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Cognitive Ageing and Risk Attitude

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Cognitive Ageing and Risk Attitude[1]

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Abstract

In this paper we investigate to what extent the decrease in the willingness to take risks 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 70% of the difference in willingness to take risks between cohorts can be traced to age-related differences in cognitive skills.

[1] This paper uses data from SHARE release 2.3.0, as of November 13th 2009. SHARE data collection in 2004-2007 was primarily funded by the European Commission through its 5th and 6th framework programmes (project numbers QLK6-CT-2001- 00360; RII-CT- 2006-062193; CIT5-CT-2005-028857). Additional funding by the US National Institute on Aging (grant numbers U01 AG09740-13S2; P01 AG005842; P01 AG08291; P30 AG12815; Y1-AG-4553-01; OGHA 04-064; R21 AG025169) as well as by various national sources is gratefully acknowledged (see http://www.share-project.org for a full list of funding institutions).

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 70%. 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

[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.

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 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

[3] Note that the word recall test score, which measures episodic memory, is the one that

includes country fixed 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. [4] We control for gender, 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), height, 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

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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).

[4] For example, education is correlated with both cognition (Glymour et al., 2008;) and risk attitudes (see, e.g. Donkers et al., 2001). Likewise height is associated with cognition (Case and Paxton, 2008) and risk attitudes (Dohmen et al. 2011) . Retirement is also a potential confounder that is related to cognitive functioning (Bonsang et al., 2010; Rohwedder and Willis, 2010) and financial risk attitude (Bodie et al., 1992).

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 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,

[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: $cognition_i = cognition*_i + \nu_i$, with $Cov(cognition*, \nu) = 0$, the bias of the coefficient on age equals

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.[6] 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 70% 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 3, show that our main findings remain unchanged: Once we control for cognitive skills and correct for measurement error, the coefficient estimate of age decreases substantially and becomes statistically insignificant. Since our results also hold for a younger sample that is more homogeneous with respect to age, we can be assured that differences in life expectancy, which might affect risk preferences directly and be proxied by very low levels of cognition at old age, are

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

[6] The F-test for the excluded instrument in the first stage is 5731.12.

not driving our result.

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 4, 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 5, 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.[7]

To address the concern that our results are entirely driven by one aspect of cognition, we include our measures of cognitive skills separately in the model rather than combining the different cognitive scores, and use the lag of each of the measures as an instrument for the current measures in the 2SLS. The results, which

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

are presented in Table 6, substantiate our main findings. It is worth noting that the 2SLS estimates, which take measurement error in the respective cognitive skill measure into account, indicate that all components of cognition have approximately the same effect on the risk attitude.[8] This finding is important as it indicates that the correlation between our cognition measure and the risk measure does not solely reflect a relationship between numeracy and financial literacy, which might also affect the preference for investing in risky assets for reasons unrelated to risk preference.[9]

Concluding remarks

We have shown that the age-related change in risk attitude is largely associated with cognitive ageing. When we take measurement error in our cognitive skills measures into account, we find that about 70 % of the association between age and risk attitudes can be attributed to cognition. To the extent that our measures do not capture all (possibly relevant) aspects of cognition, this might be even an underestimate.

Our results highlight that the process of cognitive decline is closely connected with changes in risk preferences over the life cycle. In light of recent studies that document a correlation between cognitive functioning and risk attitudes and a large literature in psychology establishing that cognition declines over the life cycle, one might be encouraged to conclude that our findings hint at a causal impact of cognition on risk preferences. Although such an interpretation seems very plausible, our data do not allow us to pin down such a conclusion. Even if we

[8] When not controlling for measurement error, numeracy has the largest effect, while memory score is not significant in all specifications. However, the fact that effect sizes and statistical significance are similar for all three measures when controlling for measurement error indicates 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.

[9] When we include the memory score and the word fluency score as explanatory variables, and leave out numeracy, we find that the age coefficient becomes -0.012 (standard error: 0.009) for the specification used for column (ix) in Table 6.

were able to learn more about econometric causality, for example by exploiting panel data on risk preferences and cognition over long time horizons, it would still be difficult, if not impossible, to assess whether cognition directly affects risk preferences or whether cognition and risk preferences are affected by simultaneous and interrelated physiological processes. Our findings already indicate the processes of cognitive aging and age-related changes in risk preferences are interconnected. Understanding through what channel cognition can have a causal impact on risk preferences would almost inevitably require knowledge of the physiological basis of risk preferences, and is beyond the scope of this paper.

References

Anderson, Nicole D., and Fregus I. M. Craik, 2000. "Memory in the Aging Brain." In *The Oxford Handbook of Memory*, ed. E. Tulving and F. I. M. Craik, 411–425. Oxford: Oxford University Press.

Barsky, Robert B., F. Thomas Juster, Miles S. Kimball, and Matthew D. Shapiro, 1997. "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study." *Quarterly Journal of Economics* 112(2):537-579.

Beauchamp, Jonathan, David Cesarini, and Magnus Johannesson, 2011. The Psychometric Properties of Measures of Economic Risk Preferences. Mimeo.

Bodie, Zvi, Robert C. Merton, and William F. Samuelson (1992). "Labor Supply Flexibility and Portfolio Choice in a Life Cycle Model." *Journal of Economic Dynamics and Control*, 16: 427-450.

Bonsang, Eric, Stéphane Adam, and Sergio Perelman (2010). "Does Retirement Affect Cognitive Functioning?" ROA-RM-2010/1, Maastricht University.

Borghans, Lex, Angela Duckworth, James Heckman and Bas ter Weel, 2008. "The Economics and Psychology of Personality Traits." *Journal of Human Resources*, 43(4): 972-1059.

Börsch-Supan, Axel, and Hendrik Jürges, 2005. *The Survey of Health, Ageing and Retirement in Europe – Methodology*. Mannheim: MEA.

Burks, Stephen V., Jeffrey P. Carpenter, Lorenz Goette, and Aldo Rustichini, 2009. "Cognitive Skills Affect Economic Preferences, Strategic Behavior, and Job Attachment." *Proceedings of the National Academy of Sciences of the United States of America*, 106 (19): 7745–7750.

Case, Anne, and Christina Paxton (2008). "Stature and Status: Height, Ability and Labor Market. Outcomes." *Journal of Political Economy* 116: 499 - 532.

Dixon, Roger A., Lars Bäckman, and Lars-Goran Nilsson, 2004. *New Frontiers in*

Cognitive Aging. Oxford: Oxford University Press.

Dohmen, Thomas, Armin Falk, David Huffman, Uwe Sunde, Jürgen, Schupp, and Gert G. Wagner, 2011. "Individual Risk Attitudes: Measurement, Determinants and Behavioral Consequences." *Journal of the European Economic Association*, 9(3): 522-550.

Dohmen, Thomas, Armin Falk, David Huffman, and Uwe Sunde, 2010. "Are Risk Aversion and Impatience Related to Cognitive Ability?" *American Economic Review*, 100(3): 1238–60.

Donkers, Bas, Bertrand Melenberg, and Arthur Van Soest, 2001. "Estimating Risk Attitudes Using Lotteries: A Large Sample Approach." *Journal of Risk and Uncertainty*, 22(2): 165–195.

Prull, Mattheuw W., John D. E. Gabrieli, and Silvia A. Bunge, 2000. "Age-related Changes in Memory: A Cognitive Neuroscience Perspective." In *Handbook of aging and cognition II*, ed. Fregus I. M. Craik and Timothy A. Salthouse, 91–153. Mahwah, NJ: Lawrence Erlbaum Associates.

Rohwedder, Susann and Robert J. Willis. 2010. "Mental Retirement." *Journal of Economic Perspectives*, 24, 1; 1-20.

Salthouse, Timothy. A., 1996. "The Processing-speed Theory of Adult Age Differences in Cognition." *Psychological Review,* 103: 403–428.

Souchay, Céline, Michel Isingrini, and Loïc Espagnet, 2000. "Aging, Episodic Memory, Feeling-of-Knowing, and Frontal Functioning." *Neuropsychology*, 14: 299–309.

Van der Linden, Martial, Serge Brédart, and Annick Beerten, 1994. "Age-related Differences in Updating Working Memory." *British Journal of Psychology*, 85:145–152.

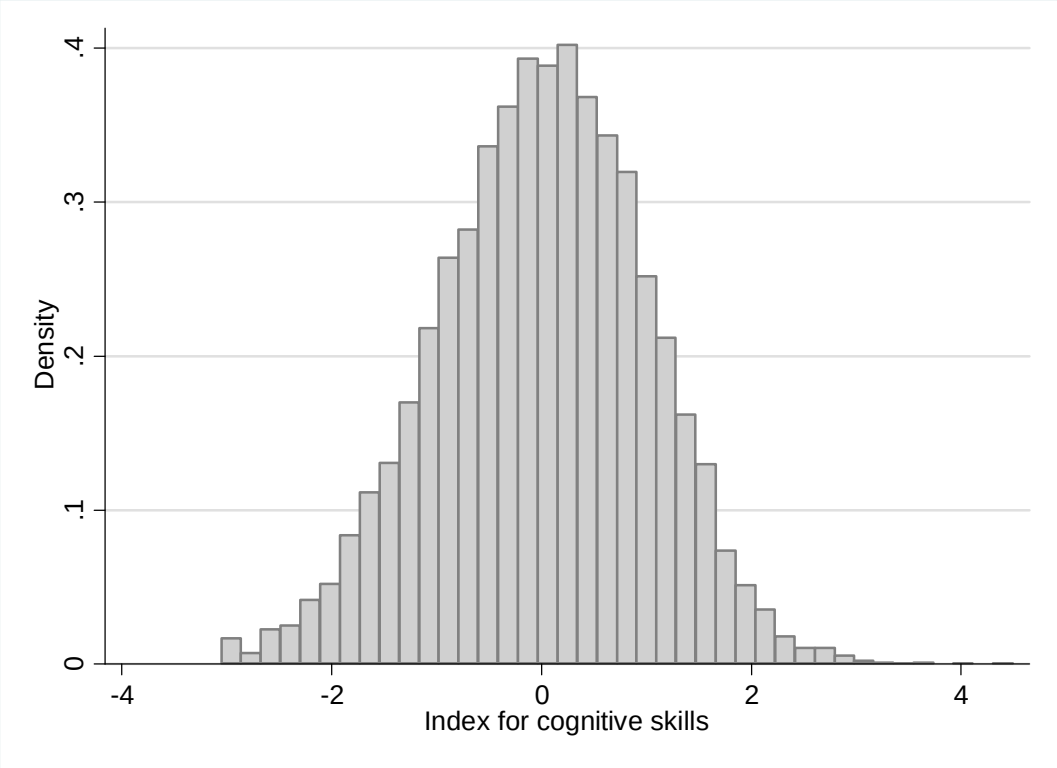
Tables and Figures

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%

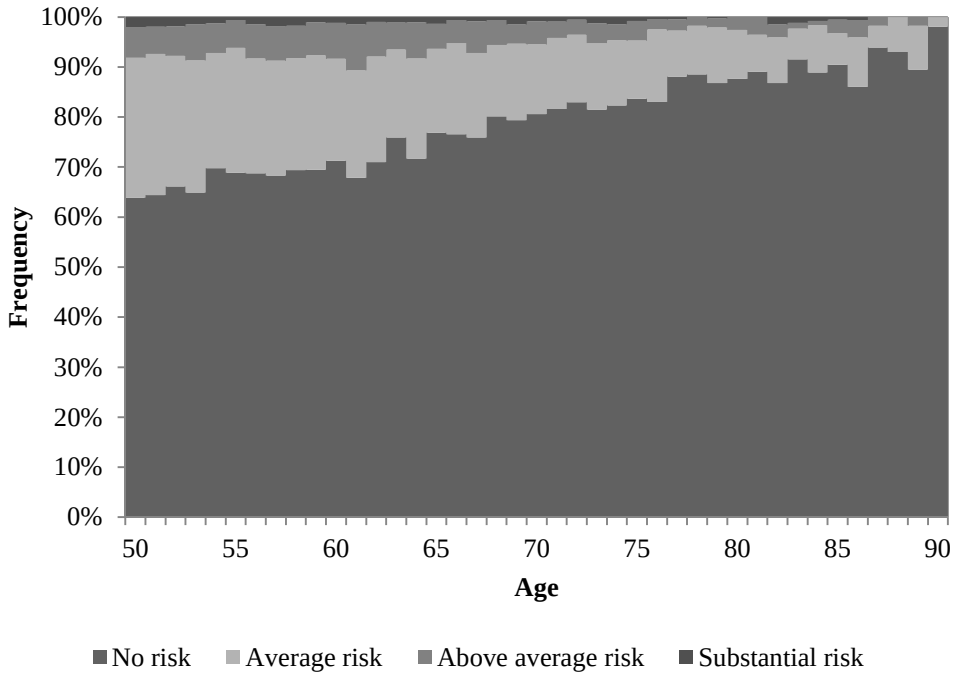
Note: SHARE 2006.

Figure 1. Distribution of the index for cognitive skills.



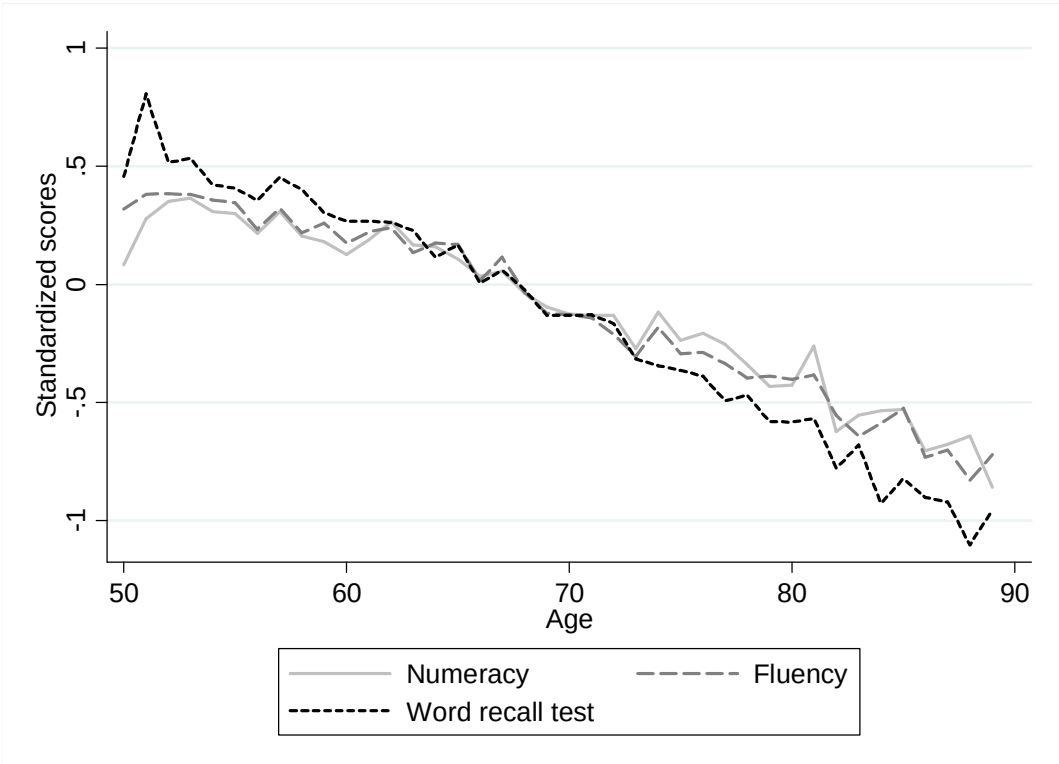
Note: SHARE 2006. The index for cognitive skills is measured as the first component from a principal component analysis using the score from the fluency test, the word recall test and the numeracy test.

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***	-0.058***	-0.043***	-0.024***	-0.040***	-0.023***	-0.161***	-0.118***	-0.012
	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	(0.020)	(0.021)	(0.009)
Index for cognitive skills	-	0.108***	-	0.064***	-	0.054***	-	0.157***	0.091***
		(0.007)		(0.007)		(0.007)		(0.018)	(0.013)
1 if female	-	-	-0.062***	-0.068***	-0.067***	-0.071***	-0.170***	-0.185***	-0.074***
			(0.016)	(0.016)	(0.016)	(0.016)	(0.038)	(0.038)	(0.016)
Years of education	-	-	0.020***	0.015***	0.017***	0.013***	0.038***	0.029***	0.011***
			(0.001)	(0.002)	(0.001)	(0.002)	(0.004)	(0.004)	(0.002)
1 if Living in a couple	-	-	0.099***	0.086***	0.056***	0.047***	0.163***	0.144***	0.041***
			(0.015)	(0.015)	(0.015)	(0.015)	(0.038)	(0.038)	(0.015)
Household size	-	-	-0.027***	-0.024***	-0.028***	-0.025***	-0.091***	-0.085***	-0.023***
			(0.008)	(0.008)	(0.008)	(0.008)	(0.020)	(0.020)	(0.008)
# of chronic diseases	-	-	-0.001	-0.001	0.000	0.000	0.002	0.002	0.000
			(0.005)	(0.005)	(0.005)	(0.005)	(0.012)	(0.012)	(0.005)
# of symptoms	-	-	-0.002	0.000	0.001	0.003	-0.002	0.003	0.005
			(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.004)
Height (in cm)	-	-	0.004***	0.004***	0.004***	0.004***	0.008***	0.007***	0.003***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Ln(Wealth)	-	-	-	-	0.038***	0.036***	0.156***	0.149***	0.034***
					(0.003)	(0.003)	(0.009)	(0.009)	(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
R^2	0.099	0.119	0.141	0.147	0.157	0.161	-	-	-
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 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***	-0.051***	-0.023*	-0.008	-0.020	-0.007	-0.096***	-0.066**	0.002
	(0.010)	(0.010)	(0.014)	(0.014)	(0.014)	(0.014)	(0.031)	(0.031)	(0.014)
Index for cognitive skills	-	0.116***	-	0.068***	-	0.055***	-	0.148***	0.098***
		(0.008)		(0.009)		(0.009)		(0.019)	(0.015)
1 if female	-	-	-0.066***	-0.073***	-0.074***	-0.080***	-0.168***	-0.183***	-0.084***
			(0.018)	(0.018)	(0.018)	(0.018)	(0.041)	(0.041)	(0.018)
Years of education	-	-	0.021***	0.016***	0.017***	0.014***	0.037***	0.028***	0.011***
			(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)
1 if Living in a couple	-	-	0.104***	0.093***	0.049***	0.043**	0.125***	0.112***	0.038**
			(0.018)	(0.018)	(0.018)	(0.018)	(0.041)	(0.041)	(0.018)
Household size	-	-	-0.028***	-0.025***	-0.028***	-0.026***	-0.078***	-0.074***	-0.024***
			(0.009)	(0.009)	(0.009)	(0.009)	(0.020)	(0.020)	(0.009)
# of chronic diseases	-	-	0.001	0.001	0.001	0.002	0.003	0.005	0.002
			(0.006)	(0.006)	(0.006)	(0.006)	(0.013)	(0.013)	(0.006)
# of symptoms	-	-	-0.004	-0.001	0.001	0.002	-0.004	0.000	0.004
			(0.005)	(0.005)	(0.005)	(0.005)	(0.011)	(0.011)	(0.005)
Height (in cm)	-	-	0.005***	0.004***	0.004***	0.004***	0.008***	0.007***	0.003***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Ln(Wealth)	-	-	-	-	0.046***	0.043***	0.161***	0.154***	0.042***
					(0.003)	(0.003)	(0.010)	(0.010)	(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
R^2	0.095	0.115	0.138	0.143	0.156	0.160	-	-	-
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.

Table 4. 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***	-0.012***	-0.008*	0.001	-0.006	0.001	-0.067***	-0.036	0.009*
	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.025)	(0.026)	(0.005)
Index for cognitive skills	-	0.060***	-	0.031***	-	0.023***	-	0.107***	0.048***
		(0.004)		(0.004)		(0.004)		(0.022)	(0.008)
1 if female	-	-	0.007	0.005	0.004	0.002	0.010	0.000	0.000
			(0.010)	(0.010)	(0.009)	(0.009)	(0.047)	(0.047)	(0.009)
Years of education	-	-	0.014***	0.012***	0.011***	0.010***	0.050***	0.043***	0.008***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)	(0.001)
1 if Living in a couple	-	-	0.075***	0.069***	0.043***	0.040***	0.158***	0.144***	0.035***
			(0.009)	(0.009)	(0.009)	(0.009)	(0.047)	(0.047)	(0.009)
Household size	-	-	-0.008	-0.006	-0.008*	-0.007	-0.050**	-0.046*	-0.005
			(0.005)	(0.005)	(0.005)	(0.005)	(0.026)	(0.026)	(0.005)
# of chronic diseases	-	-	-0.003	-0.003	-0.002	-0.002	-0.011	-0.011	-0.002
			(0.003)	(0.003)	(0.003)	(0.003)	(0.014)	(0.014)	(0.003)
# of symptoms	-	-	-0.006***	-0.005**	-0.003	-0.002	-0.024**	-0.020*	-0.002
			(0.002)	(0.002)	(0.002)	(0.002)	(0.012)	(0.012)	(0.002)
Height (in cm)	-	-	0.002***	0.002***	0.002***	0.002***	0.007**	0.006**	0.001***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)
Ln(Wealth)	-	-	-	-	0.028***	0.027***	0.297***	0.292***	0.026***
					(0.002)	(0.002)	(0.014)	(0.014)	(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
R^2	0.153	0.169	0.188	0.192	0.211	0.213	-	-	-
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 5. 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***	-0.051**	0.005	-0.108	-0.078	0.029
		(0.019)	(0.020)	(0.025)	(0.084)	(0.085)	(0.026)
	Index for cognitive skills		0.063***	0.043**		0.172**	0.122***
			(0.019)	(0.019)		(0.067)	(0.034)
	Number of observations	771	771	771	771	771	771
Belgium	Age/10	-0.086***	-0.023	0.001	-0.071	-0.006	0.019
		(0.014)	(0.015)	(0.019)	(0.047)	(0.049)	(0.020)
	Index for cognitive skills		0.151***	0.084***		0.216***	0.140***
			(0.016)	(0.017)		(0.043)	(0.028)
	Number of observations	1793	1793	1793	1793	1793	1793
Denmark	Age/10	-0.243***	-0.216***	-0.087**	-0.235***	-0.218***	-0.077*
		(0.024)	(0.027)	(0.040)	(0.074)	(0.076)	(0.041)
	Index for cognitive skills		0.065**	0.028		0.061	0.062
			(0.031)	(0.032)		(0.060)	(0.052)
	Number of observations	792	792	792	792	792	792
France	Age/10	-0.065***	-0.016	-0.023	-0.188***	-0.119*	-0.007
		(0.013)	(0.015)	(0.020)	(0.064)	(0.068)	(0.021)
	Index for cognitive skills		0.105***	0.046***		0.175***	0.089***
			(0.015)	(0.017)		(0.056)	(0.028)
	Number of observations	1270	1270	1270	1270	1270	1270
Germany	Age/10	-0.093***	-0.041**	0.005	-0.146*	-0.092	-0.008
		(0.019)	(0.021)	(0.028)	(0.083)	(0.086)	(0.033)
	Index for cognitive skills		0.114***	0.054**		0.178***	0.014
			(0.020)	(0.022)		(0.064)	(0.053)
	Number of observations	991	991	991	991	991	991
Greece	Age/10	-0.063***	-0.021	-0.033	-0.194***	-0.130**	-0.034
		(0.014)	(0.017)	(0.021)	(0.061)	(0.063)	(0.022)
	Index for cognitive skills		0.096***	0.076***		0.264***	0.070**
			(0.021)	(0.023)		(0.065)	(0.035)
	Number of observations	1453	1453	1453	1453	1453	1453

Table 5 (continued).

		Fiancial risk attitude					
		OLS	OLS	OLS	Ordered probit	Ordered probit	2SLS
		(i)	(ii)	(iii)	(iv)	(v)	(vi)
Italy	Age/10	-0.083***	-0.033*	-0.017	-0.227***	-0.198**	-0.015
		(0.016)	(0.018)	(0.020)	(0.080)	(0.083)	(0.022)
	Index for cognitive skills		0.099***	0.009		0.103	0.019
			(0.017)	(0.020)		(0.073)	(0.038)
	Number of observations	1163	1163	1163	1163	1163	1163
Netherlands	Age/10	-0.098***	-0.064***	-0.043*	-0.210***	-0.186**	-0.030
		(0.018)	(0.020)	(0.026)	(0.071)	(0.073)	(0.027)
	Index for cognitive skills		0.102***	0.021		0.082	0.070*
			(0.022)	(0.023)		(0.060)	(0.041)
	Number of observations	1148	1148	1148	1148	1148	1148
Spain	Age/10	-0.049***	-0.030**	-0.022	-0.298***	-0.250**	-0.025
		(0.012)	(0.014)	(0.018)	(0.108)	(0.113)	(0.021)
	Index for cognitive skills		0.046***	0.020		0.169*	0.013
			(0.016)	(0.019)		(0.102)	(0.040)
	Number of observations	844	844	844	844	844	844
Sweden	Age/10	-0.209***	-0.137***	-0.064*	-0.173***	-0.148**	-0.046
		(0.026)	(0.029)	(0.039)	(0.057)	(0.058)	(0.040)
	Index for cognitive skills		0.174***	0.086***		0.134***	0.164***
			(0.031)	(0.032)		(0.047)	(0.058)
	Number of observations	1317	1317	1317	1317	1317	1317
Switzerland	Age/10	-0.055	-0.025	-0.109	-0.325	-0.318	0.179
		(0.053)	(0.066)	(0.088)	(0.204)	(0.229)	(0.143)
	Index for cognitive skills		0.053	-0.006		0.013	0.559***
			(0.070)	(0.076)		(0.197)	(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 6. 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***	-0.063***	-0.043***	-0.026***	-0.040***	-0.026***	-0.161***	-0.123***	-0.013
	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	(0.020)	(0.021)	(0.009)
Numeracy score	-	0.085***	-	0.047***	-	0.040***	-	0.110***	0.042**
		(0.006)		(0.007)		(0.007)		(0.017)	(0.019)
Fluency score	-	0.039***	-	0.022***	-	0.018**	-	0.047***	0.035*
		(0.007)		(0.007)		(0.007)		(0.016)	(0.019)
Memory score	-	0.011	-	0.013*	-	0.011	-	0.045***	0.037*
		(0.007)		(0.007)		(0.007)		(0.017)	(0.022)
1 if female	-	-	-0.062***	-0.059***	-0.067***	-0.064***	-0.170***	-0.167***	-0.072***
			(0.016)	(0.016)	(0.016)	(0.016)	(0.038)	(0.039)	(0.018)
Years of education	-	-	0.020***	0.015***	0.017***	0.013***	0.038***	0.028***	0.010***
			(0.001)	(0.002)	(0.001)	(0.002)	(0.004)	(0.004)	(0.002)
1 if Living in a couple	-	-	0.099***	0.087***	0.056***	0.048***	0.163***	0.145***	0.041***
			(0.015)	(0.015)	(0.015)	(0.015)	(0.038)	(0.038)	(0.015)
Household size	-	-	-0.027***	-0.024***	-0.028***	-0.026***	-0.091***	-0.086***	-0.023***
			(0.008)	(0.008)	(0.008)	(0.008)	(0.020)	(0.020)	(0.008)
# of chronic diseases	-	-	-0.001	-0.001	0.000	0.000	0.002	0.002	0.000
			(0.005)	(0.005)	(0.005)	(0.005)	(0.012)	(0.012)	(0.005)
# of symptoms	-	-	-0.002	0.000	0.001	0.003	-0.002	0.003	0.005
			(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.004)
Height (in cm)	-	-	0.004***	0.004***	0.004***	0.003***	0.008***	0.007***	0.003***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Ln(Wealth)	-	-	-	-	0.038***	0.035***	0.156***	0.148***	0.034***
					(0.003)	(0.003)	(0.009)	(0.009)	(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
R^2	0.099	0.123	0.141	0.148	0.157	0.162	-	-	-
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.

	Means or percentage
Country:	
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%
Cognitive scores:	
Memory score	8.6
Fluency score	19.2
Numeracy score	3.5
Individual characteristics:	
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
Labour force status:	
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)
Willingness to take financial risks:		
No risks at all	Reference Category	Reference Category -
Average risks	0.250***	0.212***
	(0.009)	(0.009)
Above average risks	0.366***	0.324***
	(0.015)	(0.014)
Substantial risks	0.364***	0.317***
	(0.032)	(0.031)
Age/10 (in years)	-0.015***	0.002
	(0.003)	(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)
Labour force status:		
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
R^2	0.247	0.276
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 coefficent estimate is significantly different from zero at the 10%, 5%, 1% levels, respectively.