Financial Literacy, Human Capital and Stock Market Participation in Europe: An Empirical Exercise under Endogenous Framework

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Abstract

Households' stock market participation has significant effects on savings and on an economy's financial development and performance. Yet participation into capital markets is limited and quite heterogonous both among and within several countries. This phenomenon represents an empirical puzzle whose understanding is rather incomplete. In this work we exploit a combination of datasets for 9 European countries and use different econometric specifications that allow to control for endogeneity of financial literacy and human capital, to assess the role of several variables in affecting the probability to participate in the stock market in year 2010. Besides socio-demographic variables, we find that financial literacy has a positive and significant effect on stock market participation, together with the level of human capital. Country level differences are explained by such institutional factors as the effectiveness of the education system, captured by the student-teacher ratio, and by the attractiveness of the stock markets, proxied by the pattern of sharpe-ratios.

Keywords: Stock Market Participation, Financial Literacy, European Countries, Endogenous framework.

JEL Codes: C26, G11, I25

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1. Introduction

This paper adds to a growing literature on the determinants of stock market participation. Individuals across the globe have become increasingly active in financial markets with the advent of new technology and financial products. Also, the shift from defined-benefit to defined- contribution pension plans and the development of pension funds, by shifting the decision making responsibility from the government and employers to private individuals, have contributed to raise stock market participation. Although increased, participation rates are still relatively low in many countries and show a substantial variability across globe (Campbell 2006, Guiso et al. 2008). Several authors have pointed out that in the long run there can be considerable welfare loss in non-participation of individuals, in the form of reduction of returns to household saving and lesser asset accumulation (see, for example, Cocco et al. 2003). From the perspective of the financial system, a higher participation rate could favour a greater breadth and depth of capital markets, which is an important determinant of the equity premium and of the stock market volatility (Vissing-Jorgensen, 2002; and Brav et al. 2002).

In this background, several studies have focused on the determinants of stock market participation[1]. One of the variables that has been extensively studied in the recent past is the effect of financial literacy[2]. For example, Guiso and Jappelli (2005) using the 1995 and 1998 Bank of Italy Surveys of Household Income and Wealth (SHIW) finds that lack of financial awareness among Italian households, a prerequisite to participation in financial market, is primary reason for the limited participation.

Another set of studies explicitly tries to measure traits and skills of individuals and explores the implications on their financial behaviour, including participation to stock market. However, measuring traits that reflect a subject's skill at processing information are hard to come by and, if available, generally face a host of endogeneity issues. Within this

[1] Some explanations that have been offered for limited participation in financial markets are short sale constraints, income risk, inertia and departures from expected utility maximization (Haliassos and Bertaut, 1995). Constantinides et al. (2002) have argued that young people cannot borrow and thus do not have wealth to invest in stocks. More recent studies have incorporated other reasons, such as trust and culture (Guiso et al. 2008) and the influence of neighbours and peers (Hong et al. 2004; Brown et al. 2008).

[2] In the recent years there has been burgeoning research on the measurement of financial literacy and its effects on household behaviour especially on retirement planning (Banks et al., 2010; Lusardi and Mitchell, 2011; Van Rooij et al. 2012 among others) on savings and portfolio decisions (Jappelli and Padula, 2013; Lusardi et al., 2013). For a review see Jappelli (2010) and Banks (2010).

framework, financial literacy is measured either through the creation of financial sophistication index (Kimball and Shumway 2006; Yoong, 2011; Christelis et al. 2010; VanRooj et al 2011) or proxing through index of IQ (Grinblatt et al 2011; Kezdi and Willis 2003). As pointed out by Martin (2007), the endogeneity bias is a concern, in that, for example, unobservable preferences systematically lead individuals to purposively learn about stocks to participate in the market. Hence, in most studies on this subject endogeneity of financial literacy as an explanatory variable is controlled for.

Kimball and Shumway (2006) create an index of financial literacy and using 2005 survey of consumer attitudes administered by University of Michigan, United States find that higher investors' sophistication is associated with higher participation in stocks and with higher percentage of wealth invested in stocks. The result holds true even after controlling for potential endogeneity in dependent variables. Yoong (2011), using American Life panel (ALP), suggests that the measure of financial illiteracy negatively affects stock market participation and the result is robust to the use of different risk metrics, background controls and even endogeneity.

Christelis et al. (2010) study the link between cognitive abilities and stock holding using SHARE data for European countries and find that the propensity to invest in stocks both directly and indirectly through mutual funds and retirement accounts is strongly associated with mathematical ability, verbal fluency and recall skills. They conclude that the association between cognitive abilities and stockholding is driven by information constraints, rather than by features of preferences or psychological traits. VanRooij et al. (2011) provide evidence of the fact that higher financial sophistication is associated with higher wealth and higher probability to invest in stocks. By employing the different measures of financial knowledge[3] available in Dutch DNB household survey, they confirm that that lack of understanding of economics and finance is a significant deterrent to stock ownership[4].

Quite different from the earlier measures of financial literacy, Grinblatt et al (2011) using the data on Finnish tax administration and an IQ index based on Finnish Armed Forces (FAF) Intelligence Assessment argue that high-IQ investors are more likely to hold mutual funds and larger numbers of stocks, experience lower risk, and earn higher sharpe-ratios. The

[3] The different measures are ability to do simple calculation, compound interest rate inflation, money illusion and more advanced questions on the stock and bond characteristics and on equity premia.
[4] Similar results are obtained for U.S. by Yoong (2011) and Lusardi and Mitchell (2011).

endogeneity relating to the unobservable controls is solved using IQ of sibling and own controls and the result remains robust.

Several studies have also tried to unveil the exact channels by which financial literacy affects the decision to participate in the stock market. For example, the results of the study by Christelis et al. (2010) support the hypothesis that higher cognitive abilities, through their association with lower risk aversion, lower information costs, or higher perceived portfolio sharpe-ratio, raise stock market participation. Additionally, Arrondel et al. (2012) uncover that stock ownership strongly correlates with both expectations and realizations of stock market returns, as well as with measures of financial literacy, ability or trust. Moreover, stock market participation monotonically increases with the conditional expectation of a positive stock market return[5]. This result holds true even among the affluent and the young.

Studies on the effect of human capital (education) on stock market participation are limited. For instance, several authors have shown that college educated are more likely to own stocks and prone to high cost of borrowing (Haliassos and Bertaunt 1995; Campbell, 2006; Lusardi and de Bassa Scheresberg 2013). Cole and Shastry (2008) argue that one year of schooling increases the probability of financial market participation by 7-8%. Looking a step further, empirical studies on stock holding show that including control for educational attainment does enhance the significance of the variable financial literacy (Van Rooij et al. 2011, Behrman et al. 2012, Lusardi and de Bassa Scheresberg 2013) underlying the fact that general knowledge (education) and specialized knowledge (financial literacy) both contribute for financial decision making, both in Netherlands and United States.

Christansen et al (2008) using a large panel data hosted by Danish Institute of Governmental Research add a new dimension to the results by arguing that the stream of education has an important effect. In fact, individuals who have specialised education in economics are more likely to hold stocks than otherwise identical investors. To take care of the endogeneity bias in the estimated coefficient of the economics indicator an IV approach is employed.

In the present work we aim to understand the determinants of stock market participation of households for 9 European countries by developing an empirical model which encompasses, under a unified framework, the relationship between stock market participation, on one hand, and human capital, financial literacy and country-level

[5] Also Dominitz and Manski (2007) elicit individual's expectations of stock market returns inquiring about how well the respondent thinks the economy will do in the year ahead (Positive Nominal Return, PNR).

institutional and economic variables on the other hand, along with other socio-demographic variables.

Hence, on the one hand we draw from the exiting literature by including most of the socio-demographic and economic variables explored in studies by VanRooj et al (2011), Yoong (2011), Cole and Shastry (2008) at country level and Christelis et al. (2010) at cross-country level. We also acknowledge the fact that financial literacy is endogenous and we use some of the instruments used by Christelis et al. (2010) and Jappelli and Padula (2013) to solve the issue. Secondly, we also follow the existing literature by including human capital, proxied by years of schooling and income along with financial literacy, as the most important predictors of stock participation.

However, on the other hand we also depart from previous empirical literature in that we allow for the possibility that both human capital and financial literacy acquisition are endogenous. To the best of our knowledge, this has never been done so far (among few theoretical exceptions, see the model developed by Spataro and Corsini 2013). Hence, we allow investment in education to be driven by both individual-related abilities (including family starting conditions) and by economic/financial incentives that were present at the very stages of the investment decision (such as the attractiveness of the financial market). Moreover, the outcome of the education production process is also allowed to depend on some country-level measure of the effectiveness of the education sector, namely, the student-teacher ratios for each country and individual within their 6-15 age interval. Finally, although exploiting different database, we base our analysis on the rich information provided by SHARE, which contains both current and retrospective information that are necessary to test our empirical approach.

The paper proceeds as follows. The next section introduces our main source of data, i.e. SHARE[6], to study the determinants of stock market participation. Sections 3 examines how stock market participation is affected by education, financial literacy, attractiveness of financial markets, effectiveness of education under the assumption of no endogeneity.

[6] This paper uses data from SHARE wave 4 release 1.1.1, as of March 28th 2013 (DOI: 10.6103/SHARE.w4.111), and SHARELIFE release 1, as of November 24th 2010 (DOI: 10.6103/SHARE.w3.100). The SHARE data collection has been primarily funded by the European Commission through the 5th Framework Programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th Framework Programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th Framework Programme (SHARE-PREP, N° 211909, SHARE-LEAP, N° 227822 and SHARE M4, N° 261982). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11 and OGHA 04-064) and the German Ministry of Education and Research as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).”

Section 4 discusses the case of determinants of stock market participation under a multiple endogeneity framework. Conclusions in section 5 will end the study.

2. Data description

The data is drawn from Wave 3 and Wave 4 of SHARE, a representative sample of the adult population in several European countries. The survey covers various aspects of the well-being of the elderly population ranging from socio-economical, mental and health conditions. Wave 4 refers to year 2010 and we focus on individual information from 9 selected European economies (Austria, Belgium, Denmark, Germany, Italy, France, Switzerland, Sweden and Netherlands). Wave 3 is known as SHARELIFE which records the life histories of half of the respondents of Wave 4. More precisely, Wave 4 comprises 32337 observations and the life history information provided in Wave 3 concerning the individuals re-interviewed in Wave 4 amounts to 17533. Moreover, our analysis also uses country-level data from International Historical Statistics and Global Financial database. The variables used in the model and their sources are provided in Appendix 1.

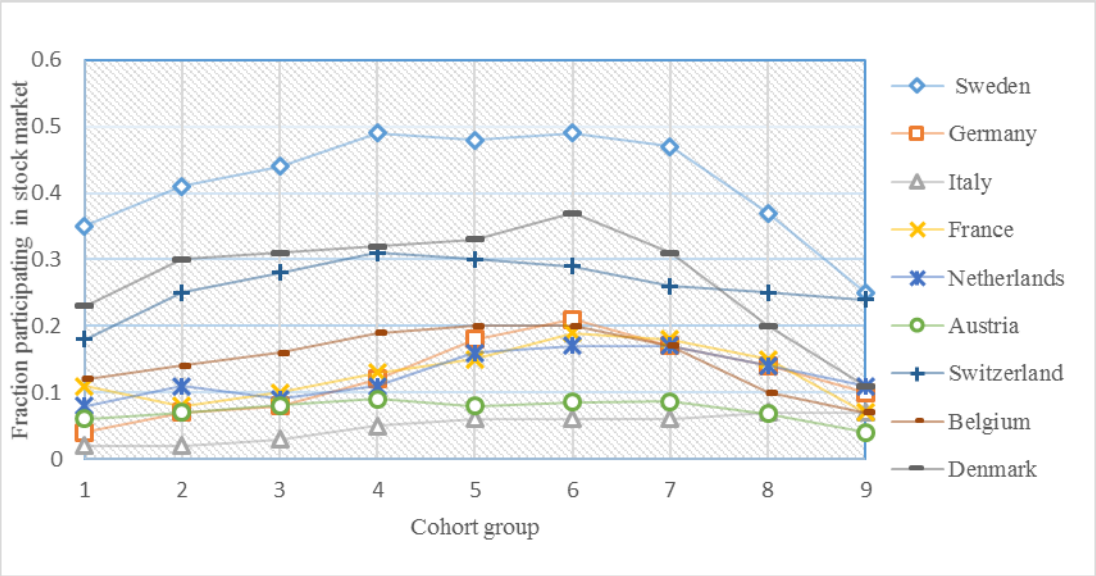
As anticipated, the independent variable in our model is participation to the stock market, a binary variable which takes value 1 if the worker has entered the stock market or 0 otherwise. More precisely, we use a standard measure of stock market participation that is both direct stock market participation through ownership of stocks and/or indirect participation through ownership of shares in mutual funds. The same measure is used for example by Vestman (2010). The measure excludes stock market participation through pension plans, including mandatory retirement accounts. In Wave 4, 16.84% of workers participated to the stock market and invested in risky assets, in line with the evidence provided by existing studies[7]. Fig 1, shows the fraction of individuals born in different cohorts and in different countries participating in the stock market. Individuals are grouped into five-year cohort groups, with group 1 comprising individuals born in years 1921-1925 and so forth. We end up with 11 cohort groups (See Appendix 3 for more details on the whole set of cohorts). More precisely, for each cohort/country group we calculate the fraction of people participating in stock markets. We note that not only is there a significant

[7] Cross-country comparisons is extremely useful to understand the patterns in household portfolio allocations. In countries like Sweden or the US over 50 percent of households enter stock market while 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 et al. 2003; Ameriks and Zeldes, 2004).

difference in the country-level probability to participate in the stock market, but, especially for some countries, also a visible age effect. More precisely, on the one hand, lower participation rates characterize Southern European countries and, on the other hand, participation rates display an inverse U shape, with higher propensity to join the financial markets associated with middle-aged individuals. In fact, in our sample stock market participation is concentrated in the age interval 52-72[8]. The first dependent variable in our model is current level of financial literacy, which has been extensively used in the literature.

As already mentioned in the introduction, several studies both in United States and other countries have found out that more financially literate individuals are also more likely to participate in stock markets (Kimball and Shumway 2006; Vanrooij et al 2011; Yoong 2011; Arrondel et al 2012). Each individual of Wave 4 is presented with four financial and numerical questions and the answers are imputed to obtain a value ranging from 1 to 5. Details of the actual questions and the construction of this indicator are given in the Appendix 2 and have been discussed in Christelis et al (2010).

Fig 1: Fraction participating in stock market by cohort group and country



Source: Authors' calculation using SHARE database.

Note. Data are provided for five-year cohort groups. Group 1: born in 1921-1925. Due to the limited observations, groups 10 and 11 (age from 66 to 75) are merged together.

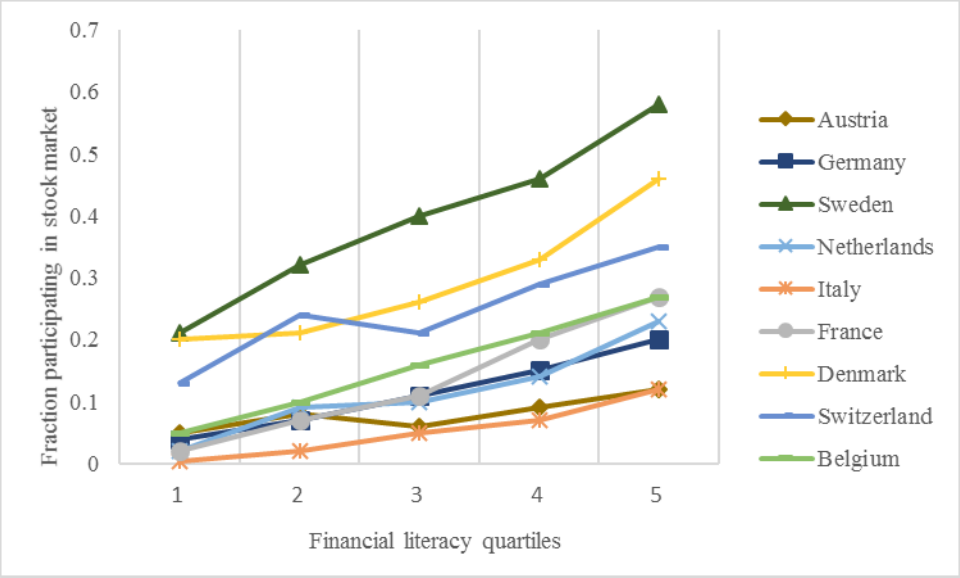
[8] In the case of older cohorts, (older than 70) stock ownership may simply be the result of differential mortality between richer and poorer households.

In Fig 2, we report the fraction of individuals participating in stock markets across different levels of financial literacy and by different European countries. The figure clearly shows that stock market participation increases sharply with financial literacy: in fact, participation in the stock market is concentrated among those with high literacy (fourth and fifth scores:), while only 3% and 9% of respondents in the first and second scores of Wave 4 joined the stock market in 2010.

The second independent variable used in our analysis is the human capital which is proxied by years of schooling. It is widely noted in the literature that human capital/education affects cognitive ability, which in turn increases participation (Cole and Shastry, 2008; Bertaut and Starr-McCluer, 2002). Fig 3 shows the fraction of individuals that invested in stock markets, by schooling years. Education years are stratified into five groups and the figure clearly shows increasing probability to be investing in the stock market as schooling years increase.

As for institutional variables at country-level, we assess the role of the effectiveness of the education system in influencing stock market participation. Following Ostroff and Schmitt (1993), effectiveness of schooling is proxied by the student-teacher ratio.

Fig 2: Fraction participating in stock market and financial literacy by country

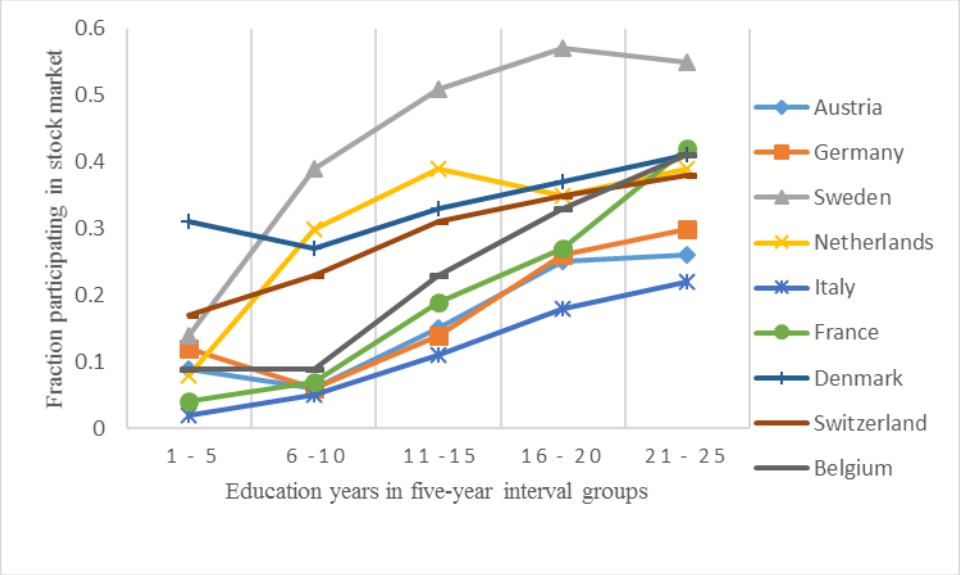


Source: Authors' calculation using SHARE database.

Note: for details on financial literacy groups see Appendix 2

As for empirical support, we hinge on few studies which have identified the effects of teacher-student ratio in a range of outcomes including improvement in test scores (Arum 1996; Finn and Achilles 1990), increased years of educational attainment (Bound and Turner 2007) and higher lifetime earnings (Card and Krueger 1996).

Fig 3: Fraction participating in stock market by schooling years and country



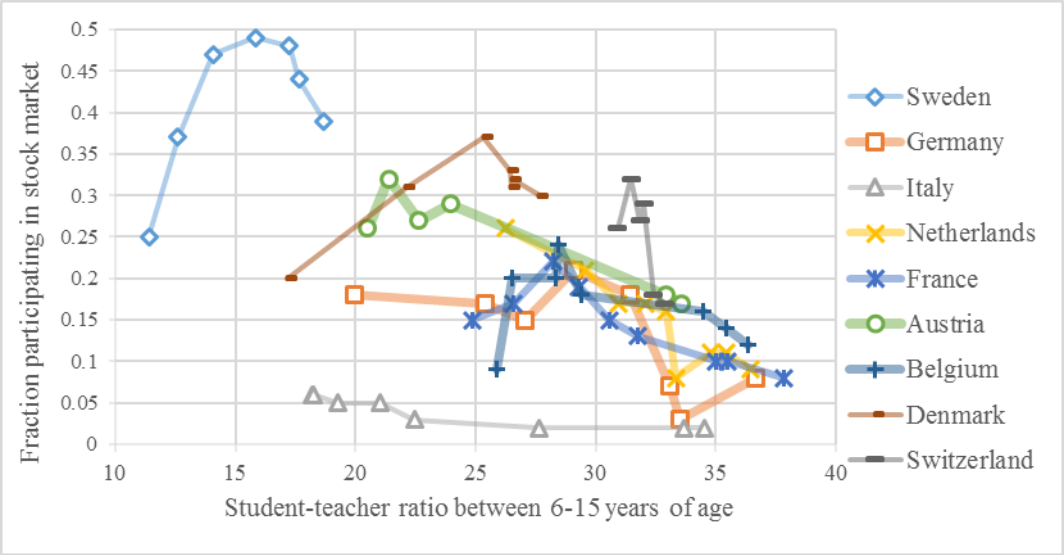
Source: Author's calculation using SHARE database

In this work we argue that, apart from the individual effect of financial literacy and human capital, the effectiveness of education could be treated as a country-level institutional variable which may exert a positive externality (peer effect) in the decision to participate in stocks.

The construction of the variable is performed by first dividing the individuals into 11 different cohort groups. From the International historical statistics on education, the 10 year average student-teacher-ratio is calculated for each individual belonging to a specific cohort and country. The years taken into account are those in which the members of each cohort group were within the age interval of compulsory schooling years (6-15).

In Fig. 4 the data on participation to the stock market and student-teacher ratio at cohort group and country level are reported. The data show that that irrespective of the different levels of student-teacher ratio instituted in different countries, the fraction of individuals holding stocks tends to decline as the student-teacher ratio increases.

Fig 4: Fraction participating in stock market by student-teacher ratio (cohort-group level) and country



Source: Authors' calculation using International Historical Statistics Note. The student teacher-ratios reported in the Figure are calculated at cohort-group level and those when individuals were between 6-15 years of age.

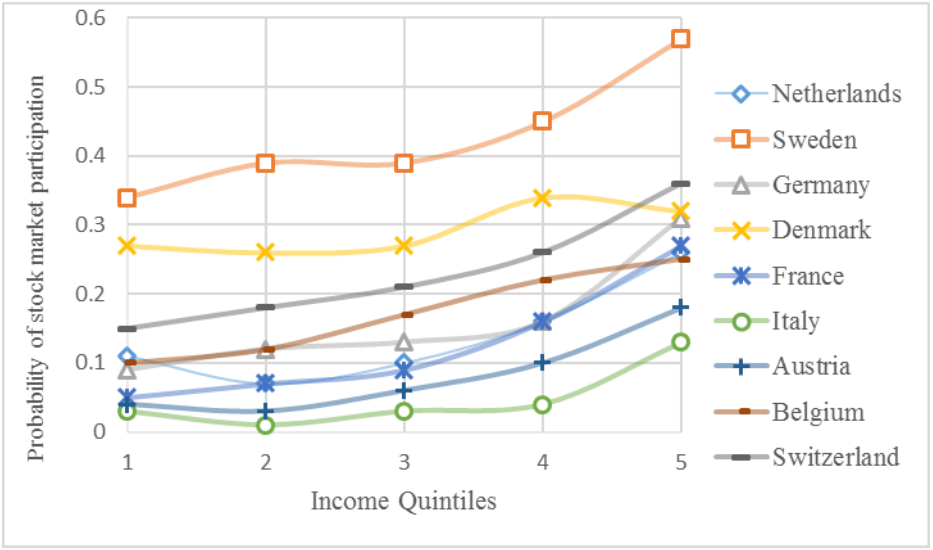
The next independent variable is income, which is measured by income-quintiles at country level. Total income is calculated by adding the wages for employed workers and income from self-employment for the self-employed workers. As for retired workers, they are calculated from social security entitlements[9].

Next, income is divided into quintiles at country level in order to take care of the country-differences in purchasing power[10]. Figure 5 reports the fraction of individuals participating in stock market grouped by income quintiles. We expect a positive relationship between income and participation in stock market as suggested, for example, by Bertaut and Starr-McCluer (2002). In fact, Fig. 5 shows that income and the participation to stock market are positively correlated.

[9] In the case of wave 2 pen1 is calculated by adding the variables annpen1v, annpen12v, annpen8v, annpenn15v, annpen16v, annpen9v and annpen2v, while ypen2 which includes disability and unemployment benefit comprises of annpen3v annpen13v, annpen10v, annpen4v, annpen5v, annpen14v, annpen11v, annpen7v and annpultv. In the case of wave 4, the imputed values were provided as ypen1 which is the old age retirement pension, while ypen2 is the disability and unemployment benefit. In the case of Sweden and Switzerland, the wages are converted to euros by using the information on exchange rate provided by the share database. For a detailed discussion see SHARE manual.

[10] We also tried to capture the difference in wages across different sectors, however large number of missing values has forced us to drop the exercise.

Fig 5: Fraction participating in stock market and income quintiles, by country



Source: Authors' calculation using SHARE database.

Note: Income quintiles are country-specific.

One of the novelties of our empirical investigation is the inclusion of a country-level financial incentive measure, proxied by the sharpe-ratio (See Appendix 4).

More precisely, we argue that the effect of the attractiveness of the stock market on the decision to join it is twofold. First, *current* financial incentives such as the sharpe-ratio may affect the *current* decision to invest in the stock market. Second, *previous* financial incentives are likely to have affected the decision to invest in financial literacy and human capital, a decision that in fact happens early in life. As for the first channel, we compute a five-year average of sharpe-ratios at country level between 2006 and 2010.

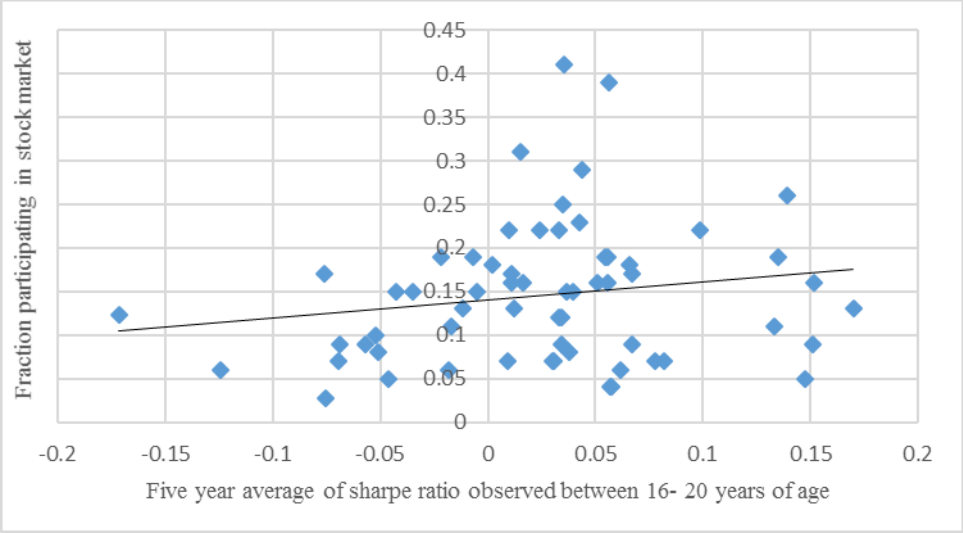
As for the first channel, we believe that the effect of financial attractiveness (proxied by the current level of sharpe-ratio) of each country is significantly different on the participation in the stock market. Besides, the effect of current level of sharpe-ratio has to be disentangled from the country-level effect which could also influence the decision to participate in the stock market. A possible method to disentangle such aforementioned effects, we divide the 9 countries into 3 subgroups namely Continental Europe, Scandinavian countries and Southern European countries based on geographical proximity. Naturally, we assume that the individuals invest in stocks in countries closer to their own country as they could exploit informational advantages in their selections of nearby stocks. We keep the current level sharpe-ratio of Continental Europe (Austria, Belgium, and Germany) as a bench

mark. We create an interaction term where we multiply the dummy for Scandinavian countries (Denmark and Sweden and Netherlands) with the current sharpe-ratio and interaction term for dummy for Southern Europe (Switzerland, France and Italy). Additionally we add the country dummies to capture the exclusive country-level effects (taxation, openness of the economy, economic freedom) which are not captured by the socio-economic variables otherwise.

As for the second channel, we compute the sharpe-ratios at cohort/country level, as five-year average, when each worker in Wave 4 was between 16-20 years old and 21-25 years old respectively (see Appendix 4 for the details on computations).

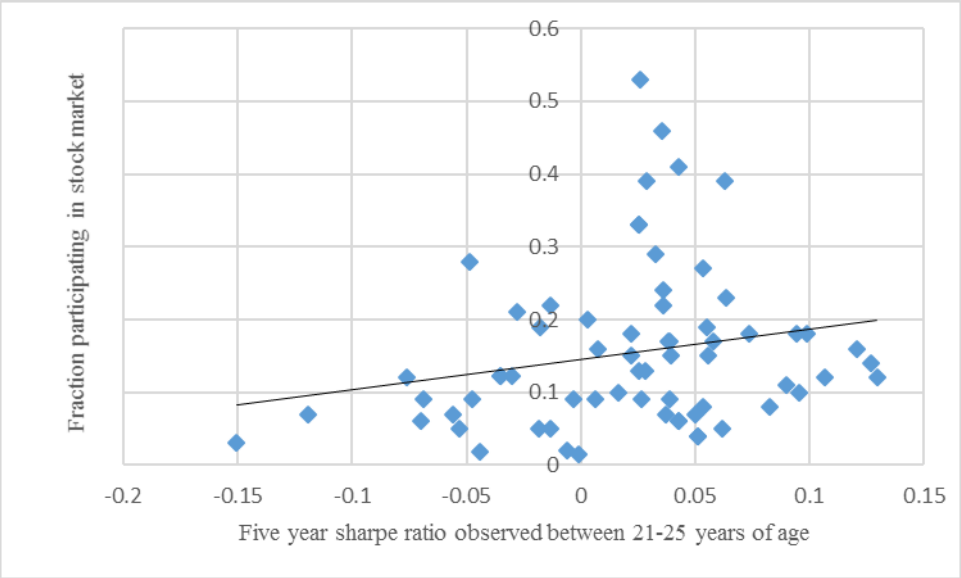
The computed sharpe-ratios at country/cohort level when each worker in Wave 4 was between 16-20 years and 21-25 years and the corresponding fractions of individuals who participated to the stock market in 2010 are plotted in Figs. 6A and 6B respectively. We have divided the data in 11 cohort groups and merged cohorts in cases of low number of observations. For illustrative purposes we calculated the fraction of individuals participating to the stock market for each cohort group (and for each cohort-group-related sharpe-ratio).

Fig 6A: Fraction participating in stock market and sharpe-ratio at age 16-20 by cohort groups



Source: Authors' calculation using Global Financial Database Note: The data is built in the following way: the FIVE-YEAR average of the sharpe-ratios for each year-of-birth-cohort is calculated. The respective fractions participating of each cohort group is plotted on the Y-axis

Fig 6B: Fraction participating in stock market and sharpe-ratio at age 21-25 by cohort groups



Source: Authors' calculation using Global Financial Database

From both figures it emerges that the fraction participating in the stock market for each cohort tends to increase when the sharpe-ratio increases.

One of the striking features of the empirical data on financial literacy is the large and persistent gender difference and this is also reflected in the economic decision to participate in stock market. As already mentioned, earlier studies have shown that women as less likely to enter the stock market (Halaisonos and Bertaunt, 1995, Croson and Gneezy 2009, Fonseca et al. 2012). In lines with the existing studies we expect a negative relationship between female individuals and stock market participation. In fact, the statistics of our sample show that the correlation between sex and stock holding is of -0.1041. The demographic variables such as age, age-squared[11] number of children in the family, marital-status, gender, house-ownership are also included into the model and used as controls in the regressions[12]. As for the case of home ownership, Vestman (2010) argues that home owners are about twice as likely as renters to participate in the stock market, both in the USA and Sweden. So we include home ownership as a dummy variable in the model with 1 as house owner and 0 otherwise. Additionally, we include a dummy for respondents who are retired to account for the fact that some households may be in the decumulation phase of their life-cycle.

[11] We also include age-squared to check the quadratic relationship between age and stock participation probability. The participation probability increases with age as people become more experienced, but with a higher age, probability starts to increase at a decreases rate as evident from the Figure 1.
[12] For earlier studies please see Haliassos and Bertaut (1995), Guiso et. al., (2003) and Campbell (2006).

2.1 Identification strategy

This section illustrates the identification strategy used to correct for the potential endogeneity of some of the independent variables. Although these variables will be referred as instruments, one should be aware of the fact that the estimation method adopted here differs from the standard two-stage instrumental variable method.

As already mentioned, in this work we allow for the possibility that both human capital and financial literacy are endogenous. The endogeneity could arise from the fact that the current level of financial literacy is influenced by the "endowment" (starting or initial conditions) before the worker enters the labour market. To correct for this fact we use instruments as suggested by Jappelli and Padula (2013) who have used Wave 1 and Wave 2 of the SHARE database to explore the effect of financial literacy on the saving decisions of workers (See Appendix 5 for detailed discussion on the instruments used for the variable financial literacy).

Additionally, the literature (Jappelli, 2010; Jappelli and Padula, 2013) acknowledges the fact that the correlation between financial literacy and investment behaviour seems at least partly driven by reverse causality. For instance a positive relation between participation in the stock market and an investor literacy (as in Van Rooij et al, 2011 and Kimball and Shumway, 2006) is consistent with the argument that financial literacy helps alerting individuals about the excess returns on stocks/bonds which induces them to invest on one hand; on the other hand, investing in advanced financial products, such as stocks or bonds could provide some kind of financial literacy training, enabling respondents to answer more questions correctly. Additionally, this positive correlation may reflect the fact that financial literacy is not distributed randomly in the population and those who possess high levels of literacy are likely to have certain characteristics, often unobservable, such as talent, ability, or patience that may lead also to "better" financial decisions. However, empirical identification of the causal effect of financial literacy on the individual financial decisions is rather difficult.

In order to address these problems, the existing literature has used an instrumental variable approach by collecting several variables that refer to respondent's childhood as in our case. These are particularly suited to be used as instruments as they are likely to be correlated with financial literacy, but uncorrelated with financial decisions in adulthood. Thus, we can say that in our empirical model the reverse causality is partially controlled by

instrumenting financial literacy through the relative score of mathematical ability and reading ability of the respondent when he was aged 10.

Moreover, we also suspect human capital, which we measure through years of schooling, to be endogenous as well. As pointed out by Griliches (1977) and Lam and Schoeni (1993), an omitted variable like the individual ability/talent of the worker which is correlated to schooling in the wage equation could overestimate the schooling's true effect on wages, because it has captured some of the wage effect of ability. In other words, differences in the initial endowments of the individual at younger ages can also induce unobserved compensatory behaviour among workers in their economic and financial decisions, and therefore the probability to participate in stock market based on only the observed human capital investment will surely provide biased results.

In other studies, Mandell (2007) finds that high school students cite their parents' occupation as their primary source of information on financial matters, and that students who score high on financial literacy tests come from well-off, well-educated households. Charles and Hurst (2003) find that investment behaviour transmitted from parent to child explains a substantial fraction of the correlation of wealth across generations. As for empirical support, Shea (2000) uses union status (and occupation) as an instrument for parental income which is usually a good proxy for the human capital invested by the next generation. Raitano and Vona (2010) using the EU-SILC dataset showed that parental occupation is an excellent predictor of several children outcomes and its effects are significant across cohorts and countries. Father's occupation ranked from 1 to 10 based on the skill level is considered as a good instrument for human capital investment of each individual in Wave 3. The details of such a classification can be found in Appendix 6.

Exploiting information provided in SHARELIFE of Wave 3, financial literacy and human capital investment are therefore instrumented with exogenous instruments such as own talent, proxied by mathematical and reading abilities of the individual at the age of 10 and starting conditions, identified by the occupation of father and number of rooms at home when 10 years old and number of books in the shelf the age of 10.

As for financial/institutional incentives that may affect the decision to invest in education, as already mentioned we include as instruments two five-year-average sharpe-

ratios at younger ages (16-20 and 21-25), which vary across countries and cohorts. In table 1, we report the sample statistics of the main variables involved in the study.

Table 1: Sample Statistics of the variables and instruments

Variable	Description	Observations	Mean	Std.dev	Min	Max
ST	Participation to Stock Market	32337	0.168	0.374	0	1
FL	Financial literacy	32337	3.461	1.145	1	5
HC	Number of years in school	32337	10.341	4.608	0	25
Age	Age at interview date	32337	65.861	10.520	31	86
Age squared	Age Squared	32337	4448.552	1431.787	961	7396
MS	Marital status	32337	0.273	0.0445	0	1
CH	Number of children	32337	2.175	1.414	1	17
FE	Female or not (Dummy)	32337	0.558	0.496	0	1
ST	Student-teacher ratio	32337	26.176	8.4339	10.366	37.822
IN	Income quintiles	32337	2.999	1.4143	1	5
HO	Ownership status of residence (Dummy)	32046	0. 705	0.498	0	1
SH	Five year average of the years (2006-2010)	32337	0.0187	0.022	-0.031	0.049
Maths	Relative score of maths at 10 (Ranked 1 to 4)	17533	3.326	0.906	1	5
Reading	Relative score of reading at 10 (Ranked 1 to 4)	17473	3.359	0.892	1	5
Father_occu	Father's occupation (ranked from 1 to 10)	17475	4.803	2.393	1	10
Rooms	Number of rooms at home at 10	17593	4.130	2.157	1	50
Book	Number of books at home at 10 (Ranked 1 to 4)	17631	2.212	1.257	1	5
SH_16	Five-year average sharpe-ratio between 16-20 years	26786	0.0135	0.054	-0.167	0.267
SH_21	Five-year average sharpe-ration between 21-25 years	28236	0.01668	0.056	-0.167	0.267
DUM_SEUR	Dummy for Southern European countries	32337	0.3954	0.4889	0	1
DUM_SCAD	Dummy for Scandinavian countries	32337	0.1995	0.3996	0	1
INT_SCAD	Interaction term (Scandinavian countries) DUM_SCAD*SH	32337	0.0056	0.0163	-0.007	0.0579
INT_SEUR	Interaction term (Southern European countries) DUM_SEUR*SH	32337	-0.0032	0.0368	-0.101	0.0283

3. Empirical Model

As far as the econometric analysis is concerned, we follow a two steps strategy. In the first step variables like financial literacy and human capital are considered as exogenous and we implement both an OLS and a probit model in order to have a baseline model.

In the second step, we allow for the endogeneity of financial literacy and human capital. In the presence of multiple endogeneity, the probit approach yields biased results as suggested by Cameroon and Trivedi (2010) and therefore we resort to control (CF) function approach which will be discussed in detail in the later part of this section. Finally, as a check, we also use an IV two-stage regression when considering the endogenous model.

3.1 Model 1: Binary probit model

The first empirical model is obtained as simple OLS and probit models (as our dependent variable - stock market participation- is binary in nature). Both estimations have the following specification:

$$\text{Stock Y } [1,0] = \alpha_{1+}\beta_1 \text{ FL} + \beta_2 \text{ HC} + \beta_3 \text{ Age} + \beta_4 \text{ Agesq} + \beta_5 \text{ MS} + \beta_6 \text{ CH} + \beta_7 \text{ IN} + \beta_8 \text{HO} + B_9 \text{ FE} + \beta_9 \text{ SH} + \beta_{10} \text{ EQ} + \beta_{11} \text{ RE} + \beta_{12} \text{ INT\_SCAD} + \beta_{13} \text{ INT\_SEUR} + \beta_{14} \text{ DUM\_SCA} + \beta_{15} \text{ DUM\_SER} + \varepsilon \quad (1)$$

where Stock, is a binary dependent variable which takes value 1 if the worker has entered the stock market or 0 otherwise. FL is the financial literacy variable, HC is the number of years of schooling, SH is the current level of (5 year average of) sharpe-ratios, IN is the income quintiles and EQ is the student teacher-ratio, ε is error term.

As in previous studies we consider some demographic characteristics such as age, age-squared, marital status (MS), number of children (CH), dummy for female (FE) and ownership status of the residence (HO). Two interaction terms (INT_SCAD) interaction with sharpe-ratio and Scandinavian countries and (INT_SEUR) and interaction with sharpe-ratio and Southern European countries. Additionally, we include dummy for retirement status (RE), Scandinavian countries (DUM_SCAD) and Southern European countries (DUM_SEUR).

Table 2 Multivariate regression using LPM and probit model and its associated marginal effects. Standard errors in brackets

	(Model 1)	(Model 2)	
Variables	OLS (1)	Probit coefficient	Marginal effects
Financial literacy	0.036***	0.172***	0.038***
	(0.002)	(0.009)	(0.002)
Schooling years	0.006***	0.029***	0.006***
	(0.000)	(0.001)	(0.000)
Age	0.022***	0.107***	0.023***
	(0.000)	(0.012)	(0.002)
Age-squared	-0.0001***	-0.0007***	-0.0001***
	(0.000)	(0.000)	(0.000)
Number of children	-0.008***	-0.048***	-0.010***
	(0.001)	(0.007)	(0.001)
Marital Status(dummy)	0.035***	0.158***	0.036***
	(0.005)	(0.022)	(0.005)
Female (dummy)	-0.035***	-0.144***	-0.032***
	(0.004)	(0.019)	(0.004)
Sharpe ratio(2006-10)	-0.513***	-2.47***	-0.0545***
	(0.073)	(0.325)	(0.033)
Income quintiles	0.024***	0.107***	0.023***
	(0.001)	(0.006)	(0.001)
Student teacher ratio	-0.002***	-0.010***	-0.002***
	(0.000)	(0.001)	(0.000)
House ownership (dummy)	0.053***	0.260***	0.054***
	(0.004)	(0.021)	(0.004)
Retired (dummy)	-0.021***	-0.054***	-0.012***
	(0.005)	(0.025)	(0.005)
Sharpe-ratio (2006-10) interacted with Scandinavian country dummy	2.20***	8.39***	1.85***
	(0.191)	(0.76)	(0.168)
Sharpe-ratio (2006-10) interacted with Southern European country dummy	1.46***	7.99***	1.762***
	(0.119)	(0.544)	(0.120)
Dummy for Scandanavia	0.066***	0.212***	0.050***
	(0.009)	(0.041)	(0.010)
Dummy for Southern Europe	-0.011*	-0.095***	-0.020***
	(0.006)	(0.029)	(0.006)
N	30837	30837	
Psuedo R^2		0.11	
R^2	0.098		

*10% significantly different from zero **5% significantly different from zero ***1% significantly different from zero

3.1.1 Empirical results

Table 2 provides the estimation on data drawn from Wave 4 under the two specifications. The empirical results show that all the variables we used in this study, apart from the dummy for retired individuals, are significant across all the specifications and with the expected signs.

Moreover, the LPM regressions OLS (1) and the marginal effects of probit model (2) provide similar results. We perform a likelihood ratio (L-R test) in order to check for overall variables' relevance. The null hypothesis is that all coefficients except that of the intercept are equal to zero. Here we get model (2) LR (χ^2) (11) = 3392.00 with prob >(χ^2)= 0.00 respectively. Therefore the hypothesis that all parameters are equal to zero can be rejected at 1% level of significance.

As for the object of our analysis, we find that the coefficient of financial literacy, human capital, income quintiles, student-teacher ratio are significant at 1% level. The benchmark sharpe-ratio, the sharpe-ratio of Scandinavia and Southern Europe is significant at 1% level. The demographic variables including age, dummy for female, number of children, house ownership and a dummy for unmarried worker are significant at 1% level. The country dummies for Scandinavian countries and Southern European countries are also significant at 1% level. The dummy for retired is significant at 5% level.

We receive expected signs for every variable in the probit regressions. Financial literacy has a positive effect on stock market participation; likewise, human capital proxied by number of years of schooling shows a positive effect. Income-quintiles show a positive effect reconfirming the fact that as income increases the probability to participate the stock market increases. Student-teacher ratio at schooling years (that is when individuals were in their 6-15 years of age) demonstrates a negative effect, suggesting that, as education quality deteriorates, there are lesser possibilities for an individual to find peers engaged in financial markets, thus reducing the probability for such an individual to participate in the stock market.

As for demographic characteristics, older and unmarried individuals have both a higher probability to participate in the stock market. Conversely, the number of children reduces the probability of stock holding, while house ownership exerts a positive effect, as suggested by the earlier literature. The retired individuals are less likely to participate in the stock market.

In order to better quantify the influence of the variables on the RHS on the probability that y_{it} takes value 1, we look at the marginal effects of the right hand side variables. Since we have both continuous variables like human capital, financial literacy, student-teacher ratio, sharpe-ratios and dummy variables like house ownership, female, single and country dummies we employ two different methods to capture the marginal effects for continuous and discrete variables, respectively.

The marginal effects of control variables are all significant. Moreover, according to our findings a 1% change in the financial literacy raises the probability to join the stock market y_{it} by 3.8% and in the case of human capital, a 1% change in the years of schooling only brings a marginal effect of 0.06%. The probability of being in the stock market decreases by 0.02% when there is a 1% increase in the student-teacher ratio. Furthermore a 1% change in wage quintiles increases the same probability by 2.3%.

The marginal effects of sharpe-ratios have to be interpreted with caution. The benchmark sharpe-ratio shows negative sign signifying the fact that sharpe-ratio in continental European countries have negative effect on the probability to participate in stock market. However the marginal effect of sharpe-ratio in the Scandinavian and Southern Europe are positive and most importantly the total effect of the financial attractiveness across the three sub-groups is also positive.

The probability to invest in the stock market increases by 5.4% if the dummy variable house ownership is 1. As for gender effect, if the dummy for female changes from 0 to 1, the probability to participate in the stock market decreases by 3.2%. If the dummy variable for single (unmarried) changes from 0 to 1, the probability to hold stocks increases by 3.6%. In the case of retired workers, the probability to invest in stocks decreases by 1.2%. In the case of continuous demographic variable like number of children, a 1% increase dampens the probability to invest in stock by 0.06%. Finally, the country dummy for Scandinavian country shows a positive marginal effect of 0.05% signifying that people from Scandinavian countries have 5% more probability to participate in the stock market than our benchmark group. Alternatively, the dummy for southern European country shows a negative effect implying the fact that individuals from countries have 2% less probability to participate in stock market.

3.2. Model II: Multiple endogeneity and estimations based on control function approach

As discussed briefly in our identification strategy, we suspect multiple endogeneity in the empirical set up, which would have the consequence of biased and ineffective estimates of the probit and Linear Probability Model (LPM) model. To illustrate this point we use the equation (1) and suppose that some of the variables on the RHS are endogenous and so may be correlated with ε. A solution to this endogeneity could be solved by inserting K, a vector of instrumental variables that are uncorrelated with ε.

In fact, one of the approaches to deal with am endogenous regressor is to estimate a linear probability model, i.e. linearly regress Y on X using two-stage least squares (2SLS) with a valid and strong set of instruments (K). However, despite its simplicity and popularity, 2SLS does not provide the consistent estimates of β (in the case of a binary variable and could even generate silly results such as choice probabilities that are negative or greater than one). Moreover, linear IV estimator performs poorly when the model is over-identified as in the case of our framework. However, we include IV-two stage regression as a check.

Alternatively, one can resort to control function approach (IVprobit) based on either the maximization of the likelihood function associated with a system of equations or on a two-step procedure when MLE is difficult to obtain. For details see Woolridge (2002 pp 474-477).

To test whether financial literacy and human capital are endogenous to the participation in stock market we employ the Wald test of endogeneity. The null hypothesis corresponds to the exogeneity case of the regressors under scrutiny. The Wald test computation (bottom of Table 3) lead us to reject the null hypothesis of exogeneity of the regressors and therefore justify the use of approaches that correct for endogeneity. Then, in order to test whether the set of instruments are valid, we exploit the Amemiya-Lee-Newey (1978) test. The null hypothesis is that the instruments are jointly valid, that is, they are uncorrelated with the error term in the structural equation and the instruments are correctly excluded from the estimated equation With the seven aforementioned instruments for the vector of endogenous variables, Table 3 shows that the Amemiya-Lee-Newey minimum χ^2 p-values is 0.30 and we reject the null hypothesis of endogeneity of the instruments. Lastly, we

evaluate the power of the instruments via F test on the joint significance of their coefficients in the first-stage regressions using the Stagier and Stock (1997) rule of thumb.

3.2.1 Empirical Results

In Table 3, two specifications are reported. Models (1) is a control function approach, Model (2) is the 2SLS approach.

Looking at Model (1) we find that the all estimated coefficients for the probability to participate in stock market are significant and with the expected signs. Financial literacy, student-teacher ratio, the sharpe-ratio, human capital and income quintiles are significant at 1% level. As for the demographic variables, age, house ownership, and single are significant and positively affect the probability to hold stocks. On the other hand, the dummy variable for female is significant at 1% level and shows a negative effect as anticipated from the earlier studies. The number of children also affects negatively the stock market participation and is significant at 5% level.

As for marginal effects, from Model (1) it turns out that a 1% increase in financial literacy could result in about 11.3% increase in the probability to participate in the stock market, while human capital shows a 1% marginal effect. This suggests again that the baseline probit coefficients of financial literacy and human capital are downward biased (see Table 3.2, Model 2).

The IV probit estimates of financial literacy and human capital coefficients are significant and much higher than the ones observed in the baseline model displayed in Table 3.2.

Table 3: Multivariate regression using control function and IV two stage approach. Standard errors in brackets

	Model 1	Model 2
VARIABLES	(1) Control function	(2) IV2LS LPM
Financial Literacy	0.113***	0.109***
	(0.021)	(0.021)
Schooling Years	0.010***	0.014***
	(0.004)	(0.004)
Age	0.047***	0.046***
	(0.007)	(0.006)
Age squared	-.0003**	-.0002***
	(0.000)	(0.000)

Number of children	-0.008**	-0.005*
	(0.002)	(0.003)
Marital Status (dummy)	0.057***	0.063***
	(0.009)	(0.010)
Female (dummy)	-0.028***	-0.034***
	(0.009)	(0.010)
Sharpe ratio (2006-10)	0.274*	0.223*
	(0.167)	(0.173)
Income quintiles	0.010***	0.09**
	(0.003)	(0.003)
Student-teacher ratio	-0.007***	-0.008 ***
	(0.000)	(0.000)
House-ownership (dummy)	0.048***	0.043***
	(0.009)	(0.009)
Retired (dummy)	-0.0321**	-0.042***
	(0.009)	(0.010)
Sharpe-ratio (2006-10) interacted with Scandinavian country dummy	1.110***	1.75***
	(0.494)	(0.542)
Sharpe-ratio (2006-10) interacted with Southern European country dummy	0.885***	0.63***
	(0.243)	(0.243)
Dummy for Scandinavia	0.023**	0.029**
	(0.132)	(0.137)
Dummy for Southern Europe	-0.0003	0.005
	(0.012)	(0.012)
Wald test	90.60	
P value	0.00	
Durbin-Wu-Hausman		40.71
P value		0.00
ALN test	0.30	
F test	175.43	152.69
Sargan Statistics		5.34
P value		0.37
Anderson canon. Corr LR		227.88
P-value		0.00
N	10372	10372

*10% significantly different from zero **5% significantly different from zero ***1% significantly different from zero

The coefficient for student-teacher ratio also is higher compared to the probit regression. As mentioned, this variable is meant to capture the effect that a better education system exerts on participation in stock market through externalities and peer effects. The marginal effect shows that a 1% increase in the student teacher ratio could decrease the probability to participate in stock market by 0.07%.

Next, the coefficient of financial attractiveness of the country proxied by sharpe-ratios is positive in all three subgroups, clearly underlining the effect of the variable in the decision to participate in the stock market. Moreover the effect of current level of sharpe-ratio is significantly higher in Scandinavian (197%) and Southern European countries (85%) as compared to Continental European countries which serves as the benchmark. This also implies that the effect of financial attractiveness performs differently in different regions of Europe may be due to different outlooks on risk and understanding of capital market functioning.

In the control function approach, as noted earlier, the effect of this variable is twofold. The sharpe-ratios observed by individuals at their young ages (16-25) could influence the decision to acquire more education and financial literacy and thus indirectly facilitate their decision to join stock markets in the latter period of time (in terms of lower costs to take track of their investments, to acquire relevant information and so on).

The effect of income remains positive and significant in all the CF approaches too and, finally, all socio-demographic control variables show significance and expected signs, with the coefficients showing marginal changes compared to the base model (see Table 3.2, Model 2).

Finally, the country level effects in the control function approach shows a person belonging to Scandinavia has 2.3% more probability to enter stock market, while we observe no separate effect of Southern European economies on the probability to enter stock market. One need to conclude that these two subgroups have no significant differences, which could bear a different effect on the participation of stock market.

4. Conclusions

In this work we have shed new light on the determinants of stock market participation under an endogenous framework for 9 European countries. Using different database and different econometric specifications, we were able to provide the precise accounts of the effects of such variables as financial literacy, human capital, and effectiveness of the education system and financial attractiveness of the markets on the probability to invest in the stock market, together with other socio-demographic individual characteristics.

Our estimates show that higher financial literacy is associated with higher probability to participate in the stock market. Additionally, human capital (schooling years) and

effectiveness of education (student-teacher ratio) are positively associated with stock market participation. Moreover, as expected, the financial attractiveness of the country is also positively influencing the participation of workers in stocks. Results are robust after the inclusion of various control variables (such as age, marital status, house ownership, gender, number of children etc.) and even controlling for possible endogeneity of both human capital and financial literacy. In fact, we find that human capital is correlated with financial literacy as both these variables depend on same set of instruments and determine stock participation jointly, although to a different extent. Another novelty of this work in the inclusion of financial attractiveness of the stock market, proxied by sharpe-ratios, which is found to affect the probability to join the stock market both directly and indirectly, by making the investment both in education and in stock more attractive. The socio-demographic control variables also used in the past studies show the expected sign. Finally, the quality of the education system is found to exert a positive effect on the propensity to invest in the stock market, due to some externality or peer effect.

As for policy implications, our findings would suggest that the enhancement of both financial literacy and human capital is crucial for ensuring better participation in capital markets. Moreover, policymakers should put much effort in filling the gender gap and in improving institutional factors such as the effectiveness of education and the performance of the financial markets (whose attractiveness could be fostered by favouring the presence of institutional investors such as pension funds).

Our analysis is not without limitations. The risk preferences of the individual are not included into the model due to data limitations. Also the sector of employment and the field of study are missing due to the lack of information in the SHARE database. The inclusion of such information in the next waves would strongly improve the quality of the database for future research of the field of financial related decisions at the European level.

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APPENDIX

Appendix 1: Description of variables used in the study and their source

Variable	Description	Source
Stock	Participation to stock market (Dummy)	SHARE
FL	Financial Literacy	SHARE
HC	Schooling Years	SHARE
Age	Age at the time of the interview	SHARE
Agesq	Age squared	SHARE
FE	Female or not	SHARE
CH	Number of children	SHARE
MS	Single/Unmarried	SHARE
SH (2006-10)	Five year average of the lag of the sharpe-ratio from the date of the interview	Global Financial Statistics Country level
EQ	Student-teacher ratio	International Historical Statistics Individual/country level
HO	House owner or not	SHARE
IN	Income Quintiles	SHARE
Maths_10	Relative position of maths when aged 10	SHARE
Reading_10	Relative position of reading when aged 10	SHARE
Father_occu	Occupation of the father	SHARE
Initial_con	Rooms at house at age of 10	SHARE
Books_10	Books at shelf when aged 10	SHARE
Sharpe_16	Sharpe ratio when aged between 16-20	Global Financial Statistics Country/cohort group level
Sharpe_20	Sharpe ratio when aged between 21-25	Global Financial Statistics Country/cohort group level
INT_SCAD	Interaction effect of Scandinavian countries	Global Financial Statistics and SHARE

INT_SEuR	Interaction effect of South European countries	Global Financial Statistics and SHARE
DUM_SCAD	Dummy for Scandinavian countries	SHARE
DUM_SEuR	Dummy for South European countries	SHARE

Appendix 2: Financial literacy in SHARE

The questions used to construct the financial literacy indicator are set out below. Possible answers are shown on cards displayed by the interviewer who is instructed not to read them out to respondents:

1. If the chance of getting a disease is 10%, how many people out of 1000 can 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 6000 euro. This is two-thirds of what it costs new. How much did the car cost new? The possible answers are 9000, 4000, 8000, 12,000, 18,000 and another answer.

4. Let's say you have 2000 euro in a savings account. The account earns 10 per cent interest each year. How much would you have in the account at the end of the second year? The possible answers are 2420, 2020, 2040, 2100, 2200, 2400.

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.

The questions were asked in national languages like German, Italian, Swedish, Danish and Dutch. As for the Austria, the language used was German. The respondents from

Belgium questions were provided in French or Flemish and for the Switzerland, the questionnaires were provided in Italian, German or French**.**

The actual range of responses was as follows: For question 1, the range of responses is five, question 2 has three alternative answers, question 3 has six responses and finally question 4 has seven responses.

Appendix 3 Cohort groups

Cohort	Years of birth	Number of observations
Cohort 1	1921-1925	1844
Cohort 2	1926-1930	3141
Cohort 3	1931-1935	3856
Cohort 4	1936-1940	4739
Cohort 5	1941-1945	5599
Cohort 6	1946-1950	5594
Cohort 7	1951-1955	4915
Cohort 8	1956-1960	1648
Cohort 9	1961-1965	453
Cohort 10	1966-1970	401
Cohort 11	1971-1975	215

Appendix 4: Variables and detailed methodology used to compute sharpe-ratios

Variable name	**Description**	**Years**
CDAXD	Germany CDAX Total return index (Stocks)	Monthly From Dec 1869 To Dec 1969 and Daily From Jan 1970 To May 2014
TRSBF250D	France CAC All tradable Total return index	Monthly From Jan 1895 To Jan 1991 and Daily From Jan 1991 To Mar 2014
BCIPRD	Italy BCI Global return Index	Monthly From Dec 1924 To Dec 1972 and Daily From Jan 1973 To May 2014
BCSHD	Brussels All share Return index	Monthly From Dec 1950 To Dec 1984 and Daily From Jan 1985 To May 2014
SSHID	Swiss performance index	Monthly From Jan 1966 To Aug 1987 and Daily From Sep 1987 To May 2014
TRNLDSTM	Netherlands Total Return Stock Index	Monthly From Dec 1950 To

		Apr 2014
OMXSBGD	OMX Stockholm Benchmark Gross Index	Monthly From Dec 1918 To Jun 1995 and Daily From Jul 1995 To May 2014
OMXCGID	OMX Copenhagen All share gross index (Denmark)	Monthly From Dec 1969 To Jul 1989 and Daily From Aug 1989 To May 2014
ATXTRO	Vienna SE ATX Total return Index (Austria)	Monthly From Dec 1969 To Jan 1996 and Daily From Jan 1996 To May 2014
TRDEUGVM	Germany 10 year government bond return index	Monthly From Dec 1923 To Apr 2014
TRFRAGVM	France 10yr government bond return index	Monthly From Dec 1796 To Apr 2014
TRITAGVM	Italy 10yr government bond return index	Monthly From Oct 1807 To Apr 2014
TRBELGVM	Belgium 10 year government bond return index	Monthly From Nov 1831 To Apr 2014
SDGTD	Switzerland TR Government bond index	Monthly From Jan 1915 To Jan 1996 and Daily From Jan 1996 To May 2014
TRNLDGVM	Netherlands 10 year government bond return index	Monthly From Dec 1813 To Apr 2014
RXTBD	Sweden Government bond return index	Monthly From Jul 1868 To Dec 1989 and Daily From Jan 1990 To May 2014
TRDNKGVM	Denmark 10 year government bond return index	Monthly From Aug 1788 To Mar 2014
TRAUTGVM	Austria 10 year government bond return index	Monthly From Jun 1923 To Apr 2014

Source: Global Financial Database

The detailed methodology of calculating the sharpe-ratios is the following. The data on the return index is computed from Global Financial Database[13]. The returns on risky assets and safe asset returns are calculated separately from the return index by applying the formula $\frac{Y_1}{Y_0} - 1$ where Y_1 is the current return index value and Y_0 is the base return index. Then we calculate the average returns by subtracting the return of the risky asset (R_f) from the return from safe asset (R_0).

$$\frac{R_f - R_o}{stdev(R_f)}$$

Finally the average returns are divided by the standard deviation of risky assets that is annualised by multiplying by $\sqrt{12}$ of the respective years.

[13] Appendix 4 gives the names of the indexes of various countries used in the study.

Appendix 5: Mathematical ability and Reading ability in SHARELIFE

SHARELIFE has a module on childhood that asks about living conditions, accommodation, and family structure. Additionally the module asks questions about mathematical ability at 10 years of age. The exact wording of the question is: ‘‘Now I would like you to think back to your time in school when you were 10 years old. How did you perform in Maths compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average? ‘‘The module asks a similar question about language skills: ‘‘And how did you perform in [country’s Language] compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average?

Appendix 6: Ranking based on skills of occupation of the father provided by SHARE Wave 3

Occupation of the father	Rank based on skill
Legislator, senior official or manager	1
Professional	2
Technician or associate professional	3
Clerk	4
Armed forces	5
Service, shop or market sales worker	6
Skilled agricultural or fishery worker	7
Craft or related trades worker	8
Plant/machine operator or assembler	9
Elementary occupation	10