risk		0.004		0.002	
		(0.0034)		(0.0035)	
health_patience		-0.008**		-0.006**	
		(0.0031)		(0.0032)	
factor_risk			0.000		-0.010
			(0.0087)		(0.0105)
factor_patience			-0.035***		-0.025***
			(0.0086)		(0.0091)
female	-0.087***	-0.097***	-0.094***	-0.088***	-0.086***
	(0.0164)	(0.0173)	(0.0172)	(0.0175)	(0.0175)
single	0.031*	0.029	0.029	0.034*	0.034*
	(0.0176)	(0.0188)	(0.0187)	(0.0189)	(0.0189)
age	0.204***	0.235***	0.238***	0.227***	0.229***
	(0.0552)	(0.0583)	(0.0582)	(0.0585)	(0.0584)
age^2	-0.046***	-0.054***	-0.055***	-0.052***	-0.052***
	(0.0132)	(0.0141)	(0.0141)	(0.0141)	(0.0141)
low_educ	-0.021	0.036	0.033	0.033	0.031
	(0.1032)	(0.1044)	(0.1038)	(0.1076)	(0.1068)
midlow_educ	-0.040	-0.038	-0.039	-0.032	-0.032
	(0.0967)	(0.1029)	(0.1020)	(0.1006)	(0.0996)
middlehigh_educ	-0.691***	-0.625***	-0.634***	-0.661***	-0.669***
	(0.0204)	(0.0194)	(0.0187)	(0.0239)	(0.0234)
highbelow_degree	-0.001	0.001	0.001	0.004	0.004
	(0.0248)	(0.0262)	(0.0261)	(0.0263)	(0.0261)
foreign_educ	0.017	0.024	0.024	0.029	0.029
	(0.0260)	(0.0277)	(0.0277)	(0.0277)	(0.0277)
noeduc	0.119***	0.128***	0.129***	0.132***	0.132***
	(0.0195)	(0.0204)	(0.0205)	(0.0207)	(0.0208)
constant	0.505***	0.538***	0.416***	0.550***	0.447***
	(0.0597)	(0.0640)	(0.0571)	(0.0662)	(0.0655)
R-squared	0.029	0.034	0.034	0.036	0.035
N	5498	4888	4888	4830	4830

*Cluster standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01*

Table 11: **Behavioral prediction analysis for being a regular drinker**

Dep Var : Drinker	(I)	(II)	(III)	(IV)	(V)
general_risk	0.010***			0.004	0.005
	(0.0031)			(0.0040)	(0.0039)
general_patience	-0.012***			-0.015***	-0.013***
	(0.0033)			(0.0038)	(0.0037)
financial_risk		0.007*		0.006	
		(0.0039)		(0.0043)	
financial_patience		-0.000		0.006	
		(0.0039)		(0.0042)	
health_risk		0.003		0.002	
		(0.0033)		(0.0035)	
health_patience		-0.003		-0.002	
		(0.0032)		(0.0032)	
factor_risk			0.020**		0.014
			(0.0087)		(0.0102)
factor_patience			-0.006		0.006
			(0.0085)		(0.0090)
female	-0.121***	-0.132***	-0.133***	-0.121***	-0.122***
	(0.0165)	(0.0173)	(0.0172)	(0.0175)	(0.0175)
single	-0.134***	-0.136***	-0.136***	-0.135***	-0.134***
	(0.0180)	(0.0193)	(0.0192)	(0.0194)	(0.0194)
age	0.075	0.071	0.070	0.068	0.067
	(0.0545)	(0.0581)	(0.0581)	(0.0579)	(0.0580)
age^2	-0.028**	-0.029**	-0.029**	-0.027*	-0.027*
	(0.0132)	(0.0142)	(0.0142)	(0.0141)	(0.0142)
low_educ	-0.123	-0.089	-0.087	-0.093	-0.089
	(0.0964)	(0.1021)	(0.1021)	(0.1009)	(0.1015)
midlow_educ	-0.161	-0.150	-0.149	-0.142	-0.141
	(0.1110)	(0.1199)	(0.1202)	(0.1188)	(0.1206)
middlehigh_educ	-0.786***	-0.759***	-0.755***	-0.812***	-0.805***
	(0.0191)	(0.0185)	(0.0178)	(0.0218)	(0.0214)
highbelow_degree	0.020	0.013	0.013	0.018	0.017
	(0.0228)	(0.0239)	(0.0239)	(0.0240)	(0.0240)
foreign_educ	-0.044*	-0.051*	-0.051*	-0.044	-0.044
	(0.0255)	(0.0276)	(0.0276)	(0.0272)	(0.0273)
noeduc	-0.111***	-0.114***	-0.114***	-0.107***	-0.108***
	(0.0212)	(0.0225)	(0.0225)	(0.0228)	(0.0228)
constant	0.692***	0.665***	0.686***	0.695***	0.745***
	(0.0575)	(0.0645)	(0.0563)	(0.0652)	(0.0611)
R-squared	0.062	0.060	0.061	0.063	0.063
N	5498	4888	4888	4830	4830

*Cluster standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01*

Table 12: **Behavioral prediction analysis for having debt**

Dep Var : Has Debt	(I)	(II)	(III)	(IV)	(V)
general_risk	0.011***			0.014***	0.013***
	(0.0029)			(0.0039)	(0.0038)
general_patience	0.001			0.007*	0.005
	(0.0031)			(0.0037)	(0.0035)
financial_risk		0.003		-0.004	
		(0.0039)		(0.0044)	
financial_patience		-0.010***		-0.014***	
		(0.0037)		(0.0040)	
health_risk		0.002		-0.001	
		(0.0032)		(0.0034)	
health_patience		0.000		-0.000	
		(0.0030)		(0.0030)	
factor_risk			0.012		-0.007
			(0.0081)		(0.0098)
factor_patience			-0.015*		-0.021**
			(0.0080)		(0.0084)
female	0.042***	0.031*	0.030*	0.034**	0.035**
	(0.0151)	(0.0161)	(0.0161)	(0.0161)	(0.0161)
single	-0.028*	-0.023	-0.025	-0.027	-0.028
	(0.0163)	(0.0179)	(0.0179)	(0.0178)	(0.0178)
age	-0.283***	-0.332***	-0.333***	-0.321***	-0.321***
	(0.0513)	(0.0553)	(0.0552)	(0.0552)	(0.0552)
age^2	0.045***	0.057***	0.057***	0.055***	0.054***
	(0.0120)	(0.0130)	(0.0130)	(0.0130)	(0.0130)
low_educ	0.152	0.167*	0.162	0.162*	0.156
	(0.0959)	(0.0990)	(0.0992)	(0.0982)	(0.0989)
midlow_educ	0.195*	0.219**	0.217**	0.217**	0.216**
	(0.1003)	(0.1027)	(0.1050)	(0.1010)	(0.1042)
highbelow_degree	0.008	0.005	0.006	0.003	0.005
	(0.0228)	(0.0245)	(0.0245)	(0.0243)	(0.0242)
middlehigh_educ	-0.274***	-0.261***	-0.260***	-0.249***	-0.259***
	(0.0187)	(0.0177)	(0.0168)	(0.0216)	(0.0212)
foreign_educ	0.044*	0.049*	0.049*	0.040	0.041
	(0.0238)	(0.0254)	(0.0255)	(0.0254)	(0.0255)
noeduc	0.032*	0.032	0.033	0.031	0.033
	(0.0189)	(0.0206)	(0.0205)	(0.0205)	(0.0204)
constant	0.494***	0.642***	0.600***	0.589***	0.496***
	(0.0566)	(0.0629)	(0.0555)	(0.0644)	(0.0620)
R-squared	0.059	0.062	0.061	0.066	0.064
N	5498	4888	4888	4830	4830

*Cluster standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01*

Table 13: **Behavioral prediction analysis for having investments**

Dep Var : (risky assets / wealth)	(I)	(II)	(III)	(IV)	(V)
general_risk	0.006***			-0.002	-0.000
	(0.0019)			(0.0023)	(0.0023)
general_patience	-0.002			-0.006***	-0.005**
	(0.0018)			(0.0021)	(0.0021)
financial_risk		0.011***		0.012***	
		(0.0022)		(0.0024)	
financial_patience		0.001		0.005**	
		(0.0019)		(0.0021)	
health_risk		-0.001		-0.000	
		(0.0018)		(0.0019)	
health_patience		-0.001		-0.000	
		(0.0017)		(0.0017)	
factor_risk			0.036***		0.040***
			(0.0091)		(0.0111)
factor_patience			-0.003		0.014
			(0.0095)		(0.0108)
female	0.002	0.004	0.001	0.006	0.003
	(0.0112)	(0.0112)	(0.0113)	(0.0112)	(0.0113)
single	-0.081***	-0.079***	-0.079***	-0.078***	-0.078***
	(0.0117)	(0.0116)	(0.0118)	(0.0116)	(0.0118)
age	0.139***	0.142***	0.136***	0.144***	0.137***
	(0.0336)	(0.0337)	(0.0337)	(0.0336)	(0.0336)
age^2	-0.032***	-0.032***	-0.031***	-0.033***	-0.031***
	(0.0080)	(0.0081)	(0.0081)	(0.0081)	(0.0080)
low educ	0.050	0.055	0.057	0.053	0.056
	(0.0678)	(0.0709)	(0.0705)	(0.0700)	(0.0694)
midlow_educ	-0.091	-0.087	-0.089	-0.088	-0.088
	(0.0675)	(0.0668)	(0.0675)	(0.0676)	(0.0680)
highbelow_degree	0.028	0.027	0.027	0.029	0.028
	(0.0187)	(0.0186)	(0.0188)	(0.0186)	(0.0188)
foreign_educ	-0.060***	-0.060***	-0.059***	-0.058***	-0.058***
	(0.0153)	(0.0153)	(0.0154)	(0.0153)	(0.0154)
noeduc	-0.159***	-0.155***	-0.155***	-0.156***	-0.156***
	(0.0122)	(0.0122)	(0.0123)	(0.0123)	(0.0123)
constant	0.188***	0.168***	0.198***	0.171***	0.224***
	(0.0370)	(0.0381)	(0.0344)	(0.0380)	(0.0369)
R-squared	0.060	0.066	0.063	0.068	0.064
N	5469	5469	5469	5469	5469

*Cluster standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01*

Table 14: **Behavioral prediction analysis for being self employed**

Dep Var : Self Employed	(I)	(II)	(III)	(IV)	(V)
general_risk	0.008***			0.004**	0.005***
	(0.0017)			(0.0020)	(0.0020)
general_patience	-0.002			-0.004	-0.003
	(0.0020)			(0.0025)	(0.0023)
financial_risk		0.011***		0.010***	
		(0.0021)		(0.0024)	
financial_patience		0.002		0.003	
		(0.0018)		(0.0021)	
health_risk		-0.002		-0.003*	
		(0.0015)		(0.0016)	
health_patience		-0.003**		-0.003*	
		(0.0014)		(0.0014)	
factor_risk			0.018***		0.010*
			(0.0053)		(0.0061)
factor_patience			-0.003		-0.002
			(0.0039)		(0.0043)
female	-0.032***	-0.039***	-0.042***	-0.036***	-0.038***
	(0.0089)	(0.0088)	(0.0089)	(0.0089)	(0.0090)
single	-0.006	-0.006	-0.005	-0.005	-0.005
	(0.0095)	(0.0099)	(0.0099)	(0.0100)	(0.0100)
age	-0.034	-0.025	-0.029	-0.027	-0.030
	(0.0317)	(0.0333)	(0.0337)	(0.0336)	(0.0339)
age^2	-0.001	-0.004	-0.003	-0.003	-0.002
	(0.0073)	(0.0077)	(0.0078)	(0.0078)	(0.0079)
low_educ	0.074	0.083	0.088	0.081	0.085
	(0.0683)	(0.0744)	(0.0742)	(0.0739)	(0.0738)
midlow_educ	-0.068***	-0.074***	-0.074***	-0.071***	-0.070***
	(0.0101)	(0.0097)	(0.0094)	(0.0098)	(0.0099)
middlehigh_educ	-0.146***	-0.153***	-0.141***	-0.169***	-0.156***
	(0.0127)	(0.0130)	(0.0120)	(0.0153)	(0.0143)
highbelow_degree	-0.043***	-0.042***	-0.042***	-0.041***	-0.042***
	(0.0107)	(0.0117)	(0.0117)	(0.0117)	(0.0117)
foreign_educ	-0.024*	-0.030**	-0.030**	-0.028**	-0.029**
	(0.0133)	(0.0133)	(0.0134)	(0.0133)	(0.0134)
noeduc	-0.026***	-0.025**	-0.027**	-0.024**	-0.024**
	(0.0099)	(0.0103)	(0.0103)	(0.0105)	(0.0105)
constant	0.141***	0.133***	0.162***	0.138***	0.152***
	(0.0379)	(0.0390)	(0.0360)	(0.0418)	(0.0427)
R-squared	0.035	0.042	0.036	0.044	0.038
N	5497	4887	4887	4829	4829

*Cluster standard errors are in parenthesis, p-value: * p<0.10, ** p<0.05, *** p<0.01*

Bibliography

Angelini, V., Brugiavini, A., and Weber, G. (2009). Ageing and unused capacity in europe: is there an early retirement trap? *Economic Policy*, 24:463–508.

Arrow, K. (1971). *Essays in the theory of risk-bearing.* Markham economics series. Markham Pub. Co.

Atella, V., Brunetti, M., and Maestas, N. (2012). Household portfolio choices, health status and health care systems: A cross-country analysis based on share. *Journal of Banking & Finance*, 36(5):1320 – 1335.

Attanasio, O. P. and Weber, G. (1989). Intertemporal Substitution, Risk Aversion and the Euler Equation for Consumption. *The Economic Journal*, 99(395):59–73.

Banks, J., Bassoli, E., and Mammi, I. (2019a). Changing attitudes to risk at older ages: The role of health and other life events. *Journal of Economic Psychology*, page 102208.

Banks, J., Batty, G., Coughlin, K., Deepchand, K., Marmot, M., Nazroo, J., Oldfield, Z., Steel, N., Steptoe, W., and M., A Zaninotto, P. (2019b). English longitudinal study of ageing: Waves 0-8, 1998-2017. *UK Data Service. SN: 5050,*, 29th Edition.

Banks, J., Blundell, R., Levell, P., and Smith, J. P. (2016). Life-cycle consumption patterns at older ages in the us and the uk: Can medical expenditures explain the difference? Working Paper 22513, National Bureau of Economic Research.

Banks, J., Kelly, E., and Smith, J. P. (2013). Spousal health effects - the role of selection. Working Paper 19438, National Bureau of Economic Research.

Banks, J., Marmot, M., Oldfield, Z., and Smith, J. P. (2006). Disease and Disadvantage in the United States and in England. *JAMA*, 295(17):2037–2045.

Becker, G. S. (1973). A theory of marriage: Part i. *Journal of Political economy*, 81(4):813–846.

Benjamin, D. J., Heffetz, O., Kimball, M. S., and Rees-Jones, A. (2012). What do you think would make you happier? what do you think you would choose? *American Economic Review*, 102(5):2083–2110.

Blundell, R., Meghir, C., and Smith, S. (2002). Pension incentives and the pattern of early retirement. *The Economic Journal*, 112(478):C153–C170.

Bolin, K., Lindgren, B., and Lundborg, P. (2008). Informal and formal care among single-living elderly in europe. *Health economics*, 17(3):393–409.

Bonin, H., Dohmen, T., Falk, A., Huffman, D., and Sunde, U. (2007). Cross-sectional earnings risk and occupational sorting: The role of risk attitudes. *Labour Economics*, 14(6):926–937.

Bonsang, E. and Dohmen, T. (2015). Risk attitude and cognitive aging. *Journal of Economic Behavior & Organization*, 112(C):112–126.

Borghans, L., Heckman, J. J., Golsteyn, B. H. H., and Meijers, H. (2009). Gender differences in risk aversion and ambiguity aversion. *Journal of the European Economic Association*, 7(2-3):649–658.

Börsch-Supan, A. (2018a). Survey of health, ageing and retirement in Europe (SHARE) wave 2. *Release version 6.1.1. SHARE-ERIC.*

Börsch-Supan, A. (2018b). Survey of health, ageing and retirement in Europe (SHARE) wave 4. *Release version 6.1.1. SHARE-ERIC.*

Börsch-Supan, A. (2018c). Survey of health, ageing and retirement in Europe (SHARE) wave 5. . *Release version 6.1.1. SHARE-ERIC.*

Börsch-Supan, A., Kneip, T., Litwin, H., Myck, M., and Weber, G. (2015). *Ageing in Europe-supporting policies for an inclusive society.* Walter de Gruyter GmbH & Co KG.

Bressan, S., Pace, N., and Pelizzon, L. (2014). Health status and portfolio choice: Is their relationship economically relevant? *International Review of Financial Analysis*, 32:109 – 122.

Breyer, F. and Fuchs, V. R. (1982). Risk attitudes in health: An exploratory study. Working Paper 875, National Bureau of Economic Research.

Brooks, C., Sangiorgi, I., Hillenbrand, C., and Money, K. (2018). Why are older investors less willing to take financial risks? *International Review of Financial Analysis*, 56(C):52–72.

Brown, J. R., Goda, G. S., and McGarry, K. (2016). Heterogeneity in state-dependent utility: Evidence from strategic surveys. *Economic Inquiry*, 54(2):847–861.

Brugiavini, A., Carrino, L., Orso, C. E., and Pasini, G. (2017). Vulnerability and long-term care in europe. an economic perspective. Springer.

Brunello, G., Weber, G., and Weiss, C. T. (2017). Books are forever: Early life conditions, education and lifetime earnings in europe. *The Economic Journal*, 127(600):271–296.

Bucciol, A., Cavasso, B., and Zarri, L. (2017). Can risk-averse households make risky investments? the role of trust in others. *The Scandinavian Journal of Economics*, 0.

Bucciol, A. and Miniaci, R. (2018). Financial risk propensity, business cycles and perceived risk exposure. *Oxford Bulletin of Economics and Statistics*, 80(1):160–183.

Bucciol, A. and Zarri, L. (2017). Do personality traits influence investors' portfolios? *Journal of Behavioral and Experimental Economics*, 68:1 – 12.

Börsch-Supan, A., Brandt, M., Hank, K., and Schröder, M. (2011). *The Individual and the Welfare State: Life Histories in Europe.*

Callegaro, L. and Pasini, G. (2007). Social interaction effects in an inter-generational model of informal care giving. *University Ca'Foscari of Venice, Dept. of Economics Working Paper No*, 10.

Callen, M., Isaqzadeh, M., Long, J. D., and Sprenger, C. (2014). Violence and risk preference: Experimental evidence from afghanistan. *American Economic Review*, 104(1):123–48.

Carrino, L., Orso, C. E., and Pasini, G. (2018). Demand of long-term care and benefit eligibility across european countries. *Health Economics*, 27(8):1175–1188.

Charles, K. K., Hurst, E., and Killewald, A. (2013). Marital sorting and parental wealth. *Demography*, 50(1):51–70.

Chen, M. K. (2013). The effect of language on economic behavior: Evidence from savings rates, health behaviors, and retirement assets. *American Economic Review*, 103(2):690–731.

Chiappori, P.-A. (1992). Collective labor supply and welfare. *Journal of political Economy*, 100(3):437–467.

Chiappori, P.-A. et al. (1988). Rational household labor supply. *Econometrica*, 56(1):63–90.

Chiappori, P.-A. and Mazzocco, M. (2017). Static and intertemporal household decisions. *Journal of Economic Literature*, 55(3):985–1045.

Christelis, D., Georgarakos, D., and Haliassos, M. (2013). Differences in Portfolios across Countries: Economic Environment versus Household Characteristics. *The Review of Economics and Statistics*, 95(1):220–236.

Christelis, D., Jappelli, T., and Padula, M. (2010). Cognitive abilities and portfolio choice. *European Economic Review*, 54(1):18 – 38.

Chuang, Y. and Schechter, L. (2015). Stability of experimental and survey measures of risk, time, and social preferences: A review and some new results. *Journal of Development Economics*, 117(C):151–170.

Davillas, A. and Pudney, S. (2017). Concordance of health states in couples: Analysis of self-reported, nurse administered and blood-based biomarker data in the uk understanding society panel. *Journal of Health Economics*, 56:87 – 102.

De Nardi, M., French, E., and Jones, J. B. (2016). Savings after retirement: A survey. *Annual Review of Economics*, 8:177–204.

Decker, S. and Schmitz, H. (2016). Health shocks and risk aversion. *Journal of Health Economics*, 50(C):156–170.

Di Novi, C., Jacobs, R., and Migheli, M. (2015). The quality of life of female informal caregivers: From scandinavia to the mediterranean sea. *European Journal of Population*, 31(3):309–333.

Di Tella, R., MacCulloch, R. J., and Oswald, A. J. (2001). Preferences over inflation and unemployment: Evidence from surveys of happiness. *American economic review*, 91(1):335–341.

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

Do, Y. K., Norton, E. C., Stearns, S. C., and Van Houtven, C. H. (2015). Informal care and caregiver's health. *Health Economics*, 24(2):224–237.

Dohmen, T., Falk, A., Golsteyn, B. H. H., Huffman, D., and Sunde, U. (2017). Risk Attitudes across the Life Course. *The Economic Journal*, 127(605):F95–F116.

Dohmen, T., Falk, A., Huffman, D., and Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability? *American Economic Review*, 100(3):1238–60.

Dohmen, T., Falk, A., Huffman, D., and Sunde, U. (2012). The intergenerational transmission of risk and trust attitudes. *Review of Economic Studies*, 79(2):645–677.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3):522–550.

Dohmen, T., Lehmann, H., and Pignatti, N. (2016). Time-varying individual risk attitudes over the Great Recession: A comparison of Germany and Ukraine. *Journal of Comparative Economics*, 44(1):182 – 200. Ukraine Escape from Post-Soviet Legacy.

Edwards, R. (2008). Health risk and portfolio choice. *Journal of Business & Economic Statistics*, 26:472–485.

Epstein, L. G. and Zin, S. E. (1991). Substitution, risk aversion, and the temporal behavior of consumption and asset returns: An empirical analysis. *Journal of political Economy*, 99(2):263–286.

Esping-Andersen, G. (1990). The three worlds of. *Welfare Capitalism.*

Evans, W. N. and Viscusi, W. K. (1991). Estimation of state-dependent utility functions using survey data. *The Review of Economics and Statistics*, pages 94–104.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., and Sunde, U. (2018). Global Evidence on Economic Preferences*. *The Quarterly Journal of Economics*, 133(4):1645–1692.

Falk, A., Becker, A., Dohmen, T. J., Huffman, D., and Sunde, U. (2016). The preference survey module: A validated instrument for measuring risk, time, and social preferences.

Fenger, M. (2007). Welfare regimes in central and eastern europe: Incorporating post-communist countries in a welfare regime typology. *Contemporary Issues and Ideas in Social Sciences.*

Finkelstein, A., Luttmer, E., and Notowidigdo, M. (2013). What good is wealth without health? the effect of health on the marginal utility of consumption. *Journal of the European Economic Association*, 11:221–258.

Finkelstein, A., Luttmer, E. F. P., and Notowidigdo, M. J. (2009). Approaches to estimating the health state dependence of the utility function. *American Economic Review*, 99(2):116–21.

Frederick, S., Loewenstein, G., and O'Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40(2):351–401.

Frey, B. and Stutzer, A. (2001). What can economists learn from happiness research? CESifo Working Paper Series 503, CESifo Group Munich.

Frey, B. S. and Stutzer, A. (2002). What can economists learn from happiness research? *Journal of Economic literature*, 40(2):402–435.

Gafni, A. and Torrance, G. W. (1984). Risk attitude and time preference in health. *Management Science*, 30(4):440–451.

Galizzi, M. M., Machado, S. R., and Miniaci, R. (2016). Temporal stability, cross-validity, and external validity of risk preferences measures: Experimental evidence from a uk representative sample. *Cross-Validity, and External Validity of Risk Preferences Measures: Experimental Evidence from a UK Representative Sample (August 12, 2016).*

Gaugler, J. E., Yu, F., Krichbaum, K., and Wyman, J. F. (2009). Predictors of nursing home admission for persons with dementia. *Medical care*, 47(2):191–198.

Gollier, C. (2002). Time diversification, liquidity constraints, and decreasing aversion to risk on wealth. *Journal of Monetary Economics*, 49(7):1439–1459.

Gollier, C. (2004). *The Economics of Risk and Time*, volume 1. The MIT Press, 1 edition.

Gourieroux, C., Monfort, A., Renault, E., and Trognon, A. (1987). Generalised residuals. *Journal of Econometrics*, 34(1-2):5–32.

Grable, J. and Lytton, R. (2001a). Assessing the concurrent validity of the scf risk tolerance question. *Journal of Financial Counseling and Planning*, 12.

Grable, J. E. and Lytton, R. H. (2001b). Assessing the concurrent validity of the scf risk tolerance question. *Journal of Financial Counseling and Planning*, 12.

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

Guiso, L., Jappelli, T., and Terlizzese, D. (1996). Income risk, borrowing constraints, and portfolio choice. *American Economic Review*, 86(1):158–72.

Guiso, L. and Paiella, M. (2005). The role of risk aversion in predicting individual behavior. Temi di discussione (Economic working papers) 546, Bank of Italy, Economic Research and International Relations Area.

Guiso, L., Sapienza, P., and Zingales, L. (2018). Time varying risk aversion. *Journal of Financial Economics*, 128(3):403 – 421.

Hammitt, J., Haninger, K., and Treich, N. (2009). Effects of health and longevity on financial risk tolerance. *The Geneva Risk and Insurance Review*, 34(2):117–139.

Harrison, G. W., Hofmeyr, A., Ross, D., and Swarthout, J. T. (2018). Risk preferences, time preferences, and smoking behavior. *Southern Economic Journal*, 85(2):313–348.

Hersch, J. (1996). Smoking, seat belts, and other risky consumer decisions: Differences by gender and race. *Managerial and Decision Economics*, 17(5):471–481.

Hess, G. D. (2004). Marriage and consumption insurance: what's love got to do with it? *Journal of Political Economy*, 112(2):290–318.

Hirschauer, N., Lehberger, M., and Musshoff, O. (2015). Happiness and utility in economic thought—or: What can we learn from happiness research for public policy analysis and public policy making? *Social Indicators Research*, 121(3):647–674.

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, 6:65–70.

Hu, Y. and Goldman, N. (1990). Mortality differentials by marital status: an international comparison. *Demography*, 27(2):233–250.

Hubbard, R., Skinner, J., and Zeldes, S. (1995). Precautionary saving and social insurance. *Journal of Political Economy*, 103(2):360–99.

Huffman, D., Maurer, R., and Mitchell, O. S. (2017). Time discounting and economic decision-making in the older population. *The Journal of the Economics of Ageing*, page 100121.

Hurd, M. D. (1999). Mortality risk and consumption by couples. Technical report, National Bureau of Economic Research.

Hyde, M., Wiggins, R. D., Higgs, P., and Blane, D. B. (2003). A measure of quality of life in early old age: The theory, development and properties of a needs satisfaction model (casp-19). *Aging & Mental Health*, 7(3):186–194.

Jianakoplos, N. and Bernasek, A. (1998). Are women more risk averse? *Economic Inquiry*, 36(4):620–30.

Jones, A., Rice, N., and Robone, S. (2018). The effect of health shocks on financial risk preferences differs by personality traits. Health, Econometrics and Data Group (HEDG) Working Papers 18/07, HEDG, Department of Economics, University of York.

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2):263–91.

Kapteyn, A. and Teppa, F. (2011). Subjective measures of risk aversion, fixed costs, and portfolio choice. *Journal of Economic Psychology*, 32(4):564–580.

Kiecolt-Glaser, J. K. and Newton, T. L. (2001). Marriage and health: his and hers. *Psychological bulletin*, 127(4):472.

Kim, Y.-I. and Lee, J. (2014). The long-run impact of a traumatic experience on risk aversion. *Journal of Economic Behavior & Organization*, 108(C):174–186.

King, A. G. (1974). Occupational choice, risk aversion, and wealth. *ILR Review*, 27(4):586–596.

Kools, L. and Knoef, M. (2019). Health and consumption preferences; estimating the health state dependence of utility using equivalence scales. *European Economic Review*.

Lillard, L. and Panis, C. (1996). Marital status and mortality: The role of health. *Demography*, 33(3):313–327.

Lillard, L. and Weiss, Y. (1997). Uncertain health and survival: Effects on end-of-life consumption. *Journal of Business & Economic Statistics*, 15(2):254–68.

Lillard, L. A. and Waite, L. J. (1995). 'til death do us part: Marital disruption and mortality. *American Journal of Sociology*, 100(5):1131–1156.

Meier, A. N. et al. (2018). Emotions, risk attitudes, and patience. *www. armandomeier. com, last access December*, 17:2018.

Meier, S. and Sprenger, C. (2010). Present-biased preferences and credit card borrowing. *American Economic Journal: Applied Economics*, 2(1):193–210.

Meier, S. and Sprenger, C. (2015). Temporal stability of time preferences. *The Review of Economics and Statistics*, 97(2):273–286.

Mischel, W. (1968). Personality and assessment. *Wiley*.

Mischel, W. and Shoda, Y. andRodriguez, M. L. (1989). Delay of gratification in children. *Science*, 244:933–938.

Mitchell, S. H. (1999). Measures of impulsivity in cigarette smokers and non-smokers. *Psychopharmacology*, 146:455–464.

Monden, C. (2007). Partners in health? exploring resemblance in health between partners in married and cohabiting couples. *Sociology of Health & Illness*, 29(3):391–411.

Moya, A. (2018). Violence, psychological trauma, and risk attitudes: Evidence from victims of violence in Colombia. *Journal of Development Economics*, 131(C):15–27.

Necker, S. and Ziegelmeyer, M. (2016). Household risk taking after the financial crisis. *The Quarterly Review of Economics and Finance*, 59(C):141–160.

Norton, E. C. (2000). Chapter 17 long-term care. volume 1 of *Handbook of Health Economics*, pages 955 – 994. Elsevier.

Outreville, J. F. (2013). The relationship between relative risk aversion and the level of education: A survey and implications for the demand for life insurance. *Journal of Economic Surveys*, 29(1):97–111.

Paiella, M. and Guiso, L. (2004). Risk aversion, wealth and background risk. Technical Report 525, Society for Economic Dynamics.

Palumbo, M. (1999). Uncertain medical expenses and precautionary saving near the end of the life cycle. *Review of Economic Studies*, 66(2):395–421.

Poterba, J. M., Venti, S. F., and Wise, D. A. (2017). The asset cost of poor health. *The Journal of the Economics of Ageing*, 9:172 – 184.

Pratt, J. W. (1964). Risk aversion in the small and in the large. *Econometrica*, 32(1/2):122–136.

Reynolds, B. (2006). The experiential discounting task is sensitive to cigarette-smoking status and correlates with a measure of delay discounting. *Behavioural Pharmacology*, 17(2):133–142.

Robles, T. F., Slatcher, R. B., Trombello, J. M., and McGinn, M. M. (2014). Marital quality and health: A meta-analytic review. *Psychological bulletin*, 140(1):140.

Rosen, H. and Wu, S. (2004). Portfolio choice and health status. *Journal of Financial Economics*, 72(3):457–484.

Ross, L. and Nisbett, R. E. (1991). The person and the situation: Perspectives of social psychology. *McGraw-Hill series in social psychology. New York, NY, England: Mcgraw-Hill Book Company.*

Sabia, S., Elbaz, A., Dugravot, A., Head, J., Shipley, M., Hagger-Johnson, G., Kivimaki, M., and Singh-Manoux, A. (2012). Impact of smoking on cognitive decline in early old age: the whitehall ii cohort study. *Archives of general psychiatry*, 69(6):627–635.

Sahm, C. (2012). How much does risk tolerance change? *Quarterly Journal of Finance (QJF)*, 02(04):1–38.

Schildberg-Hörisch, H. (2018). Are risk preferences stable? *Journal of Economic Perspectives*, 32(2):135–54.

Schurer, S. (2015). Lifecycle patterns in the socioeconomic gradient of risk preferences. *Journal of Economic Behavior & Organization*, 119:482 – 495.

Shaw, K. (1996). An empirical analysis of risk aversion and income growth. *Journal of Labor Economics*, 14(4):626–53.

Sloan, F. A., Viscusi, W. K., Chesson, H. W., Conover, C. J., and Whetten-Goldstein, K. (1998). Alternative approaches to valuing intangible health losses: the evidence for multiple sclerosis1this article was written when chesson was a student at duke university.1. *Journal of Health Economics*, 17(4):475 – 497.

Smith, J. (1999). Healthy bodies and thick wallets: The dual relation between health and economic status. *Journal of Economic Perspectives*, 13(2):145–166.

Smith, J. (2005). *Consequences and Predictors of New Health Events*, pages 213–240. University of Chicago Press.

Soede, A. J., Vrooman, J. C., Ferraresi, P. M., and Segre, G. (2004). Unequal welfare states: distributive consequences of population ageing in six european countries. *SCP, Social and Cultural Planning Office, 2004*.

Stigler, G. and Becker, G. (1977). De gustibus non est disputandum. *American Economic Review*, 67(2):76–90.

Sunde, U. and Dohmen, T. (2016). Aging and preferences. *The Journal of the Economics of Ageing*, 7:64 – 68.

Trevisan, E. and Zantomio, F. (2016). The impact of acute health shocks on the labour supply of older workers: Evidence from sixteen european countries. *Labour Economics*, 43(C):171–185.

Van Houtven, C., Coe, N. B., and Skira, M. (2010). Effect of informal care on work, wages, and wealth. *Boston College Center for Retirement Research Working Paper*, (2010-23).

Viscusi, W. K. and Evans, W. N. (1990). Utility functions that depend on health status: estimates and economic implications. *The American Economic Review*, pages 353–374.

Voors, M., Nillesen, E. E. M., Verwimp, P., Bulte, E., Lensink, R., and van Soest, D. (2012). Violent conflict and behavior: A field experiment in burundi. *American Economic Review*, 102(2):941–64.

Wooldridge, J. M. (2015). Control function methods in applied econometrics. *Journal of Human Resources*, 50(2):420–445.

Zick, C. D. and Smith, K. R. (1986). Immediate and delayed effects of widowhood on poverty: Patterns from the 1970s. *The Gerontologist*, 26(6):669–675.

Estratto per riassunto della tesi di dottorato

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Dottorato: Economia

Ciclo: 32esimo

Titolo della tesi : The effect of health on the marginal utility of consumption expenditures and on attitudes towards risk

Abstract

Standard models of microeconomic theory have relied on the hypothesis that individual's preferences are stable over time and that with one single parameter is possible to capture the individual's willing to take risks. However, some scholars have started to question not only the preference stability, but also the impact of other factors such as health on the utility specification.

With increasing shares of older people in Western countries, the ageing process has been at the core of the economic research too. Thus, understanding the effect health decline on individual's utility and preferences at older ages has become crucial.

This thesis aims at addressing some fundamental issues of the microeconomic modeling by implementing an empirical strategy on older people in Europe. I carry out several analyses to disentangle whether health deterioration is able to shape the utility function, influence the marginal utility to consume and to affect preferences towards risk.

In this framework we are able to outline several effects of health that require to rethink some of the standard hypothesis of the microeconomic theory.

Abstract (Italiano)

I modelli standard di teoria microeconomica si fondano sull'ipotesi che le preferenze dell'individuo siano stabili nel tempo e che con un solo parametro sia possibile catturare la propensione al rischio dell’individuo. Tuttavia, alcuni studiosi hanno iniziato a mettere in discussione non solo la stabilità delle preferenze, ma anche l'impatto di altri fattori come la salute sull’utilità.

Con l'aumento della popolazione in età avanzata nei paesi occidentali, anche il processo di invecchiamento è divenuto centrale nella ricerca economica. Pertanto, comprendere l'effetto del declino della salute sull'utilità e sulle preferenze dell'individuo in età avanzata è diventato cruciale.

Questa tesi mira ad affrontare alcune questioni fondamentali della modellistica microeconomica attraverso una analisi empirica sulla popolazione di individui dai 50 anni a salire, in Europa.

In questa tesi ho eseguito diverse analisi per testare se il deterioramento della salute sia in grado di modellare la funzione di utilità, influenzare l'utilità marginale al consumo e influenzare le preferenze rispetto al rischio. In questo quadro, i risultati sono in grado di delineare diversi effetti della salute. Tali evidenze richiedono di ripensare alcune delle ipotesi standard della teoria microeconomica.

Firma dello studente

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