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Cognitive Abilities and Portfolio Choice

Dimitrios Christelis[*], Tullio Jappelli[**] and Mario Padula[*]

Abstract

We study the relation between cognitive ability and the decision to invest in stocks using the recent Survey of Health, Ageing and Retirement in Europe (SHARE). The survey has detailed data on wealth and portfolio composition of individuals aged 50+ in 11 European countries and three indicators of cognitive abilities: mathematical, verbal fluency, and recall skills. We find that the propensity to invest in stocks is strongly associated with cognitive abilities, for both direct stock market participation and indirect participation through mutual funds and investment accounts. We also find that stockholding increases with social interactions, intention to leave a bequest, and is negatively associated with health status.

Keywords: cognitive abilities, stockholding, portfolio choice.
JEL classification: E2, D8, G1

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1. Introduction

A large body of empirical research documents that many individuals do not invest in stocks and other financial assets. Limited financial market participation has important implications for individual welfare and the explanation of the equity premium puzzle, and is one of the most active areas of research in the field of household finance (Campbell, 2006).

The literature relies on transaction and information costs broadly interpreted as the main explanation for why some individuals choose zero holdings for stocks and other financial assets (Vissing-Jorgensen, 2004). But the exact nature of these costs is not well understood, and the challenge of current research is to single out the factors that prevent large sectors of the population from holding stocks. In this paper we focus on lack of cognitive abilities (such as reading skills and ability to perform simple numerical calculations) as a barrier preventing stockholding and a potential explanation for limited financial market participation.

There are several channels through which cognitive skills might affect the decision to buy stocks and other financial assets. First, cognitive impairments limit investors' ability to gather and process information. Second, cognitive abilities increase the actual or perceived costs of processing information. Finally, recent research shows that cognitive abilities tend to be associated with certain features of preferences, such as risk aversion, that reduce the willingness to bear financial risks.

In order to study the impact of cognitive factors on stockownership, we exploit within and across country variability in cognitive abilities, stockholding and socioeconomic variables using data drawn from the first release of SHARE, the Survey of Health, Ageing and Retirement in Europe. SHARE surveys people aged 50 and above in 11 European countries: Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden and Switzerland. The survey asks detailed questions on demographics, physical and mental health, employment, income, assets, social activities, and expectations. All questions are standardized across countries, allowing consistent international comparisons.

Most importantly from the point of view of this paper, the survey has a complete and accurate set of indicators of ability in reading, performing numerical operations, and recalling. Cognitive abilities are known to vary across countries even taking education into account. For

instance, evidence from the OECD Programme for International Student Assessment (PISA) shows that among 15 years old with the same level of schooling there is large international variability in mathematical and science test score and that there is a consistent North-South gradient in skills.

Cross-country comparisons offer potentially very useful scenarios to understand household portfolio choice. In countries like Sweden or the US over 50 percent of households have stocks. In Southern Europe the same proportion does not exceed 20 percent. Indeed, within and across countries there is wide heterogeneity in stockholding, in particular with respect to investors' wealth, education and horizon (Guiso, Haliassos, and Jappelli, 2002; Ameriks and Zeldes, 2004). Recent studies have also found associations between stockholding and background income risk (Guiso, Jappelli and Terlizzese, 1996; Heaton and Lucas, 2000), health status (Rosen and Wu, 2003), culture and social interactions (Grinblatt and Keloharju, 2001; Hong, Kubik and Stein, 2004). Our paper tests the effect of cognitive skills on stockholding, and offers also a systematic account of the main factors affecting household portfolio choice in Europe using fully comparable microeconomic data. It represents therefore a significant improvement over previous literature based on individual country data.

The sample focuses on the elderly, and in the empirical analysis we need to recognize that the elderly face substantial mortality risk, especially at advanced ages, reducing their planning horizon. Moreover, while the retired face more limited labor income risk, they have much more uncertainty about medical expenditures. Controlling for the potential effects of health status and bequest motives on the willingness to bear financial risk is therefore particularly important in our context.

Understanding the reasons for financial market non-participation is important for many reasons. Cocco, Gomes and Maenhout (2005) show that the welfare loss from non-participation in stock markets is between 1.5 and 2 percent of consumption in calibrated life-cycle models. Limited participation and changes in participation over time is relevant also for studying the equity premium puzzle (Mankiw and Zeldes, 1991; Attanasio, Banks and Tanner, 2002), the distribution of wealth (Guvenen, 2005), household choices regarding individual retirement accounts (Bernheim and Garrett, 2003), and wealth effects on consumption (Dynan and Maki, 2001).

From a policy point of view, European pension reforms are likely to increase reliance on individual retirement accounts and investors' exposure to stock market investment. These investment opportunities will bring higher expected returns, but excessive or ill-advised trading of stocks can significantly reduce realized returns, and poor judgment in allocating retirement wealth can create major financial distress at a point in the life-cycle where the potential for offsetting adjustments is quite limited. Policy intervention to improve the quality of financial information and investors' awareness depend crucially on the extent to which cognitive abilities limit financial decisions.

The rest of the paper is organized as follows. Section 2 provides a simple framework to understand how cognition might affect stock market participation. Section 3 describes the microeconomic data and our three indicators of cognitive abilities, and Section 4 the set of variables that will be used in the empirical analysis to explain stockholding decisions. Section 5 presents the empirical results for the probability of investing in stocks, either directly or through mutual funds and investment accounts. The results are summarized in Section 6.

2. The effect of cognitive ability on stock market participation

To highlight the different channels through which cognitive ability might affect the participation decision, let's consider the static standard portfolio model where investors choose to allocate wealth *w* between a risk-free asset and a risky asset. The gross return on the risk-free asset is *R*, the excess return on the risky asset is $\widetilde{R}$, and the share of the risky asset in total wealth is α. Households allocate their wealth between the two assets solving the following problem:

$$\max_{\alpha} Eu\left[(\alpha\widetilde{R} + R)w\right]$$

The first order condition of the problem is:

$$E\widetilde{R}u'\left[(\alpha\widetilde{R} + R)w\right] = 0$$

If the expectation of the excess return is strictly positive, $E(\widetilde{R}) > 0$, risk averse agents invest a strictly positive amount in the risky asset (α>0). Taking a first order expansion of the marginal utility around α=0, $u'(Rw) + \alpha w u''(Rw)\widetilde{R} = 0$, multiplying both sides by $\widetilde{R}$, taking expectations and defining the degree of relative risk aversion $\rho(Rw) = -\dfrac{Rwu''(Rw)}{u'(Rw)}$, one obtains a well-known approximation for the optimal asset share invested in the risky asset:

$$\alpha^* \approx \frac{RE(\widetilde{R})}{\rho(Rw)E(\widetilde{R}^2)}$$

where $\rho(Rw)$ may depend on wealth and other investors' characteristics. To determine the participation decision, investors compare the value of the portfolio with the participation cost, that is $\alpha^* wE(\widetilde{R}) - f > 0$, which implies:

$$w > \frac{f\rho(Rw)(E\widetilde{R}^2)}{R\left[E(\widetilde{R})\right]^2} = \frac{f\rho(Rw)}{R}\left(\frac{1}{S^2} + 1\right) \qquad (1)$$

where $S = \dfrac{\mu}{\sigma}$ is the portfolio Sharpe ratio; $\mu = E(\widetilde{R})$ and $\sigma^2 = E(\widetilde{R}^2) - \left[E(\widetilde{R})\right]^2$ are, respectively, the mean and variance of the excess return.

Condition (1) indicates that there exists a sufficiently high level of wealth that triggers participation. As entry costs approach zero, all investors buy stocks. Condition (1) also implies that high stock market participation is associated with low fixed costs *f*, low risk aversion $\rho(Rw)$, and low Sharpe ratio *S*. The relation between cognitive ability and stock market participation may depend on each of these parameters.

Managing a portfolio requires a specific human capital investment, in terms of time and effort needed to familiarize with the notions of transaction costs, asset returns, volatility, and covariance between assets returns. Information costs represent therefore a significant barrier to entry the stock market. Cognitive ability are likely to raise such costs, represented by *f* in the framework above. Campbell (2006) argues that information barriers to invest in stocks come

from psychological factors that make stockownership uncomfortable for some households. Korniotis and Kumar (2006) point out that the perception of having limited abilities might also increase the cost of stock market participation. Low cognitive abilities might increase the perceived cost of investing in the stock market and the case for non-participation.

Starting with Kahneman and Tversky (1979), a growing strand of literature focuses on the relation between cognitive abilities and the curvature of the utility function. This literature challenges the assumptions of exponential discounting and expected utility maximization.[1] Benartzi and Thaler (1995) and Barberis, Huang and Thaler (2005) cite myopic loss aversion and narrow framing as potential explanations for limited participation in financial markets. Frederick (2005) reports experimental evidence relating cognitive ability, time and risk preferences. Benjamin, Brown, and Shapiro (2006) provide experimental evidence that greater cognitive ability is associated with more patient and less risk averse behavior.[2] Lower cognitive skills would then be associated with a higher risk aversion coefficient $\rho(Rw)$ in condition (1), making participation less likely.

A third channel between cognitive ability and participation is that cognitive ability is closely related to the ability to process information. Evidence from psychology shows that poor cognitive skills are associated with low ability of processing information and that memory affects the ability to perceive conditional probabilities and to distinguish between relevant and irrelevant information (Spaniol and Bayen, 2005). Cognitive skills act then as an additional constraint that optimizing individuals face when making their economic decisions. Sims (2003) has argued that taking into account this limited capacity can help to explain some of the empirical failures of the standard expected utility framework. Namely, low cognitive skills limit the accuracy with which investors estimate stock market returns, thus reducing expected return per unit of perceived risk. This, in turn, implies that investors' different information constraints are likely to be associated with different stock market outcomes. In terms of condition (1), limited information capacity reduces the Sharpe ratio, again making non-participation more likely.

[1] For instance, Laibson (1997) and Laibson, Repetto and Tobacman (1998) replace exponential discounting with hyperbolic discounting to explain the co-movement of consumption and income during the life cycle.

[2] Benjamin, Brown and Shapiro (2006) find that in the US Longitudinal Survey of Youth mathematical skill is associated with more asset accumulation, knowledge of pension plans, and greater financial market participation. Here we analyze a sample of individuals older than 50 and are able to control for a much wider set of variables, including financial wealth, social activities, health status, and education.

Our paper also is related to the recent literature on financial education and portfolio choice. Bernheim and Garrett (2003), focus on the effect of financial education in the workplace and show that workers saving choices are indeed affected by the employer-based programs of financial education. Lusardi and Mitchell (2005) find a negative association between planning for retirement and financial education and Graham, Harvey, and Huang (2005) document that investors who claim to understand investment products hold more efficient portfolios. In contrast to this literature, we consider a much broader notion of cognitive abilities. This helps us to circumvent the causality issue that arises when one finds a positive association between financial education and participation. Indeed, since our indicators will refer to basic numerical, verbal and recall abilities, it is hard to conceive that these skills are affected by stockownership.

3. Cognitive ability

In this paper we study the relation between cognitive ability and the decision to hold stocks either directly or indirectly, trough managed accounts or mutual funds. We use the most recent data release of the Survey of Health, Aging and Retirement in Europe (SHARE), a representative sample of the population aged 50+ in 11 European countries. The interviews took place in 2004, and wealth data refer to December 2003.[3] The survey covers 19,286 households and 32,022 individuals, and a wide range of topics, encompassing physical health, socioeconomic status, financial transfers, and intensity of social interaction. Some of the questions refer to the household (for instance, assets) while others are posed to the respondent and partner; for instance,

[3] The SHARE data collection has been primarily funded by the European Commission through the 5th framework program (project QLK6-CT-2001-00360 in the thematic program Quality of Life). Additional funding came from the US National Institute on Ageing (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064). Data collection in Austria (through the Austrian Science Foundation, FWF), Belgium (through the Belgian Science Policy Administration) and Switzerland (through BBW/OFES/UFES) was nationally funded. The SHARE data set is introduced in Börsch-Supan et al. (2005); methodological details are contained in Börsch-Supan and Jürges (2005).

the cognitive ability indicators, an overall assessment of health status, family networks and social activities.[4] In these cases, we combine information on both partners.

In this section we describe the indicators of cognitive ability that can be constructed with SHARE and document their international variability and relation with age and education. As we shall see, there is considerable within and across country variability in each of the indicators considered.

3.1. Measuring cognitive ability

SHARE devotes a whole section of the questionnaire on measuring cognitive functions. The cognitive psychology literature identifies four main domains of ability: orientation, memory, executive function and language. These abilities depend on genetic endowment and environmental factors, such as home environment in childhood and education, and change over time, see Richards et al. (2004). SHARE provides results on all these domains, and in this paper we focus on the ones that seem more relevant for financial planning: ability to perform numerical operations (which we term numeracy), planning and executive function (fluency), and memory.

The indicator of numeracy measures the ability to perform basic numerical operations. This, in turn, affects how people make financial decisions and manage their portfolios in a manner that reflects their preferences. SHARE respondents are asked to perform the following simple calculations: (1) find 10 percent of a number; (2) find one half of a number; (3) find the number of which another known number represents two thirds; (4) find 10 percent of another number. Each of the questions refers to specific economic or financial situations. On the basis of these four questions Dewey and Prince (2005) construct a numeracy indicator, which ranges from 1 to 5; details on its construction and the questions themselves are given in Appendix A.3. [5]

In Figure 1 we report the sample distribution of numeracy. The sample average is 3.4, and the standard deviation is 1.07. Less then 25% of the sample achieves the maximum score (5).

[4] The questionnaire and the sample design are patterned after the U.S. Health and Retirement Survey (HRS) and the English Longitudinal Study of Ageing (ELSA). Börsch-Supan et al. (2005) report details on sampling, response rates and definitions of variables.

[5] The aggregation of the four questions in an overall indicator of numeracy is arbitrary to some extent. We rely on the Dewey and Prince (2005) definition, although we check the robustness of the results to alternative definitions – for instance the simple sum of the correct answers to the four questions. The results are qualitatively unaffected.

Descriptive analysis shows that numeracy is strongly positively associated with education and income, while it is negatively associated with age and self-perceived health.

Executive function is measured by asking the respondent to name as much animals as she or he can in exactly one minute. Each respondent is then given a score, which is equal to the number of animals that she or he can name. We call this indicator "verbal fluency", or simply fluency. The distribution of fluency is plotted in Figure 1 (upper right graph). The sample average of fluency is 20, and the standard deviation is 7. The bulk of the distribution (50% of the sample) scores between 15 and 25, but a significant number (10%) scores above 30 or below 10.

In order to construct the memory indicator, respondents are first submitted a list of ten words, and then asked to list which ones they remember. The indicator is constructed by counting the number of words recalled, and it ranges from 0, in case no word is recalled, to 10. In the rest of the paper, we will refer to this indicator as recall, borrowing the terminology from the cognitive psychology literature. The sample mean the distribution of memory is 3.4, and the standard deviation is 2.1. Figure 1 shows that 50% of the samples scores between 2 and 5, and only 10% above 7.

In Figure 2 we plot numeracy in the 11 countries of our sample. The figure documents a moderate North-South gradient: basic mathematical skills are higher in Northern than in Southern Europe. Furthermore, in all countries the average score is higher than 3, with the exception of Spain and Italy, scoring 2.5 and 2.9 respectively. Figure 3 plots fluency across countries, confirming that in Northern Europe cognitive ability tends to be higher than in the South. The North-South gradient is also apparent for the memory, as shown in Figure 4.

3.2. Determinants of cognitive ability

Cognitive psychologists and epidemiologists recognize age and education as important determinants of cognition. Schaie (1989) points out that cognitive decline starts at the age of fifty and that memory is the first function to be affected. Kaplan et al. (2001) study the effect of the childhood socio-economic environment on cognitive function in the middle-age.

Age and education are not the sole factors affecting cognitive evolution. There is agreement among scientists that cognitive skills are also related to individual's genetic endowment.

However, while the so called empiricist approach focuses on the environmental determinant of cognitive impairment, the nativist identifies genes as the main cause of subsequent impairments, see Karmiloff-Smith (1998) for a survey. The debate is ongoing and this is not the place to address it. Moreover, we will not try to give a full account of what lies behind cognitive functions.

However, it is useful to show at this stage how much cognitive functions are related to observables, such as age and education and if, after controlling for such observables, there is any variation left. This is crucial since both age and education might have a direct effect on portfolio choice, independently of their effect on cognitive functions.

Figure 5 plots the distribution of the three indicators of cognitive ability by age, merging observations for all countries. As people age, the distributions of the three indicators shift to the left, confirming that cognitive functions decline with age. But the figure documents that there is ample variation in cognitive ability among individuals belonging to the same age group. It is a well-known fact that aging affects people differently. Indeed, the coefficient of variation of numeracy ranges from 0.23 in the age group 50-59 to 0.32 for the over 80. The coefficient of variation of numeracy ranges from 0.23 for those aged less than 59, to 0.32 for the over 80. The patterns for recall and fluency are similar. The coefficient of variation of fluency increases from 0.32 to 0.46, and that of recall from 0.40 to 0.92 from the lowest to the highest age groups.

The relation between cognitive functions and education is documented in Figure 6, showing the distribution of the three indicators in three education groups: less than high school, high school, and having a post-secondary degree.[6] Each of the three distributions shifts to the right with the level of education, in line with expectation that higher education is associated with cognitive skills. The figure, however, shows ample variation within each education group: even among post-secondary degree holders there is a substantial proportion of individuals with low cognitive ability. The variability of cognitive skills among people with similar level of education is not a unique feature of our data. For instance, the OECD PISA shows a North-South gradient in mathematical skills among young (less than 15 years old) Europeans with the same level of schooling. Frederick (2005) also reports considerable differences in cognitive abilities among US students.

[6] This includes college degrees as well as degrees granted by vocational schools and technical institutes.

4. Empirical specification

While traditional finance theory predicts that investor's willingness to take financial risks depends only on risk aversion and investment opportunities, dynamic models of portfolio choice emphasize that investment opportunities and wealth itself change over time, that investors usually face other background risks, and that transaction costs, information costs and borrowing constraints limit household financial decisions. Gollier (2001) surveys some of the recent developments.

Analytical results in this area are seldom available, as they require restrictive assumptions about preferences, or excluding some important factors affecting portfolio choice, such as background risk or transaction costs. The literature therefore relies on computational methods to solve portfolio models in an attempt to isolate the contribution of some of the factors affecting portfolio choice. On the empirical front, the literature has sought to single out the variables that are able to explain the patterns of portfolio choice in microeconomic data. In this section we describe how we use SHARE data to study the decision to buy stocks and our econometric framework.

4.1. Financial wealth and stockholding

SHARE has detailed information on financial and real assets. Financial assets are grouped in bank and other transaction accounts, government and corporate bonds, stocks, mutual funds, individual retirement accounts, contractual savings for housing, and life insurance policies. The questions on real assets refer to the value of the house of residence, other real estate, business wealth, see Christelis, Jappelli and Padula (2005) for details.

Selected sample statistics by country are reported in Table 1. The average age of the household head is approximately 63-65 years in all countries, while the percentage of couples ranges from 55 percent in Denmark to 72 percent in Italy. Individuals in Denmark, the Netherlands and Switzerland are much more likely to have a post-secondary education degree.

The share of not working persons, either because they are unemployed or because they are retired, ranges between 47 percent in Sweden to 73 percent in Italy. Household gross financial wealth also varies widely across Europe, with Switzerland clearly above the rest, followed by Sweden, while households in Italy, Spain and Greece report lower gross financial assets. The ranking between Scandinavian and Mediterranean countries is reversed if one looks at real assets, with median values of around 156,000 euro in Belgium, 151,000 euro in Italy and 70,000 in Denmark.

We adopt two definitions of stockownership: direct stockownership and total stockownership, defined as stocks held directly plus stocks held through mutual funds and investment accounts. To measure indirect stockownership we need information on the composition of mutual funds and managed accounts. The SHARE questionnaire does not provide information on the exact allocations between stocks, bonds and other assets. There are however questions for both mutual funds and investment accounts which give information on whether the amount invested is mostly in stocks, roughly equally in stocks and bonds, or mostly in bonds. We impute to these three possible values 75, 50 and 25 percent invested in stocks.[7]

Figure 7 reports the direct and total stockholding in the 11 countries of our sample; the actual values are reported in Table 1. Direct stockholding ranges from less than 5 percent in Spain to over 40 percent in Sweden. Total stockholding goes from about 10 percent in Spain, Greece and Italy to over 70 percent in Sweden. In broad terms there is a negative gradient going from Northern to Southern Europe, with a group in the middle consisting of France, Germany, Belgium, Netherlands and Switzerland. Sweden and Denmark have by the far the highest percentages of both direct and total stockholding, while Austria, Spain, Greece and Italy are at the other end of the spectrum. The histogram suggests that country effects are potentially quite important in explaining stockholding decisions of European investors. Our regression framework pays therefore particular attention to cross-country interaction effects.

[7] The Appendix reports further details on wealth definition and imputation procedures.

4.2. Health status

While the elderly are unlikely to face significant income risk, except for the inflation risk associated with annuities, they typically face a much higher health risk and therefore controlling for health is quite important in our sample.

There are several channels through which health risk might negatively affect the decision to hold stocks. Edwards (2003) shows that uninsurable morbidity risk induces investors to become effectively more risk averse, thereby reducing the asset share allocated to stocks. Edwards (2003) documents this correlation using the Health and Retirement Study (HRS) and the Survey on Assets and Health Dynamics Among the Oldest Old (AHEAD) and finds that current health status and expectations about future health affect negatively the share of risky assets.

Qiu (2004) and Goldman and Maestas (2005) argue that health risks increase the variability of future medical expenditures. As with other background risks, health risks cannot be easily avoided or diversified, and so investors will tend to reduce exposure to avoidable risks, such as financial risk. This suggests that there is a negative correlation between health risk and stockownership. These studies measure health risk by whether individuals have supplemental insurance and show that the effect of the reduced health risk through insurance is both statistically and economically significant.

Even in countries where health coverage is universal and provided free of charge, as is the case in some European countries, consumers may feel the need to increase their coverage against the risk of poor health. If insurance markets are not perfect, people must pay out-of-pocket for health expenditures. One could therefore expect health status to impact portfolio choice more in countries with relatively low protection against health risks or relatively low quality of health care. On the other hand, health care is provided also through informal family networks, and one may expect health status to impact portfolio choice less in countries in which such networks are more prevalent. The relation between health status and propensity to take financial risks therefore depends on formal and informal insurance arrangements, and in each country these effects might reinforce or offset each other.

A further reason for health to affect stockownership is that health status is correlated with individual resources, along the lines suggested by Smith (1999). Poor health is then associated

with low wealth and therefore with less investment in stocks. Rosen and Wu (2004) use the HRS and estimate the relation between health status, asset ownership and asset share invested in risky assets, and find that poor health tends to be negatively related to ownership and investment in risky assets. Rosen and Wu are also able to show that the negative association is not due to the omission of variables that simultaneously affect health and financial decisions, such as planning horizon, risk aversion and health insurance status.

While objective health data are not affected by different reporting styles across individuals and are therefore more reliable, subjective data describe individual perceptions.[8] In our context, self-reported health status might be even more relevant than objective health indicators. If people buffer health risks by investing less in stocks, it is the perception of such risks (not necessarily their actual presence) that determines financial decisions. Furthermore, using self-reported health status delivers results more easily comparable to other studies using the same variable, such as Rosen and Wu (2004).

Self-reported health status is ranked on a 1-5 scale (1=*Very Good*, 2=*Good*, 3=*Fair*, 4=*Poor*, 5=*Very Poor*). A high value of the index corresponds therefore to poorer health. Self-assessed health measures are well known to correlate strongly with objective indicators (Currie and Madrian, 1999), and may directly affect economic behavior. The distribution of self-reported health status indicates that 20.6 percent view their health as very good, 48.9 percent as good, 24.3 percent as fair, 5.3 percent as poor and the rest as very poor.[9]

The distribution of health status across countries shows some interesting differences. Table 1 reports sample averages, by country, of the main variables used in the estimation. In Spain and Italy people claim more often that they are in poor or very poor health (higher values denote worse health), while in Switzerland they report more often that they are in good health. Indeed,

[8] Empirically, health status is an intrinsically unobservable variable. Researchers generally seek to measure it using household surveys or medical-administrative records. Currie and Madrian (1999) suggest eight different categories of health indicators: (1) subjective health status; (2) health limitations to the ability to work or to carry normal activities; (3) functional limitations on normal activities; (4) chronic disease; (5) permanent disability; (6) health care utilization; (7) nutritional status, as measured by the body mass index, (8) expected mortality. SHARE has information on all these measures and provides a good means of checking whether these measures are mutually consistent and whether health outcomes can be foretold from subjective feelings about health status (Börsch-Supan, 2005).

[9] Individuals in SHARE are also asked if they suffer from chronic disease and disability. Chronic diseases affect over one third of the sample, and 13 percent report some form of disability (such as blindness, deafness or disabilities limiting mobility).

there could be differences in reporting styles across countries that result in different evaluations of similar physical problems. Jürges (2005a) attempts to disentangle real health differences from differences in reporting styles. To take into account differences in reporting style, in the empirical analysis we check the sensitivity of the results standardizing health status by country-specific means and using alternative health indicators.

4.3. Social interaction

In addition to the information that investors can collect from media and financial advisors, there are information spillovers from informed to uninformed consumers in the same social circle. Individuals often learn about investment opportunities from others, and how this occurs depends on the specific process of social learning and on how people interact. Previous literature shows that social interaction affects portfolio outcomes.

Duflo and Saez (2002) show that in the US the decision to participate in Tax Deferred Accounts is significantly affected by a similar decision of employees in the same department. Thus, the experience of peers about the performance of their investments is passed on to others. Hong, Kubik and Stein (2004) show that stock market participation is higher among more socially connected individuals. Furthermore, this effect is stronger among individuals living in communities with a higher participation rate to begin with, implying that social learning interacts positively with learning induced by market development.

A related line of research points out that trust is an important determinant of economic exchange, and financial transactions in particular. Guiso, Sapienza and Zingales (2004) find that in Italian provinces with relatively high social trust, the proportion of stockholders is higher, other things equal. People more active socially might have a stronger tendency to trust, and therefore the effect of sociability and trust are difficult to distinguish empirically.

As pointed out by Hong, Kubik and Stein (2004), word-of-mouth and observational learning are two channels through which social interaction might influence stock market participation. With respect to their analysis which focuses only on whether people interact with

neighbourhoods or take part in religious activities, we can condition on a much larger set of variables.

Our data also allow us to test if social activities amplify or dampen the effect of cognitive ability on the participation decision. In principle, the effect is ambiguous, making the empirical analysis more informative and interesting. On one hand, social learning and cognitive ability can be viewed as complements, in that the effect of cognitive ability is larger among socially connected individuals. On the other, lack of cognitive ability can be supplemented by social learning and therefore cognitive ability is more important among less socially active investors.

In order to construct our indicator of social activities we rely on a set of questions on various kinds of social activities that individuals have performed in the month prior to the interview. The possible activities that we consider as indicating some form of social interaction are (1) participating in a sport, social or other kind of club; (2) taking part in a political or community-related organization; (3) participation to religious organization.[10] We convert the first two activities in dummy variables and construct a household level indicator of social interaction as the sum of the two dummies. We enter religious participation as a separate variable to check if religion is associated with higher stock market participation, as in Hong, Kubik and Stein (2004). Table 1 indicates that religious activity ranges from approximately 12 percent in Sweden, Denmark and France to 65 percent in Greece.

Figure 8 reports the distribution of the indicator of social activities across countries. In Denmark, Germany, the Netherlands and Switzerland the index ranges from 0.72 to 0.8, meaning that households in these countries have engaged, on average, in approximately 0.75 social activities in the previous month. The level of social interaction in Austria, Italy and Greece is lower, averaging only 0.49, 0.48 and 0.34 activities per household respectively.

When looking at some of the different components of social interaction, Hank and Erlinghagen (2005) find that volunteering displays a strong North-South gradient, just as our constructed index of social activities. In addition, volunteering is positively correlated with participation in organizations and with the provision of informal help and care to other people. Interestingly, they also find that the latter two activities are also more prevalent in Northern than

[10] SHARE also has information on voluntary work, care for a sick adult, helping family and friends, attendance of an educational or training course. The coefficients of these indicators were not statistically different from zero and are therefore excluded from the final specification.

Southern countries, which is surprising since one might expect that providing help in the South, at least within families, would be more prevalent.

4.4. Investors' horizon and bequest motives

One reason why the portfolio of the elderly might differ from that of other investors is that the elderly face mortality risk, and have, of course, shorter horizons than the non-elderly. The time horizon for a couple as a unit is even shorter (Hurd, 2002). Standard finance theory with CRRA preferences, no background risk and frictionless markets, suggests that portfolio allocations are independent from investor's horizon. Departing from these assumptions, investor's horizon affects portfolio allocations. But the relation is far from simple depending, to say the least, on the choice of the utility function, the correlation of income and rate of return shocks, and the presence of transaction costs (Ameriks and Zeldes, 2004).

Even though the theoretical effect of changing the investor's horizon is ambiguous a priori, Ameriks and Zeldes (2004) present ample evidence that professionals and mutual fund companies suggest reducing stock exposure as the horizon declines. A typical advice is that the asset share invested in stocks should decline with age, for instance that the share should be 100 minus investor's age. Thus, even if there are no compelling theoretical reasons to reduce risk exposure with age, people might nevertheless do so following standard financial advice.

The time horizon interacts with the bequest motive. While both young and old persons might have a bequest motive, "… for a young person the event of a bequest is so remote as not alter behavior. For the elderly, however, a bequest motive could extend the time horizon, reducing or eliminating any effects of mortality risk" (Hurd, p. 433). For this reason, in our sample of elderly individuals, the empirical analysis we control for bequest motives and intention to leave a bequest. Our expectation is that intention to leave a bequest impacts portfolio allocations in the same direction as investors' horizons.

SHARE contains three questions on the expectation of leaving an inheritance, which are asked to all financial respondents in the household. The first question asked is whether there is a chance that the person interviewed expects to leave an inheritance greater than 50,000 euro. If the answer is affirmative then the next question asked is whether she expects to leave an inheritance

greater than 150,000 euro. If, on the other hand, the answer to the first question is negative, then she is asked whether there is a chance that she will leave any inheritance. We use the first answer to construct an indicator of the probability to leave an inheritance (details on the construction and the original questions can be found in Appendix A.4).

Table 1 reports the distribution of the expected probability of leaving an inheritance across countries, which ranges from 62% in Belgium to 42% in Spain. The expectation of leaving an inheritance is strongly positively correlated with current wealth, as shown by Jürges (2005b). He also finds that roughly one third of the households expect to bequeath at least half of their current wealth.

5. Econometric results

To model the participation decision, households compare the utility gain from owning stocks with the entry cost. We express the net utility gain as:

$$y_h^* = z_h^{'}\delta + \varepsilon_h \tag{2}$$

where h is the household index, and z_h the observable variables affecting the utility gain from owning stocks. Utility also depends on unobservable variables, which enter (2) through ε_h, a standard normally distributed random term. Household h owns stocks if $y_h^* \geq 0$, which implies that the probability of observing stockownership is $\Phi(z_h\delta)$. If the unobserved factors ε_h are normally distributed, we can use the probit model and estimate δ with standard maximum likelihood methods.[11]

[11] Assuming that ε_h is a type-1 extreme value distribution delivers the logit model and gives very similar results. The similarity of probit and logit results suggests that the normality of the latent index is a good approximation.

Given the different institutions and constraints facing investors in each country, we start out with a flexible specification in which we interact each variable with the country dummies. [12] This allows the intercept and the slope parameters of the index $z_h\delta$ to be different across countries. We then test the joint hypothesis that the slope coefficients are constant across countries and not reject it.

Our estimation exercise deals carefully also with item non-response. Non-response can bias the estimates and also lead to serious efficiency loss, which can be quite substantial due to the high number of variables involved in the regression.

Missing data are imputed through a multiple hot-decking procedure along the lines of Rubin (1987), generating *M* implicates from the original dataset. The *M* implicates are drawn with replications from the sample of non-missing observations. This allows to mimic the distribution of the missing values given the non-missing ones. We set *M* to the conventional level of five.[13] This means that we estimate separately our model on each of the five implicates and then combine the coefficients and the standard errors. The former are computed as the mean of the within imputation coefficients over the 5 imputations, the latter account for within and between imputation variability of the estimates. The Appendix A.1 and Christelis, Jappelli and Padula (2005) provide more details on the imputation procedure used and on how the results form estimating the model on each implicate are combined for testing purposes.

5.1 Baseline results

To single out the determinants of financial market participation, we study separately direct and total stockholding, which also includes stocks owned through managed investment accounts and mutual funds. The results turn out to be similar also focusing only on indirect participation, and for brevity these regressions are not reported.

[12] Our framework does not explicitly account for cross-country differences in tax regimes and other country-specific institutions. This is one reason why all our regressions employ a full set countries dummies and why we test for the stability of the coefficients across countries.

[13] This is also the number of implicates used in the US Survey of Consumer Finances. The efficiency of the estimates depends on the number of implicates and on the fraction of missing data. Rubin (1987) shows that efficiency increases with the number of implicates.

We assume that stock market participation depends on demographic variables, such as age, age squared, post-secondary degree, a dummy for couples, a dummy for not working, indicators of household resources (gross financial assets and real assets), self-reported health status, the indicator of social activities, and expectations to leave an inheritance. Furthermore, stock market participation is related to our cognitive function indicators. In our baseline specification, we separately investigate the effect of numeracy, fluency and recall on direct and total stockholding.

Our point of departure is a flexible specification with interaction of each of the explanatory variables with a full set of country dummies. This means that the effect of, say, numeracy, social activities or health status in the initial specification is not restricted to be the same in the 11 countries of sample. For each regression, we then test the hypothesis that the coefficients of all variables, except for education, financial wealth, and the country dummies, are the same across countries. The hypothesis is not rejected at standard confidence levels. We therefore present the estimates for the restricted specification; the results for the unrestricted models are available on request.

We choose to report the estimated average of the marginal effects evaluated at each observation and the associated standard errors of the main variables of interest. The average of the individual marginal effects measures the average impact on the population of a change in the variables. This measure is more accurate than the commonly used practice of evaluating the marginal effects at the mean of the regressors. Indeed, Train (2003) shows that the latter can lead to seriously biased results. Since the estimated marginal effects are averages of non-linear functions of the coefficients, we calculate standard errors using 200 bootstrap replications. The probit coefficients and standard errors of two baseline regressions for direct and total participation are fully reported in Table A1. For brevity, the coefficients of the other regressions are available on request.

The first three regressions of Table 2 refer to direct stockholding and introduce alternative indicators of cognitive abilities. Each of the effects is positive, precisely estimated and economically important. Column (1) shows that increasing numeracy by one unit (equivalent to one standard deviation of the variable) is associated with an increase in the probability of direct stockownership by 1.7 percentage points. Since the sample average of direct stockholding is 16

percent, an increase in numeracy of one unit is associated with an increase of stockholding of about 10 percent of its initial value.

Raising fluency in column (2) by one standard deviation (8 points) is associated with an increase in the probability of stockholding of 0.2×8=1.6 percentage points. Finally, raising the recall indicator by one standard deviation (2.1) is associated with an increase in stockholding of 1.7 points. Overall, the results support the hypothesis that higher cognitive abilities, through their association with lower risk aversion, lower information costs, or higher perceived Sharpe ratio, raise stock market participation.[14] Raising simultaneously the three variables by one standard deviation, raises stock market participation be about 6 percentage points.

Table 2 reports other several interesting results. The effects of health status on stockholding is negative, possibly because poor health is associated with higher health risk and risk expenditures, higher risk aversion or lower household resources, confirming the empirical findings of Rosen and Wu (2004) with US data. Socially active households are more likely to own stocks, though the effect is rather small (about 1 percentage point). Raising the chance of leaving an inheritance from zero to 1 is associated with an increase in the probability of stockholding of 2.9 percentage points.

Having a post-secondary degree increases the probability of owning stocks by 4.1 points, compared to non-graduates, consistent with the idea that individuals with higher education are more financially sophisticated and thus face lower costs of stockholding. Financial wealth is strongly associated with the probability of stockholding. The most natural interpretation is that fixed transaction costs prevent poor households from becoming stockholder. Evaluated at sample mean, the probit regression indicates that raising financial wealth by 1,000 Euro increase the probability of direct stockholding by 0.4 percentage points. It is worth stressing that in the probit regressions education and financial wealth are interacted with the country dummies, and that in Table 2 we report the average effect across countries.

In columns (3), (4) and (5) we repeat the estimation for total stockholding. The results are very similar, in terms of magnitude and significance of the effects, to direct stockholding. The

[14] Computing the change in the probability of owning stocks when each of the three indicators increases from the 25th to the 75th percentile of its distribution delivers similar results. The effect is 1.6 percentage points for numeracy, 1.7 points for fluency and 2.2 points for recall.

most notable difference is that the effect of social activity is positive (0.8 percent), but it is not statistically different from zero. On the other hand, the effects of post-secondary education and financial wealth are larger than in the regressions for direct stockholding.

Since the three indicators of cognitive abilities are correlated and individuals scoring high in numeracy tend also to score high in fluency and recall, one wanders if the three variables have independent explanatory power on stockholding. In Table 3 we enter simultaneously all three variables in the same regression. The results for direct and total stockholding in columns (1) and (3) suggest that each of the three variables has an independent effect on stockholding. The magnitude of the effects is only slightly reduced. Raising numeracy, fluency and recall by one standard deviation increases stockholding by 1.3, 0.8 and 0.6 percentage points respectively.

The association of stockholding with the other variables (health status, propensity to leave an inheritance, social activities, education, financial wealth) is unaffected, for both direct and total stockholding. In particular, the effect of education is 3.7 percentage points for direct stockholding and 4.4 points for total stockholding. The strong effect of education warrants the inclusion of the post-secondary degree dummy in the baseline specification. Since cognitive skills are partly acquired through education, it is also of interest to omit education from the regression. The estimated effects in columns (2) and (4) of Table 3 represent the "gross effects" of cognitive variables on participation. The effect of numeracy increases from 1.3 to 1.6 percentage points with respect to the specification that includes education, while the effects of fluency and recall are unchanged, in both the direct and total participation equations.

5.2. Sample splits

Couples and singles typically have different planning horizon, resources and constraints, and therefore we want to see if the results change by focusing on couples and singles in isolation. Table 4 reports the estimates for direct and total participation splitting the sample by marital status. The results are similar in the two sub-samples, but the estimates are less precise. The effect of social activities for couples is positive (0.7 percent) but not statistically different from zero, while in the sample of singles the effect is larger (1.2 percent) and more precisely estimated.

The converse is true for the recall variable, which is statistically different from zero only in the sample of couples.

Hong, Kubik and Stein (2004) have emphasized the role of social activities as one of the channels through which people learn about financial matters, and therefore as one vehicle enhancing stock market participation. They show that social investors - investors who are more active socially - are more likely to participate and that a social multiplier operates in such a way that the effect of the determinants of stockholding is magnified among more socially active individuals. We already documented the effect of sociability on participation.

To establish if there is a social multiplier we split the sample between social (60.7 percent of the sample) and non-social investors (39.3 percent) and estimate the model within each of the two sub-samples. The social multiplier theory suggests that the effect of cognitive ability is higher in the sample of more socially active investors. The results are reported in Table 5. Comparing columns (1) and (2), we find that the effect of numeracy and recall on direct stockholding is substantially larger among socially active households. The results for total participation are similar. This suggests that social interactions magnify the effect of mathematical skills and memory on stock market participation.

Social interactions also amplify the effect of the chance of leaving an inheritance and of education on direct and total participation, which is again consistent with the existence of a social multiplier. Among the more socially connected, the effect of post-secondary education is 4.3 percentage points, against 2.8 points in the sample of individuals who don't engage in social activities. The pattern of results is similar for total participation, though the effects are larger.

6. Conclusions

The Survey of Health, Ageing, and Retirement in Europe shows that there is substantial heterogeneity in the rate of financial markets participation, both within and across countries. This is not a new feature of the microeconomic data, as recent evidence for a sample of EU countries and the US shows that heterogeneity in stockownership is a widespread phenomenon in microeconomic data, with large international differences. But SHARE data are collected on a

comparable basis for 11 European countries and Switzerland, and are an extremely rich source to account for investors' heterogeneity.

In particular, SHARE allows us to investigate the relation between cognitive abilities, as measured in the psychological and epidemiological literature, and the decision to invest in stocks, either directly or through mutual funds and other investment accounts. Cognitive abilities might reduce the perceived cost of investing in the stock market, be correlated with risk tolerance and the ability to process financial data, raising stock market participation.

We focus on three domains of cognitive abilities: numeracy, verbal fluency and memory, and find that they all affect stockownership. Since our regressions control also for education, our results imply that cognitive abilities have an independent effect on the decision to hold stocks. The survey contains many indicators of the life of the elderly in Europe, ranging from physical health, socio-economic status, intensity of social interaction, and intention to leave bequests. This gives the opportunity to quantify the contribution of many different factors in explaining heterogeneity in stockownership in Europe. Other things equal, we find that cognitive impairments reduce the propensity to hold stocks. The effects are statistically significant and economically important: increasing simultaneously each of the three variables by one standard deviation (approximately from the 25^{th} to the 75^{th} percentile of each distribution) is associated with an increase in direct and total participation of around 6 percentage points.

We also report other interesting results. Health status is associated with lower stockownership, while social activities are positively correlated with the decision to own stocks. Those who intend to leave an inheritance are more likely to participate in the stock market. Finally, the effect of cognitive abilities on participation is larger among the more socially connected individuals, suggesting that social learning and cognitive skills are complementary in enhancing stock market participation.

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Appendix

A.1 Data construction

We first give a brief description of the financial assets data construction, while full details are given in Christelis, Jappelli and Padula (2005). The questions asked on financial assets are as follows: first the respondent is asked whether she owns the asset and then if yes, in what amount. If the respondent refuses to answer the amount question or claims she does not know, then she is introduced into an unfolding brackets sequence which uses three threshold values which differ by country and asset item. The respondent is randomly assigned to one of the three thresholds and she is asked if she owns more or less than that threshold. Depending on her answer, she is then asked about the next higher or lower threshold and so on. Going from the raw data to the aggregated measure of gross financial assets requires the following procedures to be performed:

1. Data cleaning, which involves putting implausibly high or low values to missing and imputing them [see point iii) below] and converting responses in local currency to responses in euro when appropriate.
2. Conversion of all answers into values adjusted for differences in the purchasing power of money across countries using purchasing power parity data from the OECD.
3. Imputing missing values, which is done first for questions on ownership and then for questions on amounts. The imputation method is the hotdeck using the approximate Bayesian bootstrap as described in Rubin and Schenker (1986) and implemented in Stata with the package hotdeck by Mander and Clayton. The hotdeck is typically conditioned on country, bracket (when this information is available) and age group. Multiple imputation methods are adopted and thus the hotdeck procedure is run five different times to generate five different datasets.

We adopt two definitions of stockownership: stocks held directly, or stocks held directly plus stocks held through mutual funds and investment accounts. To measure indirect stockownership we need information on what percentage of mutual funds and individual retirement are invested in stocks. The SHARE questionnaire does not provide information on the exact allocations. There are however questions for both mutual funds and individual retirement accounts which give information on whether the amount invested is mostly in stocks, roughly equally in stocks and bonds, or mostly in bonds. We impute to these three possible answers 75, 50 and 25 percent invested in stocks.

Having imputed the value of real and financial assets, we then proceed sequentially for each variable. We impute, for each country, the missing values for the cognitive variables, education, self-reported health status, social activities, religious participation and probability of leaving an inheritance by sequential regressions using as regressors age and the variables already imputed.

Since the statistical analysis is performed at the household level we choose to combine the information of the two partners in the couple as follows: for the cognitive variables, education, probability of leaving an inheritance, and social activities we take the maximum of the two partners, while for age and health status we take the average.

A.2. Cognitive abilities

A.2.1. Numeracy

The (abridged) questions on numeracy are as follows. Possible answers are shown in a card while the interviewer is instructed not to read them out to the respondent:

1. *If the chance of getting a disease is 10 per cent, how many people out of one thousand would be expected to get the disease?* The possible answers are 100, 10, 90, 900 and another answer.
2. *In a sale, a shop is selling all items at half price. Before the sale a sofa costs 300 euro. How much will it cost in the sale?* The possible answers are 150, 600 and another answer.
3. *A second hand car dealer is selling a car for 6,000 euro. This is two-thirds of what it costs new. How much did the car cost new?* The possible answers are 9,000, 4,000, 8,000, 12,000, 18,000 and another answer.
4. *Let's say you have 2,000 euro in a saving account. The account earns ten per cent interest each year. How much would you have in the account at the end two years?* The possible answers are 2,420, 2,020, 2,040, 2,100, 2,200, 2,400 and another answer.

If a person answers (1) correctly she is then asked (3) and if she answers correctly again she is asked (4). Answering (1) correctly results in a score of 3, answering (3) correctly but not (4) results in a score of 4 while answering (4) correctly results in a score of 5. On the other hand if she answers (1) incorrectly she is directed to (2). If she answers (2) correctly she gets a score of 2 while if she answers (2) incorrectly she gets a score of 1.

A.2.2. Fluency

The indicator of fluency is based on the following question: "I would like you to name as many different animals as you can think of. You have one minute to do this." The indicator is then the number of valid animals named by the respondent. Any member of the animal kingdom, real or mythical is considered a valid answer. Repetitions and proper nouns are instead invalid.

A.2.3. Recall

To measure memory, the interviewer reads a list of ten items and after a while the respondent is asked which one he or she remembers. The list includes the following items: Butter, Arm, Letter, Queen, Ticket, Grass, Corner, Stone, Book, Stick. The recall item is the number of items recalled by the respondent.

A.3 Social activities

The SHARE questions on which we base our indicator of social activity is as follows: *Have you done any of these activities in the last month?* Possible answers are: (1) voluntary or charity

work; (2) care for a sick or disabled adult; (3) help for family, friends or neighbors; (4) attendance of an educational or training course; (5) participation in a sport, social or other kind of club; (6) taking part in a religious organization (church, synagogue, mosque etc.); (7) taking part in a political or community-related organization; (8) None of these. The indicator of social activities is the sum of (5) and (7) at the household level.

A.4 Probability of leaving an inheritance

The questions that refer to the probability of leaving an inheritance are as follows (the interviewer is instructed to make sure that the respondent includes property and other valuables):

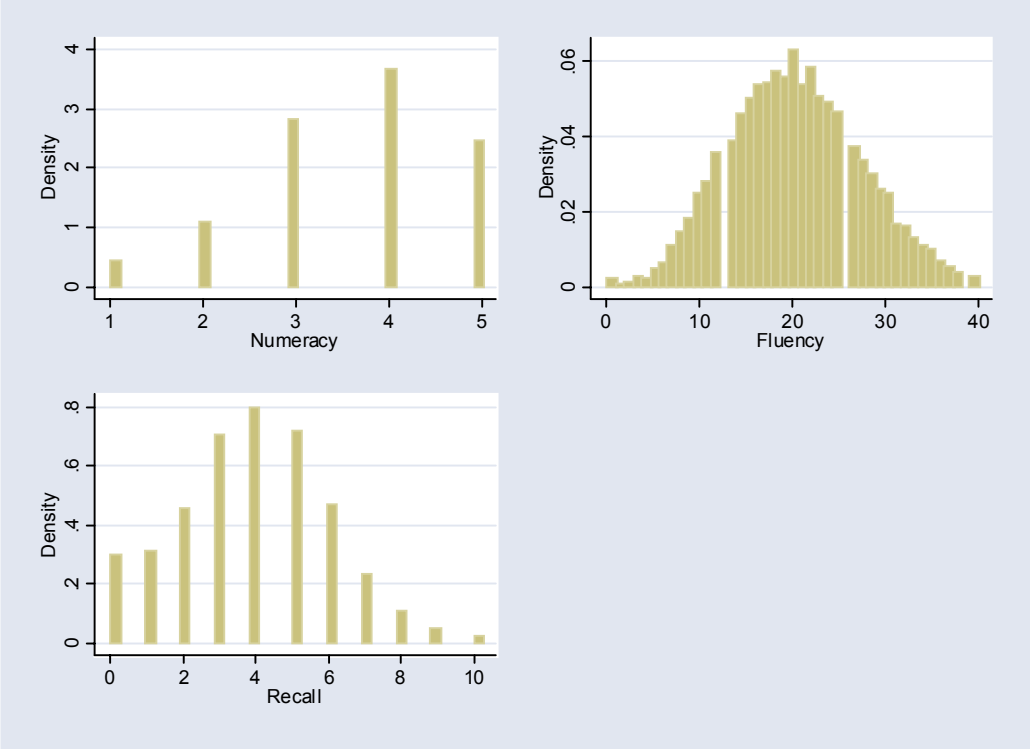
1. *Including property and other valuables, what are the chances that you or your husband/wife/partner will leave an inheritance totaling 50,000 euro or more?* The possible answers range from 0 to 100.
2. *Including property and other valuables, what are the chances that you or your husband/wife/partner will leave any inheritance?* The possible answers range from 0 to 100.
3. *Including property and other valuables, what are the chances that you or your husband/wife/partner will leave an inheritance totaling 150,000 euro or more?* The possible answers range from 0 to 100.

If the respondent gives a zero answer to (1) she is then asked (2), while only if she gives a positive value as an answer to (1) is she asked (3). Our measure of inheritance is the maximum of the chances of leaving an inheritance greater than 50,000 euro across the two partners in a household headed by a couple or the value reported by the household head in a household not headed by a couple.

A.5 Working status

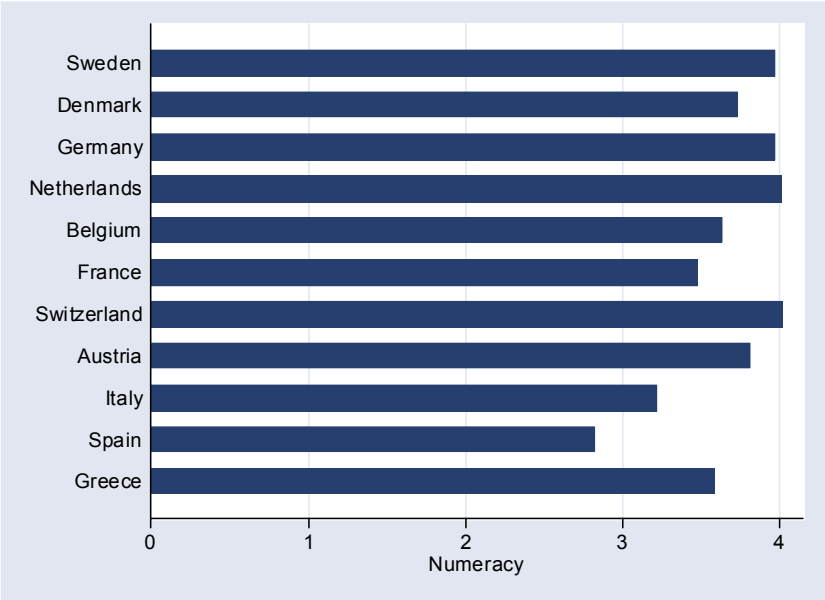
The question refers to employment status: (1) self-employed, (2) dependent worker, (3) retired, (4) unemployed, (5) out of the labor force. The dummy for “Not working” takes the value of one in the last three cases.

Figure 1. Sample distributions of the indicators of cognitive abilities



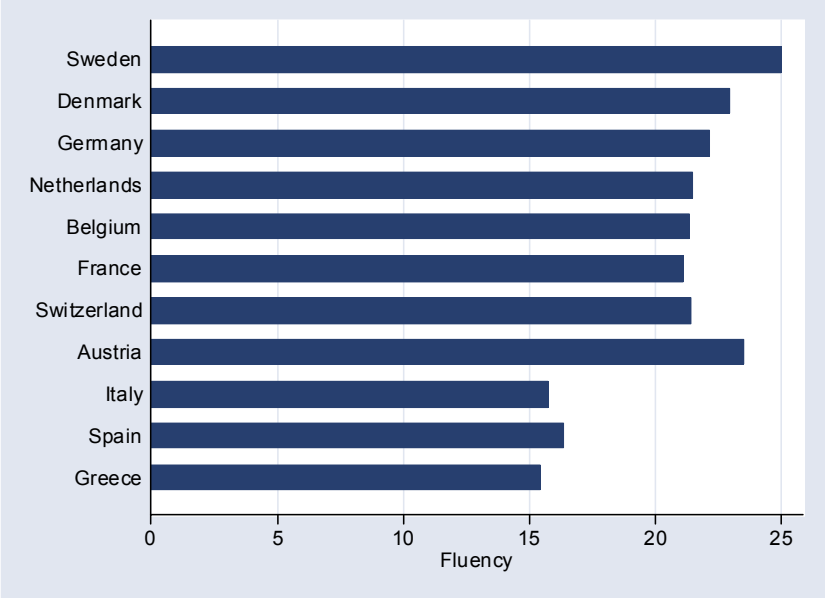
Note. Numeracy is constructed on the basis of the number of correct answers to four basic mathematical tests. Fluency is measured as the number of animals that the interviewee can name in one minute. Recall is measured as the number of items that the interviewee can recall in a list of 10.

Figure 2
International comparison of cognitive abilities: Numeracy



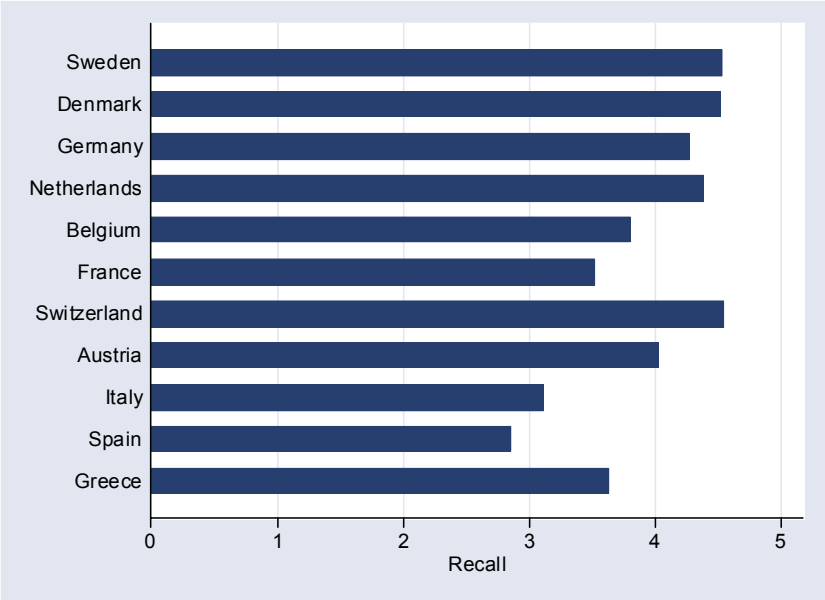
Note. The figure plots the country-wide mean of the numeracy indicator.

Figure 3
International comparison of cognitive abilities: Fluency



Note. The figure plots the country-wide mean of the fluency indicator.

Figure 4
International comparison of cognitive ability: Recall

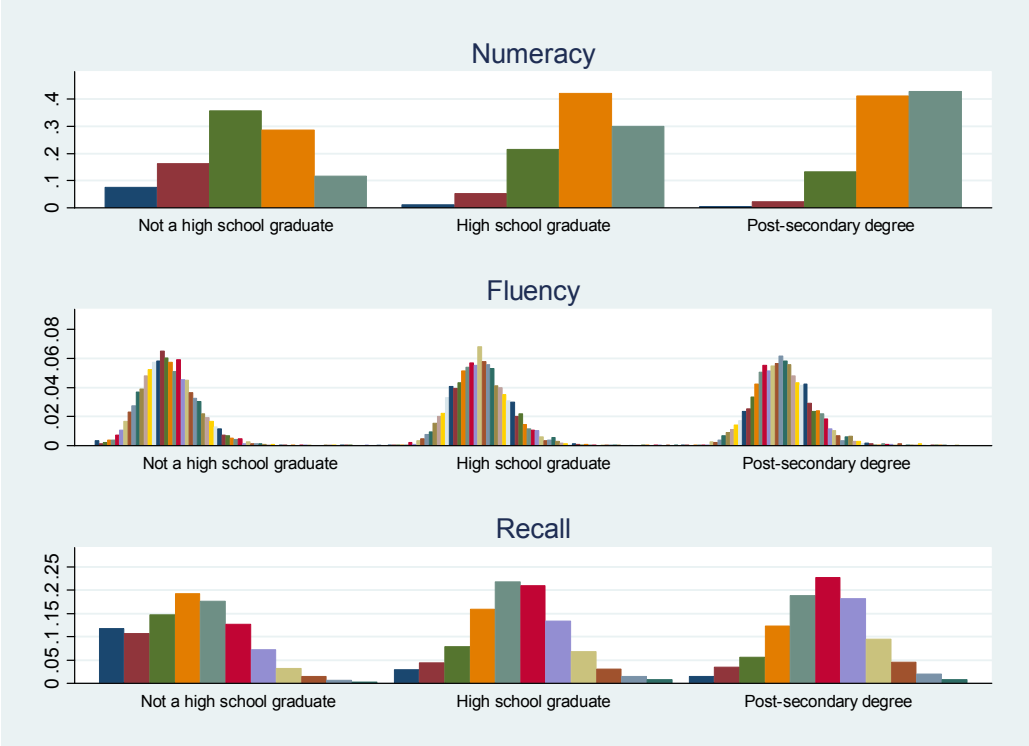


Note. The figure plots the country-wide mean of the recall indicator.

Figure 5
Distribution of numeracy, fluency and recall by age-groups

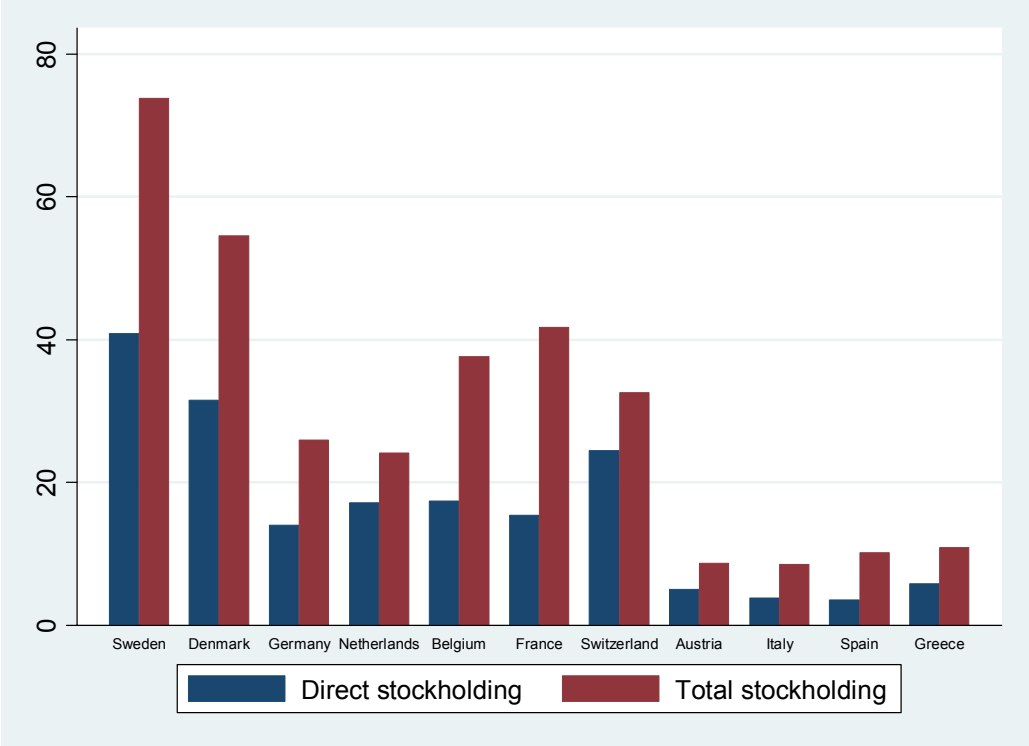
Note. The figure plots the distribution the numeracy, fluency and recall indicators as function of age.

Figure 6
Distribution of numeracy, fluency and recall by education



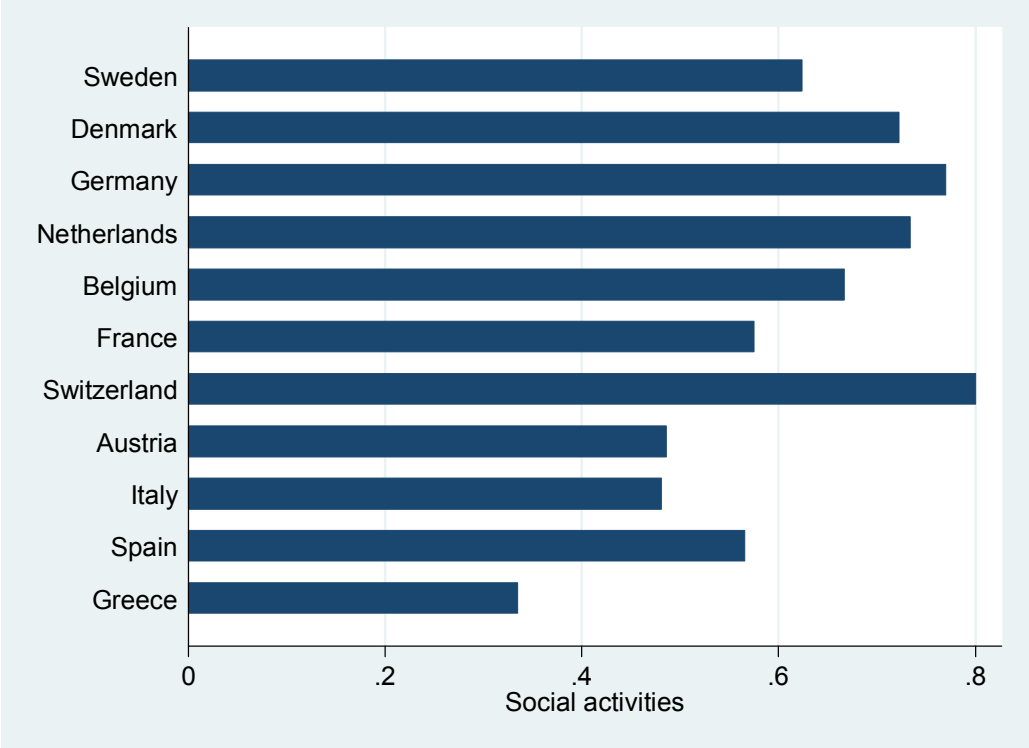
Note. The figure plots the distribution the numeracy, fluency and recall indicators as function of education.

Figure 7
International comparison of direct and total stockholding



Note. The figure plots the country-average of direct and total stockownership. The direct stockholding dummy equals one for households who own stocks. Total stockholding also accounts for stocks owned through managed investment accounts and mutual funds.

Figure 8
International comparison of social activities



Note. The social activities indicator is constructed as the number of social activities in which the household has engaged in the last month.

Table 1
Demographic and economic characteristics

	Sweden	Denmark	Netherlands	Germany	Belgium	France
Direct stockholding (%)	40.8	31.7	13.9	17.1	17.4	15.1
Total stockholding (%)	73.8	54.8	25.7	24.1	37.7	41.3
Age	64.2	63.3	63.4	62.7	63.6	63.7
Couple (%)	68.1	55.0	69.9	71.8	64.8	58.1
Post secondary education (%)	22.0	31.7	25.7	20.1	23.7	18.8
Not-working (%)	46.7	49.0	58.2	58.3	65.4	61.7
Self-reported health	2.2	2.2	2.4	2.2	2.2	2.3
Numeracy	3.7	3.5	3.7	3.7	3.4	3.2
Fluency	23.0	21.5	20.4	19.8	19.7	19.6
Recall	3.9	4.1	3.7	3.8	3.3	3.1
Social activities	0.62	0.72	0.77	0.73	0.67	0.58
Religious participation (%)	12.5	10.5	19.9	18.2	11.6	12.0
Probability of leaving an inheritance (%)	56.9	60.5	50.0	45.2	62.0	52.7
Gross financial assets (‘000s euro)	27.6	20.4	19.4	19.6	21.0	11.8
Real assets (‘000s euro)	75.1	69.7	78.1	102.7	156.0	147.9
Number of households	2,140	1,180	2,003	1,959	2,464	2,114

	Switzerland	Austria	Italy	Spain	Greece	Total
Direct stockholding (%)	24.6	4.9	3.8	3.6	5.7	16.0
Total stockholding (%)	32.7	8.6	8.5	10.7	10.6	30.6
Age	63.5	64.1	63.8	65.1	63.0	63.7
Couple (%)	60.2	50.9	72.0	69.3	56.3	64.2
Post secondary education (%)	25.3	19.9	5.8	7.8	14.6	19.1
Not-working (%)	50.1	70.3	73.2	68.6	65.5	61.3
Self-reported health	1.9	2.3	2.5	2.6	2.2	2.3
Numeracy	3.8	3.7	2.9	2.5	3.4	3.4
Fluency	20.3	21.9	14.4	15.1	14.8	19.1
Recall	4.0	3.6	2.6	2.4	3.3	3.4
Social activities	0.80	0.49	0.48	0.57	0.34	0.61
Religious participation (%)	22.2	48.3	20.7	38.3	64.5	24.1
Probability of leaving an inheritance (%)	56.3	46.2	56.8	42.1	56.9	53.2
Gross financial assets (‘000s euro)	37.9	6.3	3.1	2.3	2.5	11.5
Real assets (‘000s euro)	97.9	86.2	150.6	147.6	106.1	114.1
Number of households	716	1,462	1,780	1,756	1,715	19,289

Note: Age, self-reported health, numeracy, fluency, recall and social activities are expressed in means, gross financial and real assets in medians. Direct and total stockholding, being in a couple, social activities, gross financial and real assets refer to households while the remaining variables refer to individuals.

Table 2. The effect of cognitive abilities on stockholding: separate effect of numeracy, fluency and recall

	Direct participation			Total participation		
	(1)	(2)	(3)	(4)	(5)	(6)
Numeracy	0,017 (0,003) **			0,017 (0,004) **		
Fluency		0,002 (0,000) **			0,002 (0,000) **	
Recall			0,008 (0,001) **			0,008 (0,002) **
Self-reported health	-0,010 (0,003) **	-0,010 (0,003) **	-0,010 (0,003) **	-0,008 (0,003) *	-0,008 (0,003) *	-0,008 (0,003) **
Social activities	0,009 (0,004) *	0,009 (0,004) *	0,009 (0,004) *	0,008 (0,005)	0,008 (0,005)	0,008 (0,005)
Leaving an inheritance	0,029 (0,008) **	0,030 (0,007) **	0,030 (0,007) **	0,040 (0,008) **	0,041 (0,008) **	0,041 (0,008) **
Post-secondary Education	0,041 (0,006) **	0,043 (0,006) **	0,043 (0,006) **	0,049 (0,007) **	0,050 (0,006) **	0,052 (0,006) **
Financial Assets (in 1,000 euro)	0,004 (0,000) **	0,004 (0,000) **	0,004 (0,000) **	0,011 (0,000) **	0,011 (0,000) **	0,011 (0,000) **
R^2	0,29	0,29	0,29	0,52	0,52	0,52
Observations	19.286	19.286	19.286	19.286	19.286	19.286

Note. Mean of marginal effects evaluated at each observation. Each regression includes also real assets, a dummy for couples, age, age squared, a dummy for working status, a dummy for religious participation, a full set of country dummies, and interaction of country dummies with financial wealth and education. Standard errors are reported in parenthesis, calculated using 200 bootstrap replications. The results are a combination of those of five separate regressions (one for each implicate dataset), using the multiple imputation methodology of Rubin (1987). A single star means significance at the 5% confidence level while two stars at the 1% level. The R^2 measure is computed as in Estrella (1998).

Table 3. The effect of cognitive abilities on stockholding

	Direct participation		Total participation	
	With education	**No education**	**With education**	**No education**
	(1)	(2)	(3)	(4)
Numeracy	0,013	0,016	0,013	0,016
	(0,003) **	(0,003) **	(0,004) **	(0,004) **
Fluency	0,001	0,001	0,002	0,002
	(0,000) *	(0,000) **	(0,000) **	(0,000) **
Recall	0,006	0,006	0,005	0,006
	(0,001) **	(0,001) **	(0,002) **	(0,002) **
Self-reported health	-0,009	-0,010	-0,006	-0,007
	(0,003) *	(0,003) **	(0,003) *	(0,003) *
Social activities	0,008	0,010	0,007	0,009
	(0,004) *	(0,004) *	(0,005)	(0,006)
Leaving an inheritance	0,028	0,030	0,038	0,040
	(0,008) **	(0,008) **	(0,008) **	(0,008) **
Post-secondary education	0,037		0,044	
	(0,006) **		(0,007) **	
Financial assets (in 1,000 euro)	0,004	0,004	0,010	0,010
	(0,000) **	(0,000) **	(0,000) **	(0,000) **
R^2	0,29	0,29	0,52	0,52
Observations	19.286	19.286	19.286	19.286

Note. Mean of marginal effects evaluated at each observation. Each regression includes also real assets, a dummy for couples, age, age squared, a dummy for working status, a dummy for religious participation, a full set of country dummies, and interaction of country dummies with financial wealth and education. Standard errors are reported in parenthesis, calculated using 200 bootstrap replications. The results are a combination of those of five separate regressions (one for each implicate dataset), using the multiple imputation methodology of Rubin (1987). A single star means significance at the 5% confidence level while two stars at the 1% level. The R^2 measure is computed as in Estrella (1998). The coefficients and standard errors of the regressions in columns (1) and (3) are reported in Table A1.

Table 4. The effect of cognitive abilities on stockholding for couples and singles

	Direct participation		Total participation	
	Couples	**Singles**	**Couples**	**Singles**
	(1)	(2)	(3)	(4)
Numeracy	0,014	0,012	0,016	0,010
	(0,005) **	(0,003) **	(0,005) **	(0,004) *
Fluency	0,001	0,001	0,001	0,002
	(0,001)	(0,001) *	(0,001) *	(0,001) **
Recall	0,008	0,001	0,006	0,003
	(0,002) **	(0,002)	(0,002) *	(0,003)
Self-reported health	-0,013	-0,003	-0,007	-0,004
	(0,005) *	(0,004)	(0,005)	(0,004)
Social activities	0,007	0,012	0,003	0,017
	(0,006)	(0,006) *	(0,007)	(0,008) *
Leaving an inheritance	0,034	0,020	0,053	0,019
	(0,011) **	(0,009) *	(0,010) **	(0,011)
Post-secondary education	0,046	0,018	0,050	0,034
	(0,007) **	(0,008) *	(0,008) **	(0,011) **
Financial assets (in 1,000 euro)	0,004	0,004	0,010	0,012
	(0,000) **	(0,000) **	(0,000) **	(0,000) **
R^2	0,31	0,21	0,54	0,43
Observations	12.377	6.909	12.377	6.909

Note. Mean of marginal effects evaluated at each observation. Each regression includes also real assets, a dummy for couples, age, age squared, a dummy for working status, a dummy for religious participation, a full set of country dummies, and interaction of country dummies with financial wealth and education. Standard errors are reported in parenthesis, calculated using 200 bootstrap replications. The results are a combination of those of five separate regressions (one for each implicate dataset), using the multiple imputation methodology of Rubin (1987). A single star means significance at the 5% confidence level while two stars at the 1% level. The R^2 measure is computed as in Estrella (1998).

Table 5 . The effect of cognitive abilities on stockholding, by participation in social activities

	Direct participation		Total participation	
	No social activities	**Social activities**	**No social activities**	**Social activities**
	(1)	(2)	(3)	(4)
Numeracy	0,010	0,016	0,011	0,016
	(0,004) *	(0,004) **	(0,005)	(0,005) **
Fluency	0,001	0,001	0,002	0,001
	(0,001) *	(0,001)	(0,001) **	(0,001)
Recall	0,003	0,008	0,004	0,006
	(0,002)	(0,002) **	(0,002)	(0,003) *
Self-reported health	-0,009	-0,009	-0,001	-0,009
	(0,005)	(0,005)	(0,005)	(0,005)
Leaving an inheritance	0,024	0,030	0,028	0,047
	(0,010) *	(0,011) **	(0,015)	(0,014) **
Post-secondary education	0,028	0,043	0,037	0,050
	(0,009) **	(0,008) **	(0,011) **	(0,009) **
Financial assets (in 1,000 euro)	0,004	0,004	0,010	0,010
	(0,000) **	(0,000) **	(0,000) **	(0,000) **
R^2	0,25	0,30	0,49	0,53
Observations	8.750	10.536	8.750	10.536

Note. Mean of marginal effects evaluated at each observation. Each regression includes also real assets, a dummy for couples, age, age squared, a dummy for working status, a dummy for religious participation, a full set of country dummies, and interaction of country dummies with financial wealth and education. Standard errors are reported in parenthesis, calculated using 200 bootstrap replications. The results are a combination of those of five separate regressions (one for each implicate dataset), using the multiple imputation methodology of Rubin (1987). A single star means significance at the 5% confidence level while two stars at the 1% level. The R^2 measure is computed as in Estrella (1998).

Table A1 . Probit regressions for direct and total participation

Variable	Direct participation		Total participation	
	Coefficient	Standard error	Coefficient	Standard error
Age	0,014	(0,019)	0,025	0,018
Age squared	0,000	(0,000)	0,000	0,000
Numeracy	0,080	(0,020) **	0,069	0,019 **
Fluency	0,006	(0,003) *	0,009	0,002 **
Recall	0,036	(0,009) **	0,028	0,009 **
Self-reported health	-0,053	(0,021) *	-0,031	0,018
Leaving an inheritance	0,172	(0,045) **	0,204	0,044 **
Social activities	0,053	(0,026) *	0,040	0,030
Couple	-0,039	(0,038)	-0,070	0,033 *
Real assets (in 1,000 euro)	0,062	(0,009) **	0,046	0,008 **
Not working	0,002	(0,043)	-0,084	0,045
Religious participation	-0,075	(0,039)	-0,056	0,044
Post secondary education				
Total effect – Sweden	0,062	(0,072)	0,014	0,099
Incremental effect - Denmark	-0,078	(0,111)	0,097	0,137
Incremental effect - Germany	0,319	(0,106) **	0,185	0,127
Incremental effect - Netherlands	0,122	(0,119)	0,320	0,127 *
Incremental effect - Belgium	0,117	(0,104)	0,394	0,125 **
Incremental effect - France	0,305	(0,110) **	-0,029	0,129
Incremental effect - Switzerland	0,112	(0,154)	0,188	0,152
Incremental effect - Austria	0,447	(0,170) *	0,483	0,166 **
Incremental effect - Spain	0,125	(0,231)	0,429	0,172 *
Incremental effect - Italy	0,534	(0,176) **	0,363	0,156 *
Incremental effect - Greece	0,260	(0,146)	0,104	0,138
Financial assets (in 1,000 euro)				
Total effect – Sweden	0,369	(0,027) **	0,593	0,030 **
Incremental effect - Denmark	-0,075	(0,037) *	-0,101	0,041 *
Incremental effect - Germany	0,060	(0,066)	-0,125	0,052 *
Incremental effect - Netherlands	-0,018	(0,043)	-0,226	0,041 **
Incremental effect - Belgium	0,032	(0,041)	-0,129	0,051 *
Incremental effect - France	-0,051	(0,041)	-0,052	0,046
Incremental effect - Switzerland	0,060	(0,076)	-0,141	0,072
Incremental effect - Austria	-0,019	(0,058)	-0,203	0,050 **
Incremental effect - Italy	0,057	(0,073)	0,012	0,088

Incremental effect - Spain	-0,087	(0,039) *	-0,208	0,044 **
Incremental effect - Greece	0,027	(0,049)	-0,284	0,042 **
Country dummies				
Denmark	0,165	(0,154)	-0,256	0,140
Germany	-1,361	(0,304) **	-1,373	0,206 **
Netherlands	-0,778	(0,179) **	-1,103	0,148 **
Belgium	-1,074	(0,173) **	-1,024	0,175 **
France	-0,608	(0,175) **	-0,698	0,148 **
Switzerland	-1,047	(0,391) *	-1,334	0,351 **
Austria	-1,423	(0,250) **	-1,742	0,198 **
Italy	-1,491	(0,296) **	-2,231	0,348 **
Spain	-0,955	(0,169) **	-1,036	0,142 **
Greece	-1,062	(0,209) **	-0,779	0,142 **
Constant (Sweden)	-3,180	(0,642) **	-2,473	0,621 **
R^2	0,29		0,52	
Observations	19.286		19.286	

Note. The regressions are used to evaluate the effects reported in columns (1) and (3) of Table 3. The results are a combination of those of five separate regressions (one for each implicate dataset), using the multiple imputation methodology of Rubin (1987). A single star means significance at the 5% confidence level while two stars at the 1% level. The R^2 measure is computed as in Estrella (1998).