

Cognitive Ageing and Risk Attitude¹

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Abstract

In this paper we investigate to what extent changes in risk attitudes with age can be traced to the cognitive ageing process. We use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) that includes both a measure of financial risk preference and measures of cognitive ability for a representative sample of individuals aged 50+ in 11 European countries. The availability of a large set of variables in SHARE allows us to control for potential confounding factors that may be related to both cognitive skills and risk attitudes. Conditional on socio-demographic characteristics, about two fifth of the age-related cross-sectional difference in willingness to take risks can be explained by a noisy measure of cognitive skills. Due to the attenuation bias that results from measurement error in the cognitive skills measure, this is a lower bound estimate. Using the lag of the measured cognitive score as an instrument for the noisy contemporaneous cognitive skills measure, we show that about seventy percent of the difference in willingness to take risks between cohorts can be traced to age-related differences in cognitive skills.

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1. Introduction

Cognitive skills and risk preference change over the life-cycle. The performance on a wide variety of cognitive tasks declines systematically with age (see Dixon et al., 2004), including processing speed (Salthouse, 1996) and working memory (Van der Linden et al., 1994). Likewise, a growing empirical literature in economics indicates a systematic relationship between risk attitudes and age (Barsky et al., 1997; Borghans et al., 2008; Dohmen et al., 2011; Donkers et al., 2001). These studies reveal a gradually lower willingness to take risks in older cohorts suggesting that individuals become less willing to take risks as they grow older. Another set of recent empirical studies reveals a negative correlation between cognitive skills and risk aversion (e.g., Burks et al., 2009; Dohmen et al., 2010; Beauchamp et al., 2011). Together these findings motivate the question of whether and to what extent the decline in the willingness to take risks over the life cycle is caused by the decline in cognition.

In this paper, we shed light on this question by empirically investigating what fraction of the age effect on the willingness to take risks is explained by cognitive decline. We use data from the Survey of Health, Ageing, and Retirement in Europe (SHARE), which contains information on risk attitudes and cognitive skills for individuals that are sampled to be representative of the non-institutionalized population aged 50 and older in various European countries. Cognitive skills are assessed with the help of short and simple tests of episodic memory (words learning and recall task), executive skills (verbal fluency task) and numeracy (arithmetical calculations task). The measure of risk attitude is based on a question that asks respondents to self-report their willingness to take financial risks. Consistent with the empirical findings in the literature, we estimate a significant effect of age on risk attitudes in a regression framework that does not include controls for cognitive functioning. We then evaluate whether and by how much the coefficient of age changes when we control for cognition, and find that about two fifth of the age-related cross-sectional difference in willingness to take risks can be explained by the inclusion of our measure of cognition. This is plausibly a lower bound estimate because cognition is likely to suffer from measurement error. In fact, when we correct for the attenuation bias that results from measurement error in the cognitive skills measure by using the lag of the measured cognitive score as an instrument for the noisy contemporaneous cognitive skills measure, the age coefficient is reduced by about seventy percent. These findings suggest that the difference in willingness to take risks between cohorts can be traced to age related differences in cognitive functioning. This result is important as it contributes to a better understanding of factors that drive changes in risk attitudes over the life-cycle. The remainder of the paper is organized as follows. The next

section describes the data. Section 3 presents the results and section 4 concludes.

2. Data

We use data from the first and second wave of SHARE, a multidisciplinary and cross-national panel database of micro data on health, socio-economic status as well as social and family networks. The first wave covered more than 30,000 individuals aged 50 or older living in 11 European countries. These countries represent the diverse regions in Europe, ranging from Scandinavia (Denmark and Sweden) through Central Europe (Austria, France, Germany, Switzerland, Belgium, and the Netherlands) to the Mediterranean (Spain, Italy and Greece).² Details on the sampling procedure, questionnaire contents and fieldwork methodology are reported by Börsch-Supan et al. (2005) and at the SHARE website (<http://www.share-project.org/>).

We rely on a question about financial risk attitudes that was asked to individuals who are responsible for financial matters in the household in the second wave of SHARE. The wording of this question is as follows:

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*

For the analysis, we have recoded the variable so that 1 corresponds to individuals reporting “not willing to take any financial risks” and 4 to “take substantial financial risks expecting to earn substantial returns”. 75.6% of the individuals report “not willing to take any financial risks” (See Table 1). Self-reported financial risk attitudes predict actual risky behaviour in terms financial investments. Table A2 in Appendix reports estimates of linear probability models for the choice of investing in stocks. Column (i) shows the results for a model that controls for

² Two 'new' EU member states - the Czech Republic and Poland - as well as Ireland have joined SHARE in 2006 and participated in the second wave of data collection in 2006-07.

willingness to take risks, age, and country fixed effects. The specification in column (ii) includes additional controls for gender, education, marital status, household size, body height, health, labour force status, and wealth. Willingness to take financial risks is highly statistically significant in both specifications, indicating that our measure of risk preference is a good predictor of actual risk-taking behaviour in portfolio choice.

SHARE also measures cognitive skills of all respondents by using short and simple tests of episodic memory (learning and recall), executive skills (verbal fluency) and numeracy (arithmetical calculations). The episodic memory task is a test of verbal learning and recall. Participants were asked to memorize a list of ten common words, and asked to enumerate as many of these words as possible, both in the immediate and delayed recall tasks. The immediate recall phase was just after the interviewer had read out the list of words, while the delayed recall phase occurred after the fluency and the numeracy tests have been completed. For the fluency task, respondents had to name as many different animals as possible in one minute. Numeracy is assessed by asking a few questions that involve simple calculations based on real life situations. Respondents who correctly answer the first question are asked a more difficult one, while those who make a mistake are asked an easier one. We combine the three cognitive tests scores in one index of cognition using principal component analysis, and construct a measure of cognition by standardizing the first principal component. Figure 1 shows that the distribution of the cognition measure is close to a standard normal distribution, a feature that is common to widely used standardized test scores.

In our analysis we restrict the sample to respondents who had answered the financial risk attitudes question and whose cognitive skills measures are available for the first and the second wave. We discard observations with missing values for the variables used in the empirical analysis. The final estimation sample includes 11,662 observations.

3. Results

3.1. Main results

We start our analysis by showing in Figure 2 that older cohorts are less willing to take financial risks than younger cohorts. Likewise, Figure 3 shows that the scores for all three cognitive tests decline with age.³ A regression analysis that controls for includes country fixed

³ Note that the word recall test score, which measures episodic memory, is the one that tends to decline fastest with age. This is in line with evidence from several studies in neuropsychology that have also shown that this aspect of cognition is particularly affected by aging (Souchay et al., 2000; Anderson and Craik, 2000; Prull et al., 2000).

effects to capture cross country differences in institutions, culture and socio-economics confirms that the age differences in risk attitudes are statistically significant (see Column (i) of Table (2)). The model in Column (ii) of Table 2, which augments the specification of Column (i) by our compound measure of cognition, reveals a statistically significant relationship between risk attitudes and cognition. This is in line with Dohmen et al. (2010) and Burks et al. (2009). Importantly, however, the estimated relationship between age and risk attitudes is substantially weakened when cognitive skills are controlled for. This suggests that an important component of the negative association between risk attitude and age is due to cognitive ageing.

The availability of a wide range of individual characteristics in SHARE allows us to control for potential confounding factors that may relate to both risk preferences and cognitive skills. We include a gender dummy because women have been found to be less willing to take risks than men (Croson and Gneezy, 2009). Other control variables include education (measured by number of years of education according to the ISCED-97 classification), an indicator variable for living in a couple, household size, health (proxied by the number of reported symptoms, and the number of chronic diseases that have been diagnosed by a doctor), height⁴, and labour force status (measured by a set of indicator variables for unemployment, disability, non-participation and retirement). Columns (iii) and (iv) report the results of the model that includes those additional control variables. Except for the number of chronic diseases and the number of symptoms, all control variables are significantly related to the measure of risk attitude. Compared with column (i), the negative effect of age in column (iii), although highly significant, is lower in magnitude suggesting that a non-negligible part of the observed decrease in the willingness to take risk with age is explained by age-related differences in those socio-demographic characteristics.

As shown in column (iv), the cognitive skills measure has now a lower effect on reported financial risk attitude, but it is still highly significant. By comparing the age coefficient estimates in columns (iii) and (iv), we see that, conditional on socio-demographic characteristics, differences in cognitive skills with age still explain a non-negligible part of the age-related decline in willingness to take risks. Conditional on the controls included in the model, it suggests that more than two fifth of the observed decline in the willingness to take risks is explained by the cognitive ageing process. Columns (v) and (vi) report the results of the models that additionally control for (the log of) household wealth, and show that our main

⁴ Height has been shown to be correlated with both cognitive skills and risk attitude (Dohmen et al. 2011).

results are not sensitive to the inclusion of this variable. Columns (vii) and (viii) report the results from ordered probit models taking into account the ordinal nature of our risk measure, and show that the main results are not sensitive to the model specification.

Measures of cognitive skills obtained through simple tests are only imperfect proxies for cognitive ability, and the measures themselves are likely to suffer from measurement error. Under the classical errors-in-variables assumption, the coefficient estimate of the measure of cognitive ability will suffer from attenuation bias. Furthermore, the presence of measurement error in the cognitive skills measure is also likely to generate inconsistent estimates for the other covariates. It can be shown that, if age and cognitive ability are negatively correlated and that risk attitude is positively correlated to cognitive ability, the OLS estimates will overestimate the negative effect of age on risk attitude.⁵ Intuitively, age absorbs part of the true variation of risk that is due to cognitive decline. Assuming that measurement error is uncorrelated over time, this issue can be mitigated by using the lag of the cognitive skills score as an instrument for contemporaneous cognitive skills.

Column (ix) reports 2SLS estimates that take account of the measurement error in cognitive test scores. Three results are notable. First, comparing the estimates in Column (vi) and Column (ix) we observe that the estimated coefficient on cognitive skills increases by almost 70% when we control for measurement error. Second, controlling for measurement error also brings down the estimated age coefficient. Third, a comparison of the age coefficient in column (v) and (ix) reveals that about seventy percent of the change in financial risk attitude with age is explained by the cognitive ageing process, conditional on the socio-demographic characteristics.

3.2. Robustness checks

In this section we test the sensitivity of our main results. In order to test whether our results are driven by selection bias that would arise if mortality rates at older age is higher among those who are more willing to take risks, we restrict the sample to those being younger than 75 years of age. The results, which are reported in Table A3, show that our main findings remain unchanged: Once we control for cognitive skills and correct for measurement error,

⁵ Assuming a model with only two covariates: $risk_i = \beta_1 age_i + \beta_2 cognition*_i + \varepsilon_i$, where only an imperfect measure of $cognition*$ is available: $cognition_i = cognition*_i + v_i$, with $Cov(cognition*, v) = 0$, the bias of the

coefficient on age equals $\frac{\sigma_v^2 \sigma_{age\ cognition}}{\sigma_{age}^2 \sigma_{cognition}^2 - \sigma_{age\ cognition}^2 + \sigma_v^2 \sigma_{age}^2} \beta_2$, where σ_x^2 and σ_{xy} represent the variance of the variable x and the covariance between the variables x and y , respectively.

the coefficient estimate of age decreases substantially and becomes statistically insignificant. In order to check whether our results are also robust to using a measure of revealed financial risk preference, we re-estimated the specifications in Table 2 replacing the self-reported measure of willingness to take financial risks by an indicator variable for stock ownership. The results, which are reported in Table 3, corroborate a negative and statistically significant relationship between age and revealed risk preferences if cognition is not controlled for. Importantly, the estimates also re-confirm that the impact of age on revealed risk preferences is substantially reduced once we control for cognitive ability. Moreover, controlling for measurement error in cognitive skills increases the fraction of the age coefficient that is explained when controlling for cognition. In fact, the estimated age effect becomes even insignificant once we control for cognitive skills and the same set of additional control variables that were included in the model in Column (iv) of Table 2. When we correct for measurement error in cognitive test scores by instrumenting for contemporaneous scores by using lagged test scores, our 2SLS estimates yield a positive and marginally significant (at the 10%-level) coefficient estimate of age.

Next, we also checked whether the results are driven by one particular country only by estimating the specifications reported in Table 2 for each country separately. The ensuing estimates, reported in Table 4, reveal a negative relationship between willingness to take financial risks and age in all countries. This relationship is always weakened once we control for cognition.⁶

Finally, instead of combining the different cognitive scores, we include them separately in the model and use the lag of each of the measures as an instrument for the current measures in the 2SLS. The results, which are presented in Table 5, substantiate our main findings. It is worth noting that the different components of cognition seem to have different effects on the willingness to take financial risks. Numeracy has the largest effect while memory score is not significantly related to the outcome variable. The 2SLS estimates, which take measurement error in the respective cognitive skill measure into account, suggest, however, that all components of cognition have approximately the same effect on the risk attitude, indicating that the differences in OLS estimates for the three measured components of cognition are mainly driven by differences in the magnitude of measurement error across the different measures of cognitive skills.

⁶ For some countries, the estimated effect age coefficient already becomes statistically insignificant once the full set of additional controls is added.

Conclusion

Older individuals have been found to exhibit higher risk aversion than younger individuals in several studies. At the same time, it is well established that individuals experience a cognitive decline as they grow older. Finally, it has recently been shown that cognitive functioning and measures of risk attitude are related. Based on those three facts, we infer that part of the age-related differences in risk attitude may be explained by the cognitive ageing process. In this paper, we tested for this hypothesis and provide evidence that the change in risk attitude at older age is driven by cognitive decline. We show that about 70% of the age-related change in risk attitude can be attributed to cognitive ageing. We also show the importance of taking into account measurement error when using cognitive skills measures as explanatory variables.

These findings are important as they shed light on what drives changes in risk attitudes over the life-cycle, a process that is not yet understood well, and because they point towards a causal relationship between cognitive ability and risk preference.

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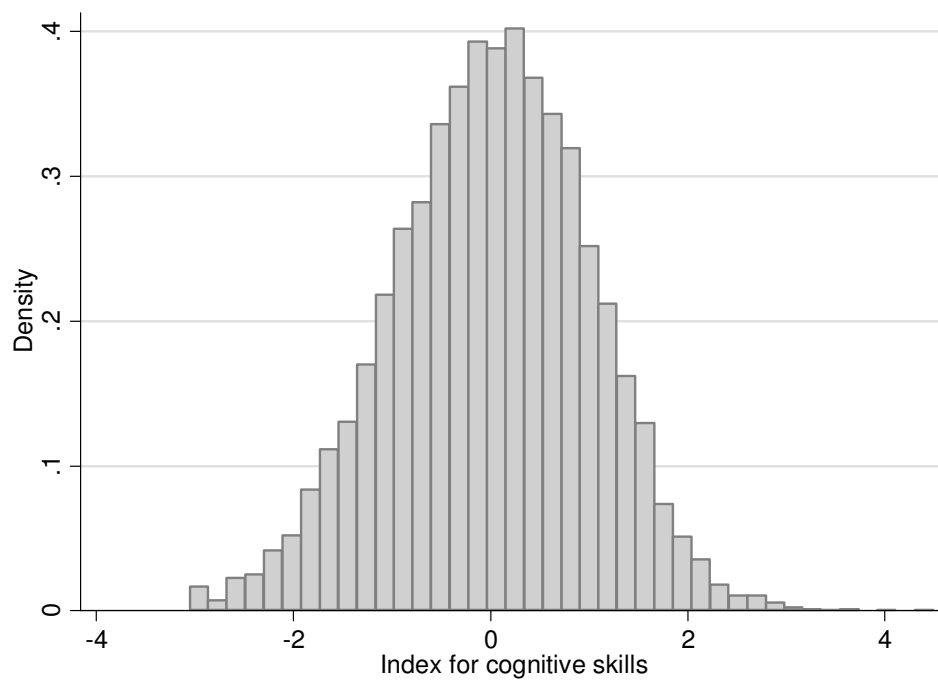
Tables and Figures

Table 1. Distribution of financial risk preference

| Financial risk preferences | Freq. | Percent |
|---|--------|---------|
| Not willing to take any financial risks | 8,852 | 75.9% |
| Take average financial risks | 1,998 | 17.1% |
| Take above average financial risks | 694 | 6.0% |
| Take substantial financial risks | 118 | 1.0% |
| Total | 11,662 | 100.0% |

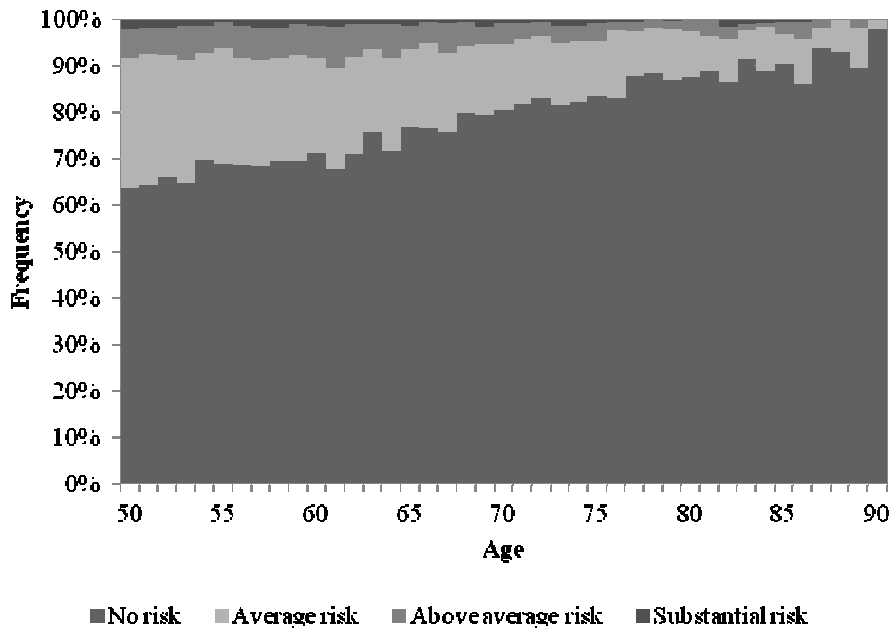
Note: SHARE 2006.

Figure 1. Distribution of the index for cognitive skills.



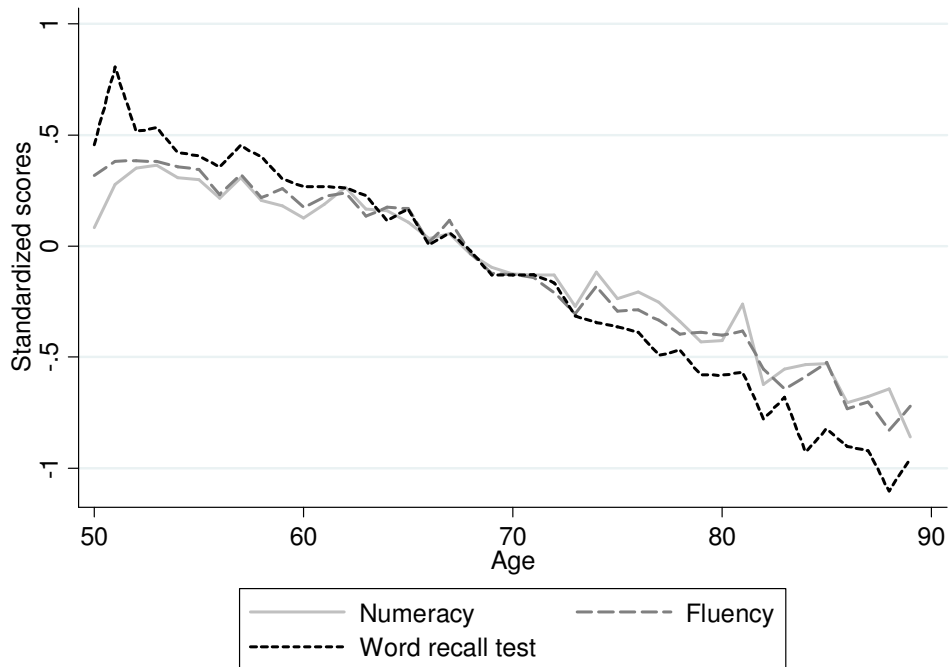
Note: SHARE 2006. The index for cognitive skills is measured as the first component from a principal component analysis using the score from the fluency test, the word recall test and the numeracy test.

Figure 2. Financial risk preference and age.



Note: SHARE 2006.

Figure 3. Cognitive score and age



Note: SHARE 2006.

Table 2. Models for financial risk attitude.

| | Financial risk attitude | | | | | | | | |
|----------------------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | OLS | OLS | OLS | OLS | OLS | OLS | Ordered probit | Ordered probit | 2SLS |
| | (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) |
| Age/10 (in years) | -0.104*** (0.006) | -0.058*** (0.006) | -0.043*** (0.008) | -0.024*** (0.008) | -0.040*** (0.008) | -0.023*** (0.008) | -0.161*** (0.020) | -0.118*** (0.021) | -0.012 (0.009) |
| Index for cognitive skills | - | 0.108*** (0.007) | - | 0.064*** (0.007) | - | 0.054*** (0.007) | - | 0.157*** (0.018) | 0.091*** (0.013) |
| 1 if female | - | - | -0.062*** (0.016) | -0.068*** (0.016) | -0.067*** (0.016) | -0.071*** (0.016) | -0.170*** (0.038) | -0.185*** (0.038) | -0.074*** (0.016) |
| Years of education | - | - | 0.020*** (0.001) | 0.015*** (0.002) | 0.017*** (0.001) | 0.013*** (0.002) | 0.038*** (0.004) | 0.029*** (0.004) | 0.011*** (0.002) |
| 1 if Living in a couple | - | - | 0.099*** (0.015) | 0.086*** (0.015) | 0.056*** (0.015) | 0.047*** (0.015) | 0.163*** (0.038) | 0.144*** (0.038) | 0.041*** (0.015) |
| Household size | - | - | -0.027*** (0.008) | -0.024*** (0.008) | -0.028*** (0.008) | -0.025*** (0.008) | -0.091*** (0.020) | -0.085*** (0.020) | -0.023*** (0.008) |
| # of chronic diseases | - | - | -0.001 (0.005) | -0.001 (0.005) | 0.000 (0.005) | 0.000 (0.005) | 0.002 (0.012) | 0.002 (0.012) | 0.000 (0.005) |
| # of symptoms | - | - | -0.002 (0.004) | 0.000 (0.004) | 0.001 (0.004) | 0.003 (0.004) | -0.002 (0.010) | 0.003 (0.010) | 0.005 (0.004) |
| Height (in cm) | - | - | 0.004*** (0.001) | 0.004*** (0.001) | 0.004*** (0.001) | 0.004*** (0.001) | 0.008*** (0.002) | 0.007*** (0.002) | 0.003*** (0.001) |
| Ln(Wealth) | - | - | - | - | 0.038*** (0.003) | 0.036*** (0.003) | 0.156*** (0.009) | 0.149*** (0.009) | 0.034*** (0.003) |
| Controls for labour force status | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 |

Note: SHARE 2006. The dependent variable takes the value of 1 for individuals not willing to take any financial risks and 4 if the individual reports willing to take substantial financial risks expecting receive a substantial return. Cognitive skills are measured as the first component from a principal component analysis using the score from the fluency test, the word recall test and the numeracy test. Standard errors are in parentheses. (*), (**), (***) mean that the coefficient estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.

Table 3. Models for stocks ownership

| | Stock ownership | | | | | | | | |
|----------------------------------|----------------------|----------------------|----------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
| | OLS | OLS | OLS | OLS | OLS | OLS | Probit | Probit | 2SLS |
| | (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) |
| Age/10 (in years) | -0.038*** (0.003) | -0.012*** (0.004) | -0.008* (0.005) | 0.001 (0.005) | -0.006 (0.005) | 0.001 (0.005) | -0.067*** (0.025) | -0.036 (0.026) | 0.009* (0.005) |
| Index for cognitive skills | - | 0.060*** (0.004) | - | 0.031*** (0.004) | - | 0.023*** (0.004) | - | 0.107*** (0.022) | 0.048*** (0.008) |
| 1 if female | - | - | 0.007 (0.010) | 0.005 (0.010) | 0.004 (0.009) | 0.002 (0.009) | 0.010 (0.047) | 0.000 (0.047) | 0.000 (0.009) |
| Years of education | - | - | 0.014*** (0.001) | 0.012*** (0.001) | 0.011*** (0.001) | 0.010*** (0.001) | 0.050*** (0.004) | 0.043*** (0.005) | 0.008*** (0.001) |
| 1 if Living in a couple | - | - | 0.075*** (0.009) | 0.069*** (0.009) | 0.043*** (0.009) | 0.040*** (0.009) | 0.158*** (0.047) | 0.144*** (0.047) | 0.035*** (0.009) |
| Household size | - | - | -0.008 (0.005) | -0.006 (0.005) | -0.008* (0.005) | -0.007 (0.005) | -0.050** (0.026) | -0.046* (0.026) | -0.005 (0.005) |
| # of chronic diseases | - | - | -0.003 (0.003) | -0.003 (0.003) | -0.002 (0.003) | -0.002 (0.003) | -0.011 (0.014) | -0.011 (0.014) | -0.002 (0.003) |
| # of symptoms | - | - | -0.006*** (0.002) | -0.005** (0.002) | -0.003 (0.002) | -0.002 (0.002) | -0.024** (0.012) | -0.020* (0.012) | -0.002 (0.002) |
| Height (in cm) | - | - | 0.002*** (0.001) | 0.002*** (0.001) | 0.002*** (0.001) | 0.002*** (0.001) | 0.007** (0.003) | 0.006** (0.003) | 0.001*** (0.001) |
| Ln(Wealth) | - | - | - | - | 0.028*** (0.002) | 0.027*** (0.002) | 0.297*** (0.014) | 0.292*** (0.014) | 0.026*** (0.002) |
| Controls for labour force status | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 11,217 | 11,217 | 11,217 | 11,217 | 11,217 | 11,217 | 11,217 | 11,217 | 11,217 |

Note: SHARE 2006. The dependent variable is takes the value of 1 for individuals reporting having stocks and 0 otherwise. Cognitive skills are measured as the first component from a principal component analysis using the score from the fluency test, the word recall test and the numeracy test. Standard errors are in parentheses. (*), (**), (***) mean that the coefficient estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.

Table 4. Models for financial risk attitude. Country by country estimation

| | | Financial risk attitude | | | | | |
|---------|----------------------------|-------------------------|----------------------|---------------------|----------------------|----------------------|---------------------|
| | | OLS | OLS | OLS | Ordered probit | Ordered probit | 2SLS |
| | | (i) | (ii) | (iii) | (iv) | (v) | (vi) |
| Austria | Age/10 | -0.076*** (0.019) | -0.051** (0.020) | 0.005 (0.025) | -0.108 (0.084) | -0.078 (0.085) | 0.029 (0.026) |
| | Index for cognitive skills | | 0.063*** (0.019) | 0.043** (0.019) | | 0.172** (0.067) | 0.122*** (0.034) |
| | Number of observations | 771 | 771 | 771 | 771 | 771 | 771 |
| Belgium | Age/10 | -0.086*** (0.014) | -0.023 (0.015) | 0.001 (0.019) | -0.071 (0.047) | -0.006 (0.049) | 0.019 (0.020) |
| | Index for cognitive skills | | 0.151*** (0.016) | 0.084*** (0.017) | | 0.216*** (0.043) | 0.140*** (0.028) |
| | Number of observations | 1793 | 1793 | 1793 | 1793 | 1793 | 1793 |
| Denmark | Age/10 | -0.243*** (0.024) | -0.216*** (0.027) | -0.087** (0.040) | -0.235*** (0.074) | -0.218*** (0.076) | -0.077* (0.041) |
| | Index for cognitive skills | | 0.065** (0.031) | 0.028 (0.032) | | 0.061 (0.060) | 0.062 (0.052) |
| | Number of observations | 792 | 792 | 792 | 792 | 792 | 792 |
| France | Age/10 | -0.065*** (0.013) | -0.016 (0.015) | -0.023 (0.020) | -0.188*** (0.064) | -0.119* (0.068) | -0.007 (0.021) |
| | Index for cognitive skills | | 0.105*** (0.015) | 0.046*** (0.017) | | 0.175*** (0.056) | 0.089*** (0.028) |
| | Number of observations | 1270 | 1270 | 1270 | 1270 | 1270 | 1270 |
| Germany | Age/10 | -0.093*** (0.019) | -0.041** (0.021) | 0.005 (0.028) | -0.146* (0.083) | -0.092 (0.086) | -0.008 (0.033) |
| | Index for cognitive skills | | 0.114*** (0.020) | 0.054** (0.022) | | 0.178*** (0.064) | 0.014 (0.053) |
| | Number of observations | 991 | 991 | 991 | 991 | 991 | 991 |
| Greece | Age/10 | -0.063*** (0.014) | -0.021 (0.017) | -0.033 (0.021) | -0.194*** (0.061) | -0.130** (0.063) | -0.034 (0.022) |
| | Index for cognitive skills | | 0.096*** (0.021) | 0.076*** (0.023) | | 0.264*** (0.065) | 0.070** (0.035) |
| | Number of observations | 1453 | 1453 | 1453 | 1453 | 1453 | 1453 |

Table 4 (continued).

| | | Fiancial risk attitude | | | | | |
|----------------------------|----------------------------|------------------------|----------------------|---------------------|----------------------|---------------------|---------------------|
| | | OLS | OLS | OLS | Ordered probit | Ordered probit | 2SLS |
| | | (i) | (ii) | (iii) | (iv) | (v) | (vi) |
| Italy | Age/10 | -0.083*** (0.016) | -0.033* (0.018) | -0.017 (0.020) | -0.227*** (0.080) | -0.198** (0.083) | -0.015 (0.022) |
| | Index for cognitive skills | | 0.099*** (0.017) | 0.009 (0.020) | | 0.103 (0.073) | 0.019 (0.038) |
| | Number of observations | 1163 | 1163 | 1163 | 1163 | 1163 | 1163 |
| Netherlands | Age/10 | -0.098*** (0.018) | -0.064*** (0.020) | -0.043* (0.026) | -0.210*** (0.071) | -0.186** (0.073) | -0.030 (0.027) |
| | Index for cognitive skills | | 0.102*** (0.022) | 0.021 (0.023) | | 0.082 (0.060) | 0.070* (0.041) |
| | Number of observations | 1148 | 1148 | 1148 | 1148 | 1148 | 1148 |
| Spain | Age/10 | -0.049*** (0.012) | -0.030** (0.014) | -0.022 (0.018) | -0.298*** (0.108) | -0.250** (0.113) | -0.025 (0.021) |
| | Index for cognitive skills | | 0.046*** (0.016) | 0.020 (0.019) | | 0.169* (0.102) | 0.013 (0.040) |
| | Number of observations | 844 | 844 | 844 | 844 | 844 | 844 |
| Sweden | Age/10 | -0.209*** (0.026) | -0.137*** (0.029) | -0.064* (0.039) | -0.173*** (0.057) | -0.148** (0.058) | -0.046 (0.040) |
| | Index for cognitive skills | | 0.174*** (0.031) | 0.086*** (0.032) | | 0.134*** (0.047) | 0.164*** (0.058) |
| | Number of observations | 1317 | 1317 | 1317 | 1317 | 1317 | 1317 |
| Switzerland | Age/10 | -0.055 (0.053) | -0.025 (0.066) | -0.109 (0.088) | -0.325 (0.204) | -0.318 (0.229) | 0.179 (0.143) |
| | Index for cognitive skills | | 0.053 (0.070) | -0.006 (0.076) | | 0.013 (0.197) | 0.559*** (0.216) |
| | Number of observations | 120 | 120 | 120 | 120 | 120 | 120 |
| Control variables included | | No | Yes | Yes | Yes | Yes | Yes |
| Control for wealth | | No | No | Yes | Yes | Yes | Yes |

Note: SHARE 2006. The dependent variable takes the value of 1 for individuals not willing to take any financial risks and 4 if the individual reports willing to take substantial financial risks expecting receive a substantial return. Cognitive skills are measured as the first component from a principal component analysis using the score from the fluency test, the word recall test and the numeracy test. Standard errors are in parentheses. (*), (**), (***) mean that the coefficient estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.

Table 5. Models for financial risk attitude including the three measures of cognitive skills.

| | Financial risk attitude | | | | | | | | |
|----------------------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | OLS | OLS | OLS | OLS | OLS | OLS | Ordered probit | Ordered probit | 2SLS |
| | (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) |
| Age/10 (in years) | -0.104*** (0.006) | -0.063*** (0.006) | -0.043*** (0.008) | -0.026*** (0.008) | -0.040*** (0.008) | -0.026*** (0.008) | -0.161*** (0.020) | -0.123*** (0.021) | -0.013 (0.009) |
| Numeracy score | - | 0.085*** (0.006) | - | 0.047*** (0.007) | - | 0.040*** (0.007) | - | 0.110*** (0.017) | 0.042** (0.019) |
| Fluency score | - | 0.039*** (0.007) | - | 0.022*** (0.007) | - | 0.018** (0.007) | - | 0.047*** (0.016) | 0.035* (0.019) |
| Memory score | - | 0.011 (0.007) | - | 0.013* (0.007) | - | 0.011 (0.007) | - | 0.045*** (0.017) | 0.037* (0.022) |
| 1 if female | - | - | -0.062*** (0.016) | -0.059*** (0.016) | -0.067*** (0.016) | -0.064*** (0.016) | -0.170*** (0.038) | -0.167*** (0.039) | -0.072*** (0.018) |
| Years of education | - | - | 0.020*** (0.001) | 0.015*** (0.002) | 0.017*** (0.001) | 0.013*** (0.002) | 0.038*** (0.004) | 0.028*** (0.004) | 0.010*** (0.002) |
| 1 if Living in a couple | - | - | 0.099*** (0.015) | 0.087*** (0.015) | 0.056*** (0.015) | 0.048*** (0.015) | 0.163*** (0.038) | 0.145*** (0.038) | 0.041*** (0.015) |
| Household size | - | - | -0.027*** (0.008) | -0.024*** (0.008) | -0.028*** (0.008) | -0.026*** (0.008) | -0.091*** (0.020) | -0.086*** (0.020) | -0.023*** (0.008) |
| # of chronic diseases | - | - | -0.001 (0.005) | -0.001 (0.005) | 0.000 (0.005) | 0.000 (0.005) | 0.002 (0.012) | 0.002 (0.012) | 0.000 (0.005) |
| # of symptoms | - | - | -0.002 (0.004) | 0.000 (0.004) | 0.001 (0.004) | 0.003 (0.004) | -0.002 (0.010) | 0.003 (0.010) | 0.005 (0.004) |
| Height (in cm) | - | - | 0.004*** (0.001) | 0.004*** (0.001) | 0.004*** (0.001) | 0.003*** (0.001) | 0.008*** (0.002) | 0.007*** (0.002) | 0.003*** (0.001) |
| Ln(Wealth) | - | - | - | - | 0.038*** (0.003) | 0.035*** (0.003) | 0.156*** (0.009) | 0.148*** (0.009) | 0.034*** (0.003) |
| Controls for labour force status | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 | 11,662 |

Note: SHARE 2006. The dependent variable takes the value of 1 for individuals not willing to take any financial risks and 4 if the individual reports willing to take substantial financial risks expecting receive a substantial return. Cognitive test scores are normalized. Standard errors are in parentheses. (*), (**), (***) mean that the coefficient estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.

Appendix

Table A1. Descriptive statistics.

| | <u>Means or percentage</u> |
|------------------------------------|--------------------------------|
| <u>Country:</u> | |
| Austria | 6.6% |
| Belgium | 15.4% |
| Denmark | 6.8% |
| France | 10.9% |
| Germany | 8.5% |
| Greece | 12.5% |
| Italy | 10.0% |
| Netherlands | 9.8% |
| Spain | 7.2% |
| Sweden | 11.3% |
| Switzerland | 1.0% |
| <u>Cognitive scores:</u> | |
| Memory score | 8.6 |
| Fluency score | 19.2 |
| Numeracy score | 3.5 |
| <u>Individual characteristics:</u> | |
| Age | 66.3 |
| 1 if woman | 53.4% |
| Years of education | 10.4 |
| 1 if living in a couple | 64.3% |
| Household size | 2.0 |
| Number of chronic diseases | 1.58 |
| Number of symptoms | 1.74 |
| Height (in cm) | 167.9 |
| <u>Labour force status:</u> | |
| 1 if working | 24.5% |
| 1 if retired | 56.3% |
| 1 if unemployed | 2.3% |
| 1 if disabled | 3.0% |
| 1 if inactive | 13.9% |
| Household wealth (median) | 227,484 |
| Number of observations | 11,662 |

Note: SHARE 2006.

Table A2. Linear probability model of stocks ownership.

| | Stock ownership | |
|---|----------------------|----------------------|
| | (i) | (ii) |
| <u>Willingness to take financial risks:</u> | | |
| No risks at all | Reference Category | Reference Category - |
| Average risks | 0.250*** (0.009) | 0.212*** (0.009) |
| Above average risks | 0.366*** (0.015) | 0.324*** (0.014) |
| Substantial risks | 0.364*** (0.032) | 0.317*** (0.031) |
| Age/10 (in years) | -0.015*** (0.003) | 0.002 (0.005) |
| 1 if female | - | 0.016* (0.009) |
| Years of education | - | 0.008*** (0.001) |
| 1 if Living in a couple | - | 0.033*** (0.009) |
| Household size | - | -0.003 (0.004) |
| # of chronic diseases | - | -0.002 (0.003) |
| # of symptoms | - | -0.004* (0.002) |
| Height (in cm) | - | 0.001** (0.000) |
| <u>Labour force status:</u> | | |
| 1 if working | - | - |
| 1 if retired | - | 0.022** (0.010) |
| 1 if unemployed | - | 0.008 (0.021) |
| 1 if disabled | - | 0.015 (0.020) |
| 1 if inactive | - | 0.017 (0.012) |
| Ln(Wealth) | - | 0.021*** (0.001) |
| Country fixed effect | Yes | Yes |
| Number of observations | 11,217 | 11,217 |

Note: SHARE 2006. The dependent variable takes the value of 1 for individuals reporting having stocks and 0 otherwise. Standard errors are in parentheses. (*), (**), (***) mean that the coefficient estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.

Table A3. Models for financial risk preference. 50-75 year-old.

| | Financial risk attitude | | | | | | | | |
|----------------------------------|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | OLS | OLS | OLS | OLS | OLS | OLS | Ordered probit | Ordered probit | 2SLS |
| | (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) |
| Age/10 (in years) | -0.094*** (0.010) | -0.051*** (0.010) | -0.023* (0.014) | -0.008 (0.014) | -0.020 (0.014) | -0.007 (0.014) | -0.096*** (0.031) | -0.066** (0.031) | 0.002 (0.014) |
| Index for cognitive skills | - | 0.116*** (0.008) | - | 0.068*** (0.009) | - | 0.055*** (0.009) | - | 0.148*** (0.019) | 0.098*** (0.015) |
| 1 if female | - | - | -0.066*** (0.018) | -0.073*** (0.018) | -0.074*** (0.018) | -0.080*** (0.018) | -0.168*** (0.041) | -0.183*** (0.041) | -0.084*** (0.018) |
| Years of education | - | - | 0.021*** (0.002) | 0.016*** (0.002) | 0.017*** (0.002) | 0.014*** (0.002) | 0.037*** (0.004) | 0.028*** (0.004) | 0.011*** (0.002) |
| 1 if Living in a couple | - | - | 0.104*** (0.018) | 0.093*** (0.018) | 0.049*** (0.018) | 0.043** (0.018) | 0.125*** (0.041) | 0.112*** (0.041) | 0.038** (0.018) |
| Household size | - | - | -0.028*** (0.009) | -0.025*** (0.009) | -0.028*** (0.009) | -0.026*** (0.009) | -0.078*** (0.020) | -0.074*** (0.020) | -0.024*** (0.009) |
| # of chronic diseases | - | - | 0.001 (0.006) | 0.001 (0.006) | 0.001 (0.006) | 0.002 (0.006) | 0.003 (0.013) | 0.005 (0.013) | 0.002 (0.006) |
| # of symptoms | - | - | -0.004 (0.005) | -0.001 (0.005) | 0.001 (0.005) | 0.002 (0.005) | -0.004 (0.011) | 0.000 (0.011) | 0.004 (0.005) |
| Height (in cm) | - | - | 0.005*** (0.001) | 0.004*** (0.001) | 0.004*** (0.001) | 0.004*** (0.001) | 0.008*** (0.002) | 0.007*** (0.002) | 0.003*** (0.001) |
| Ln(Wealth) | - | - | - | - | 0.046*** (0.003) | 0.043*** (0.003) | 0.161*** (0.010) | 0.154*** (0.010) | 0.042*** (0.003) |
| Controls for labour force status | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 9,332 | 9,332 | 9,332 | 9,332 | 9,332 | 9,332 | 9,332 | 9,332 | 9,332 |

Note: SHARE 2006. The dependent variable is takes the value of 1 for individuals not willing to take any financial risks and 4 if the individual reports willing to take substantial financial risks expecting receive a substantial return. Cognitive skills are measured as the first component from a principal component analysis using the score from the fluency test, the word recall test and the numeracy test. Standard errors are in parentheses. (*), (**), (***) mean that the coefficient estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.