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

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Abstract

This paper investigates risk attitudes at older ages in 14 European countries. Older individuals report lower willingness to take risks in all countries. Using panel data we are able to show that this relationship between financial risk attitudes and age is not due to cohort effects or selective mortality. We also show that key mechanisms driving this change 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 frequently as individuals age. These life-events are a particularly important explanation of the evolution of risk attitudes for women.

JEL Classification: D90, D91, D81.

Keywords: Risk attitudes; ageing; health status; life-events; SHARE

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 behaviours 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 subsequent work (Bonsang and Dohmen [2015]) argues that such changes in risk attitude might occur via the cognitive decline that happens at older ages. Our study takes these results as a starting point and investigates the change in attitudes to financial risk at older ages in more detail. We use panel data from 14 European countries to confirm the result in Dohmen et al. [2011] and then move on to exploit 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 and show that these are an important driver of the changes in risk attitudes.

Understanding not just the cross-sectional distribution of risk attitudes but also the evolution of risk attitudes 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 risk attitudes of future older cohorts is essential information for the successful design of important welfare programs such as pension schemes, long-term care coverage and health care provision to the elderly, or for broader policy interventions related to annuity or insurance markets.

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 sub-sample 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. Consistent with previous literature, our panel data specification with controls for individual heterogeneity also finds a role for income changes and for cognition changes in explaining risk attitudes. But our main contribution are to find and document an important role for other life-events such as widowhood, leaving work, drawing a pension, and also particular health. Primarily, we find an important role for health in explaining changes in risk attitudes and this estimate is robust to a number of different ways of measuring health. 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.

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 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 behaviour. 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. [1]

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. But 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.

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 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

[1] 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.

for the multidimensional nature of respondents' health.

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).[2] 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.

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

[2] See [Börsch-Supan, 2018a], [Börsch-Supan, 2018b] and [Börsch-Supan, 2018c], respectively.

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*

The elicitation method draws upon a well-established question format, included also in the Survey of Consumer Finances[3] 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, 2001]. Along these lines, we show in Appendix A that this measure of risk attitude is a good predictor of the likelihood of owning financial investments in the SHARE sample.

In table 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.

Figure 5 illustrates 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

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

risk preference questions in SHARE wave 2.[4] 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 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.

In tables 3 and 4 we exploit the panel data nature of our data and summarise the transitions in risk attitudes between the two measurements that were taken. Taking Table 3 first, the upper panel reports changes from wave 2 to 5 for the first part of our sample and the data shows that 46.29% of respondents who displayed some degree of willingness to take risks did not report this at the next measurement. In the bottom panel, we report transitions from wave 4 to 5 in the other part of our sample, where about 49.56% of respondents were in the same category. In contrast, a relatively small percentage of individuals who were initially reporting an unwillingness to take risks changed their reports as they got older (19.12% from wave 2 to 5, and 13.94% from wave 4 to 5). In keeping with these off-diagonal transition rates, we see much more persistence in the 'unwilling to take risks' category than in the group that reports some level of risk-taking attitudes.

These transition rates, marginal distributions of risk attitudes and cellsizes are combined in the calculations underlying table 4 which shows how the overall sample breaks down across the two measures of risk attitudes. Over half the sample report unwillingness to take financial

[4] 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.

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.

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 A-2 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.

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]).

4 Empirical Strategy and Results

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:

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

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. 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 [5], and we build our measure of pension through the following procedure.

For each individual we compute:

$$\Delta_{iw}^{ER} = ER_{iw} - Age_{iw} \tag{2}$$

$$\Delta_{iw}^{SR} = SR_{iw} - Age_{iw} \tag{3}$$

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.

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

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:

$$\mathrm{P}(Pension_{iw} = 1|\boldsymbol{x}_{iw}, c_i) = \Phi(\beta_1 \Delta_{iw}^{ER} + \beta_2 \Delta_{iw}^{SR} + \boldsymbol{x}_{iw}\boldsymbol{\beta} + c_i). \tag{4}$$

We obtain the generalised residuals [Gourieroux et al., 1987] from equation (4); then, following a control function approach (see Wooldridge [2015]) for nonlinear models with binary endogenous variables, we estimate the model in (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 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 A, 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[6].

4.2 Results

Table 5 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 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

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

aversion across countries.[7] 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 5 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; and 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

[7]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.

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 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 6. 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 6 it is clear there is no further attenuation of the age coefficients in comparison to Table 5 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 A-3 to A-4 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 A-5 to A-6). 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.

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 7 we present the estimates for model (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.

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.

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 are 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: **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 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: Gender

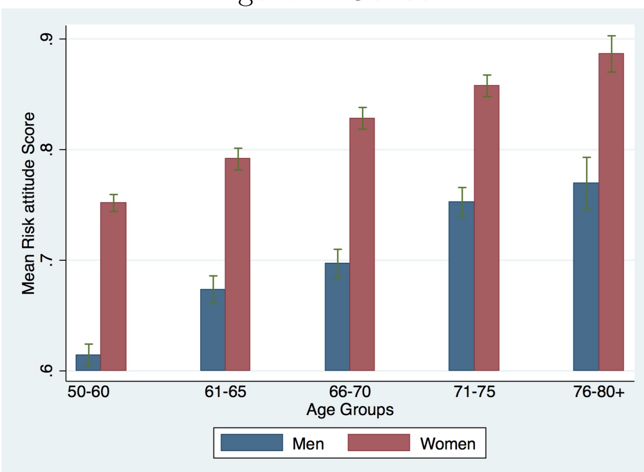


Figure 2: Couple

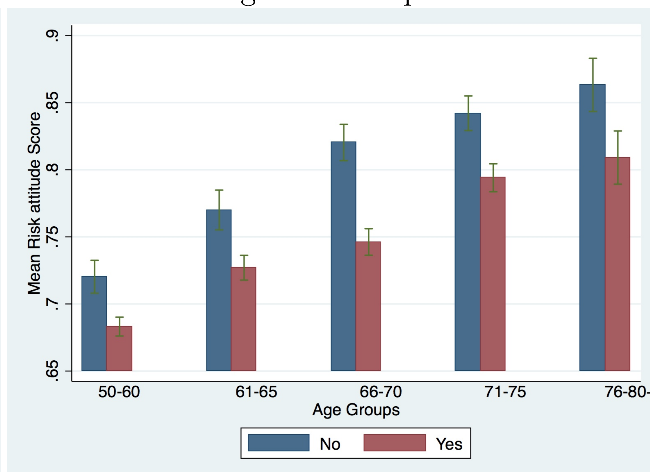


Figure 3: Education:

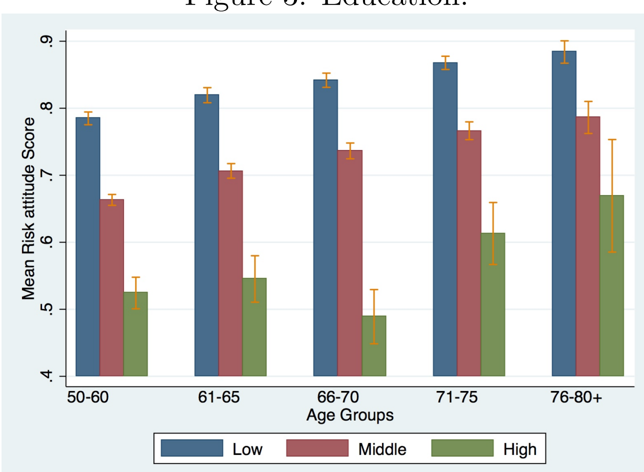
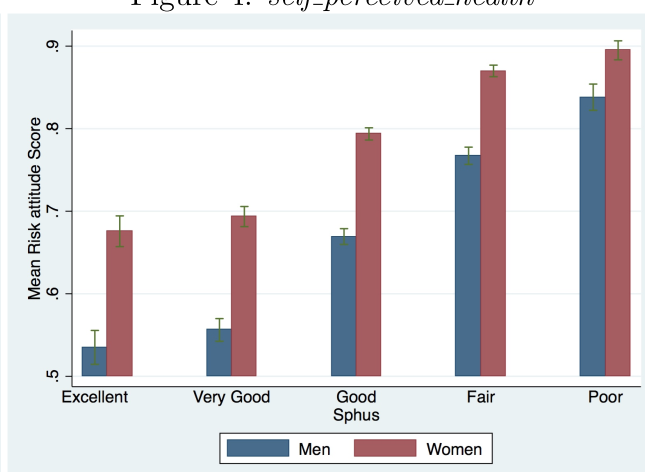


Figure 4: *self_perceived_health*



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 3: **Transitions in risk attitudes**

Individuals aged 50-75 in W2

	Risk attitude		Total
	0	1	
0	1571	1354	2925
	53.71	46.29	100.00
1	1221	5165	6386
	19.12	80.88	100.00
Total	2792	6519	9311
	29.99	70.01	100.00

Individuals aged 50-75 in W4

	Risk attitude		Total
0	2258	2219	4477
	50.44	49.56	100.00
1	1973	12179	14152
	13.94	86.06	100.00
Total	4231	14398	18629
	22.71	77.29	100.00

NOTE: This table provides changes in risk attitude replies. The upper table shows changes from wave 2 to 5, the bottom table presents changes from wave 4 to 5. Rows report responses and percentages for the 1st reply, while columns reports the final prevalence and percentage.

Table 4: **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 unwillinginess 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 5: **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: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table 6: **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<0.10, ** p<0.05, *** p<0.01. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table 7: 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.

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A Appendix A

A.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 A-1 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 A-1 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].

A.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 A-3 and A-4 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 A-5 and A-6. 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 A-5) and 1.2 percentage points for females (A-6). 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 A-1: **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<0.10, ** p<0.05, *** p<0.01

Table A-2: **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 A-3: **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<0.10, ** p<0.05, *** p<0.01. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table A-4: **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: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table A-5: **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<0.10, ** p<0.05, *** p<0.01. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.

Table A-6: **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<0.10, ** p<0.05, *** p<0.01. P-values for the coefficients of age, health and numeracy are adjusted following the Holm-Bonferroni's correction and are available upon request.