Does financial literacy reduce wealth inequality? Quantile regression evidence from 14 European countries

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Abstract

This essay investigates the heterogeneous effects of financial literacy across the unconditional wealth distribution and its implications for wealth inequality. Using data from the Survey of Health, Ageing and Retirement in Europe, the study employs an IV generalized quantile regression approach to identify the causal relationship between financial literacy and household wealth at different points of the wealth distribution. The empirical results suggest a robust stylised fact: Financial literacy affects individuals differently over the unconditional wealth distribution, and these effects deviate considerably from those documented in the literature so far. While financial literacy increases the level of wealth holdings across all quantiles, it has substantially higher returns at the lower quantiles of the wealth distribution. This suggests that (a) those who benefit most from additional financial knowledge are individuals at the lower quantiles of wealth and (b) as more individuals become financially literate, overall wealth inequality decreases.

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1 Introduction

Although the relationship between financial literacy and wealth accumulation is well-established in the literature (Behrman et al. (2012); van Rooij et al. (2012)), the question of whether financial literacy affects individuals differently over the wealth distribution has remained unexplored. Moreover, despite the recent theoretical advances (Lusardi et al. (2017)), the literature has not investigated the potential role of financial literacy on wealth inequality, and especially during retirement age. Information on these questions could be of great interest to both researchers and policy-makers, as it can shed some light on crucial issues, such as "Which individuals would benefit most from financial knowledge?" and "What are the implications for wealth inequality?".

The objective of this paper is to empirically examine how financial literacy affects wealth holdings across the wealth distribution and to understand its implications for wealth inequality. To address this question, an unconditional quantile regression method, proposed by Firpo et al. (2009), is used. Unconditional quantile regressions produce "snapshots" of the estimated relationship at different points of the distribution and, therefore, offer a panoramic -and yet parsimonious- way of capturing the whole distribution. This methodological framework allows for the decomposition of the financial literacy effect on a between- and within-component of wealth inequality and, therefore, for the following two questions to be answered: How does financial literacy affect the level of wealth holdings within each quantile of the wealth distribution? And second, how much do these effects vary between different quantiles and do they follow a certain trend (increasing/decreasing) across the wealth distribution[1]? Potential endogeneity issues are addressed, by applying an instrumental variable approach.

The analysis is based on cross-sectional data from the 2013 wave of the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE is the most comprehensive European dataset on households portfolios and wealth holdings, covering mature market participants who control a large portion of society's resources and wealth, yet nevertheless face important challenges in terms of financial security at retirement and wealth accumulation (Christelis et al. (2013)). SHARE dataset devotes an entire module to questions related to individuals' financial assets -such as bank and pension accounts, bonds, stocks, funds and savings-, alongside a rich set of individual characteristics and socio-economic variables. Furthermore, besides infor-

[1]While the former question can also be answered by using standard conditional quantile regressions, the latter one captures an inequality-enhancing between-quantiles effect which can only be estimated via unconditional quantile regressions (Firpo et al. (2009)).

mation on wealth holdings, SHARE provides information on individuals' numeracy and financial literacy, as well as information on individuals' childhood and early-life events, such as school performance and the family's living and health conditions[2]. In this study, this information is used in the context of the instrumental variables empirical analysis (same as in Jappelli and Padula (2013)). In addition, the unique format of the SHARE dataset allows us to capture significant cross-country variability and, therefore, to improve the efficiency of the estimates and to inform policies with a stronger pan-European orientation.

The estimation results reveal interesting findings that are not apparent just by looking at mean regression estimates. The regression estimates show that financial literacy has significant heterogeneous effects on wealth holdings across the wealth distribution. The results indicate that individuals in higher quantiles accumulate more wealth, but their wealth -as a function of financial literacy- increases at a much slower rate than that of individuals at lower quantiles. In particular, an increase in financial literacy boosts wealth holdings of higher-wealth individuals (90th quantile) by about 22%; whereas among lower-wealth individuals (10th quantile) financial literacy has a significant effect of more than 75%. Our estimates also show that greater financial literacy would decrease the "50-10 gap" (the difference between the 10th and the 50th quantile of log wealth) by about 50%. Overall, the results suggest that (a) everyone on the wealth distribution can benefit by financial literacy, but those who benefit most are individuals at the lower quantiles of wealth and (b) as more individuals become financially literate, overall wealth inequality decreases.

This study contributes to the growing body of economic research on financial literacy and its important implications for welfare. To the best of my knowledge, this is the first study to examine empirically the heterogeneous causal effects of financial literacy across the unconditional wealth distribution. Several studies have shown that financial literacy and wealth accumulation are strongly related, however two major issues are identified in the recent literature: first, the endogeneity of financial literacy and second the heterogeneous returns to financial literacy (Lusardi and Mitchell (2014)). While theoretical work considers both issues simultaneously (Lusardi et al. (2017))[3], the existing empirical research has only focused on the issue

[2]SHARE is a panel dataset which provides information on a wide range of thematic blocks (or modules) such as demographic characteristics, education, physical and mental health, cognitive ability, economic and financial activities and well-being. SHARE also includes information on individuals' life histories and early life events, as part of the third wave (SHARELIFE, 2008) which is repeated/complemented in the fifth wave (2013).

[3]In their recent work, Lusardi et al. (2017) develop a stohastic life-cycle model featuring endogenous financial knowledge accumulation and examine the effect of financial literacy on wealth inequality. As part of the sensitivity analysis, the authors allow for different elasticity of returns to financial knowledge and they find that wealth inequality (measured as the ratio of the

of endogeneity and the use of IV estimation techniques (Behrman et al. (2012); van Rooij et al. (2012)). The analysis proposed in this study is based on an unconditional quantile regression method (Firpo et al. (2009)) and a quantile instrumental variable approach (Powell (2017)) which addresses both heterogeneity and endogeneity simultaneously.

This study and the findings described above may have important implications on public policy frontiers and official organizations across Europe. While there is plentiful evidence of a positive association between financial literacy and wealth holdings on average, the effect of financial literacy across the whole distribution of wealth is still unknown. One of the results from this study is that financial literacy plays a significant role in reducing overall wealth inequality. This result suggests that policies aiming at reducing wealth inequality should consider financial literacy as a powerful public policy tool. Another finding is the substantial heterogeneity in returns to financial literacy, which indicates that such policies should be targeted at particular groups of individuals who can benefit most from investments in financial knowledge.

The remainder of the paper is organized as follows: Section 2 provides an overview of the literature related to both wealth accumulation and financial literacy. In Section 3 we introduce the dataset, present some descriptive statistics and explain how our dependent and key-independent variables are constructed. Section 4 discusses the methodology. Section 5 presents the results on the baseline regressions and the robustness checks and finally Section 6 concludes.

2 Background

Households hold very different amounts of wealth. The literature on wealth inequality underscores four main mechanisms which affect households' saving behaviour and wealth accumulation: Heterogeneity in lifetime earnings, intergenerational transfers and the willingness to leave bequests, motives for precautionary savings and governmental transfers. Some new theoretical models have shifted their focus on alternative explanations, such as differences in time preferences, expectations about the future, health, longevity and income shocks and, more recently, differences in financial knowledge. In the following, we discuss this literature and, then, we overview the empirical findings on financial literacy and wealth outcomes.

wealth-to-income ratio for College and Less than High School groups) decreases as the knowledge production function becomes more concave. In other words, the robustness analysis suggests that less-educated households have higher marginal returns to financial literacy, while better-educated individuals have flatter wealth-financial literacy slopes.

2.1 Theoretical Models

Starting from the simplest version of the life-cycle model of consumption-saving behaviour, individuals are assumed to be forward-looking, aiming to maintain a fairly constant standard of living over their lifetimes (Modigliani, F. and Brumberg (1954)). This model implies that the relationship between labour market income, consumption and saving vary over the life cycle; people maximize their expected lifetime utility by accumulating and then de-cumulating wealth effectively over their lifetimes. Such a mechanism is plausible in theory. However, in reality it is not the primary mechanism at work. Life-cycle saving cannot explain the very highly concentrated levels of wealth we observe in practice and emprirical evidence shows that wealth accumulation and consumption follow different patterns than that predicted by the model (see e.g. Dynan et al. (2010)).

One of the first innovations in the standard life-cycle theory has been the introduction of precautionary saving motives (Deaton (1992)). In a world with large short-term income fluctuations, a buffer of precautionary savings could be the main reason to protect oneself against these shocks. In another attempt to explain heterogeneity in motives for saving, Hubbard et al. (1995) highlight the role of Social Security benefits. According to their model, governmental transfers may crowd out private saving and discourage wealth accumulation.

Although a large majority of individuals accumulate wealth for their own life cycle purposes, some of them might care for the financial welfare of their descendants. The literature on inequality and bequest behaviour is vast and it posits that intergenerational transfers vary considerably across families and might have a strong impact on the levels of wealth accumulation (see e.g. Davies (1982); Laitner (1992)).

In recent years, new theoretical advances have shifted their focus on individuals' preferences. For instance, Cagetti (2003) suggests that consumers differ significantly in terms of time preferences and rates of risk aversion, and the combination of these two may explain differences in their savings choices. In addition, household composition, such as the household size (Attanasio et al. (1999); Scholz et al. (2006)), has also been suggested as a potential channel generating wealth inequality, by directly affecting discount factors or the marginal utility of consumption. Finally, De Nardi et al. (2011) suggest that differences in medical expenses and life expectancies can also explain part of the observed divergence in wealth accumulation and especially among the elderly.

Each of these models represents a useful theoretical advance, however, their ability to explain the amount of wealth concentration observed in the data is dubious (De Nardi and Fella (2017)). One of the main assumption these models are based on

is that people are able to undertake complex economic calculations and make optimal financial decisions related to wealth accumulation/decumulation and retirement planning. However, this is far from reality; Individuals are often found to lack basic levels of financial knowledge conducive to making financial decisions and executing complex financial plans (see e.g. Hilgert et al. (2003); Lusardi and Mitchell (2007b); Lusardi et al. (2010); Lusardi and Mitchell (2011a)). The importance of financial knowledge is highlighted even further by the multiple challenges that individuals face nowadays[4] and the necessity to take charge of their financial security and their retirement preparation. Therefore, a recent wave of papers (Delavande et al. (2008); Jappelli and Padula (2013); Hsu (2016); Lusardi et al. (2017)) has begun to push for more realistic models of saving and consumption behaviour, allowing for the acquisition of human capital in the form of financial knowledge.

For instance, Jappelli and Padula (2013) consider a multi-period life cycle model with endogenous financial literacy. In the empirical part of their analysis, they utilize data from SHARE and show that there is a strong relationship between financial literacy and wealth over the life cycle, with both increasing until retirement and decreasing thereafter. However, in their model, they do not explore the potential heterogeneous effects of financial literacy and its implications for wealth inequality. This gap is addressed by a more recent study by Lusardi et al. (2017) who develop a multi-period life-cycle model and investigate the role of financial literacy as a potential channel of heterogeneity in wealth outcomes[5]. When they allow for concavity in the financial-knowledge production function, by reducing the elasticities of returns to financial knowledge (i.e. $\alpha<1$), they find that wealth inequality decreases. In other words, their analysis suggests that -except for the case of a linear production function- less-educated households have higher marginal returns to financial literacy investments, while better-educated individuals have flatter wealth-financial literacy investment slopes.

This paper departs from the recent theoretical contribution of Lusardi et al. (2017) to examine empirically how the effects of financial literacy vary across the wealth distribution, who benefits most and what the implications are for wealth

[4]In the recent years, the financial and economic landscape across several European countries has undergone significant alterations; there has been rapid technological changes and markets innovation as well significant changes in the pension system. For instance, advanced credit and mortgage lending procedures have implemented, while a wide range of alternative financial services have grown widespread. In addition, the shift from defined benefits (DB) to defined contribution (DC) pension plans has led to an increasingly personalized retirement environment, in which individuals are responsible for their own well-being.

[5]In the model they develop, Lusardi et al. (2017) incorporate all the key features of standard theoretical models, such as borrowing constraints, mortality risk, demographic factors, stock market returns, and earnings and health shocks.

inequality.

2.2 Empirical Studies

A large number of studies have examined the effect of financial literacy on individuals' economic behaviour and its implications for their welfare. Much of the extant literature has focused on the link between financial literacy and retirement preparation and its impact on wealth accumulation. In a series of studies, Lusardi and Mitchell (2007a,c, 2011a,b) show that more financially literate individuals in the U.S. are more likely to plan for retirement, and therefore to accumulate more wealth. Banks et al. (2011) use data from the UK and show that numeracy levels are strongly correlated with various measures of wealth and retirement saving outcomes. More recently, Clark et al. (2017) employ administrative data linking investment performance of a retirement plan and employees' financial knowledge and show that higher financial literacy is associated with more profitable investing.

Another group of studies has analysed the role of financial literacy on people's financial welfare through saving and investment choices. Bernheim (1995, 1998) was among the first to note the strong association between financial literacy and savings, as well as differences in saving behaviour. van Rooij et al. (2011) find that financial literacy induces participation in the stock market and boosts wealth accumulation. On the other hand, financial ignorance can result in significant welfare costs. Calvet et al. (2007) examine the economic costs of underdiversification in Sweden and they find that for a median household the lack of diversification can lead to an annual return loss of 2.9% on a risky portfolio, or 0.5% of household disposable income. In addition, Cocco et al. (2005) calculate welfare losses amounting to 4% of wealth, due to lower participation rates in the financial markets.

Some other authors examine the role of financial literacy on debt management and the choice of debt products. For instance, Campbell (2006) find that less literate individuals are the least likely to refinance their mortgages, something which comes with important costs due to higher interest rates, and Agarwal et al. (2009) provide evidence that older individuals are more likely to incur higher fees and are prone to the use of high-cost borrowing. Similar findings are reported in a subsequent study designed by Lusardi and Tufano (2015). Finally, Gerardi et al. (2010) report that less knowledgeable individuals were 20% more likely to default on their mortgages during the Great Recession in the United States.

All these studies document important links between financial literacy and several economic behaviours, and they offer significant insights into the role of financial literacy on individuals' welfare. However, the relationship between financial literacy

and wealth inequality has largely remained unexplored and the issue of endogeneity has not been addressed by many studies[6].

There are two empirical studies which are closer to our work; the first one uses data from Chile and evaluates the effects of financial literacy and schooling on different measures of wealth holdings (Behrman et al. (2012)). The authors employ several instruments for both financial literacy and schooling attainment in order to isolate their causal effects on wealth accumulation. Their results show that both financial literacy and schooling attainment have significant positive effects on wealth outcomes. When they instrumentalise the key variables, they find that financial literacy has even stronger effects on wealth than the ones suggested by ordinary least-squares estimates. The second study uses 2005 data from the De Nederlandsche Bank (DNB) Household Survey (DHS) and focuses on the relationship between financial literacy and household wealth (van Rooij et al. (2012)). The authors run an ordinary least-squares regression and provide evidence of a positive and statistically significant relationship between financial literacy and wealth holdings after controlling for various determinants of wealth, such as income, age, education, household composition, as well as risk attitudes and attitudes towards savings. In order to eliminate potential measurement errors, in a second stage, the authors use instrumental variables techniques to assess the causal effect of financial literacy on wealth accumulation.

As far as the methodology is concerned, the use of quantile regressions has been limited in this literature. There is a recent study by Bilias et al. (2017) which uses quantile regressions to examine the link between intemporal changes in the equity holdings in the U.S, changing characteristics of the stockholding pool and net wealth inequality. The authors conclude that the changes in the characteristics of the stockholding pool, and especially those characteristics related to investors' financial attitudes and practices (and therefore linked to financial literacy), are the main reason explaining the shifts in stock market participation between the 1990s and 2000s. The authors also find that inequality in the ownership of equity is positively related to wealth inequality. In another study, Christelis et al. (2013) use quantile regressions to examine whether the differences in the distributions of asset

[6]The existing empirical literature on financial literacy has mainly focused on between-levels inequality. This channel of inequality is responsible for differences in mean wealth accumulation associated with individuals having different financial literacy levels. Such differences are related to OLS and they are not informative about the potential heterogeneous effects of financial literacy across the wealth distribution. The lack of studies on this topic is quite surprising, especially due to the recent theoretical developments by Lusardi et al. (2017) who develop a multi-period life cycle model with endogenously determined financial literacy and examine the effects of financial literacy on wealth within a distributional setting.

ownership rates in the US and Europe are due to differences in the population's characteristics or/and differences in economic environments.

This study adds to this literature by exploring the heterogeneous effects of financial literacy across the wealth distribution and its implications for wealth inequality. Our rich data set allows us to investigate this relationship in a European setting, accounting for several potential indicators of wealth, such as income, age, schooling, inheritance, risk attitudes, household characteristics and macro-economic effects. Moreover, to correct for the potential endogeneity of financial literacy, we use a rich set of plausible exogenous instruments and we run IV quantile regressions.

3 Data and descriptive statistics

3.1 Survey of Health, Ageing, and Retirement in Europe

In our study, we use data from the SHARE (Survey of Health, Ageing, and Retirement in Europe). SHARE is the most comprehensive European dataset on households portfolios and wealth holdings, covering mature market participants (aged 50 and above) who control a large portion of society's resources and wealth, yet still face the biggest disparities in terms of wealth accumulation. SHARE is designed to ensure comparability with other international ageing surveys, such as the English Longitudinal Study of Ageing (ELSA) and the U.S. Health and Retirement Study (HRS). By this time, SHARE has collected five panel waves[7] (2004/05, 2006/07, 2011/12, 2013 and 2015) on current individual life circumstances and a divergent wave on life histories[8] (2008/09, SHARELIFE).

In our analysis, we use the fifth wave (2013) which covers 14 European countries and provides detailed information on household wealth and financial literacy, along-

[7]The first wave, which was conducted in 2004/05, collects and provides detailed information from 30,434 respondents in eleven European countries: Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, and Switzerland. Israel also joined the SHARE framework at the end of 2004. Three new countries, Czech Republic and Poland and Ireland, participated in the second wave of the survey, which was conducted in 2006. The number of observations in the second wave rises to 37,900. The life history data were collected in the third wave (SHARELIFE) and provided information for 29,699 respondents across fourteen countries for the period 2008-09. The participation of new countries as well as the national samples of the current European countries increased importantly in the last three regular panel waves, which were conducted in 2011/12, 2013 and 2015 respectively. Estonia, Hungary, Portugal and Slovenia joined the survey for the first time in the fourth wave (2011), in which 59,358 SHARE respondents were interviewed. In addition, Luxemburg was added in the fifth wave (2013), storing information for 68,419 respondents. Finally, the picture of the ageing process across Europe is completed with the addition of Croatia in the last wave (2015), which provides information for 71,606 respondents.

[8]By the end of 2024, four additional panel waves are being planned to take place on a biennial basis. The preparation and design of the Wave 7 questionnaire has already been completed and combines both a life history interview and a regular panel interview for Wave's 3 respondents.

side several demographic characteristics and personality traits. The main reason we chose this specific wave for our analysis is because it contains a mini-childhood module[9] which involves questions about individuals' childhood, such as school performace, number of books in the residence, as well as the family's living and health conditions. This information comes as a complement to wave 3 (SHARELIFE) and is used in the second part of our analysis, in the context of the instrumental variables empirical strategy. Table 1 summarizes the country participation in the fifth wave (2013) of the survey and the number of observations per country.

Table 1: Country participation in SHARE Wave 5 (2013).

Country	#Respondents	Percent
Austria	4,560	6.66
Belgium	5,792	8.47
Czech Republic	5,866	8.57
Denmark	4,279	6.25
Estonia	6,083	8.89
France	4,650	6.80
Germany	5,783	8.45
Israel	2,794	4.08
Italy	4,902	7.16
Luxemburg	1,610	2.35
Netherlands	4,253	6.22
Slovenia	3,010	4.40
Spain	6,976	10.20
Sweden	4,745	6.94
Switzerland	3,116	4.55
Total	68,419	100.00

We limit our attention to Europe and thus Israel is excluded from the analysis. This leaves the research sample with 14 European countries and 2,794 less observations. In addition, we restrict our sample to individuals between the ages of 30 and 100 years old (2,223 observations are deleted). In order to exploit as much of the available information as possible for the regression analysis and to decrease the item non-response bias, missing values of steady characteristics (such as gender, year of

[9]The main module files are part of the general questionnaire and are repeated in each wave, providing information on Demographics and Networks, Children, Physical Health, Behavioural Risks, Cognitive Function, Mental Health, Health Care, Employment and Pensions, Grip Strength, Social Support, Financial Transfers, Housing, Household Income, Consumption, Assets, Activities and Expectations. SHARE also includes seven additional modules which are not part of every wave and contain information on Mini Childhood (only in wave 5), Social Networks, Computer Use, Walking Speed, Chair Stand, Blood Sample and Peak Flow.

birth) and childhood life information, have been fixed and replaced with non-missing values from other waves. The same methodology was used in the case of our key independent variable (financial literacy), as well as in the case of risk attitudes and time preferences[10]. In addition, imputed variables were used in the case of our independent variable (wealth) and some other indicators. After excluding from the analysis all cases with missing values on at least one variable, the final sample is formed to 56,370 - 54,936, depending on the specification.

3.2 Variable Definitions and Descriptive Statistics

3.2.1 Wealth

We study the heterogeneous effects of financial literacy on household wealth at different points of the wealth distribution and its implications for wealth inequality. Due to the substantive number of missing values in the original series, we use SHARE's imputed variable[11] for net household wealth [12]. In this setting, wealth corresponds to net worth and is defined as the sum of real and financial assets net of debts and liabilities. A detailed classification of the three wealth components is presented below:

- **Real assets**: they reflect the sum of the value of the main residence net of mortgage, other real estate, owned businesses and vehicles. The calculations take into account percentages of ownership, wherever they apply.
- **Financial Assets**: they are measured as the sum of values of bank and other transaction accounts, individual retirement accounts, government and corporate bonds, stocks, mutual funds, contractual savings for housing, and life insurance policies.
- **Liabilities**: they include debt on cars and other vehicles, credit cards debts, loans from banks, building societies and other financial institutions as well as debts to relatives or friends and overdue bills.

SHARE obtains financial information from the primary respondent and all monetary

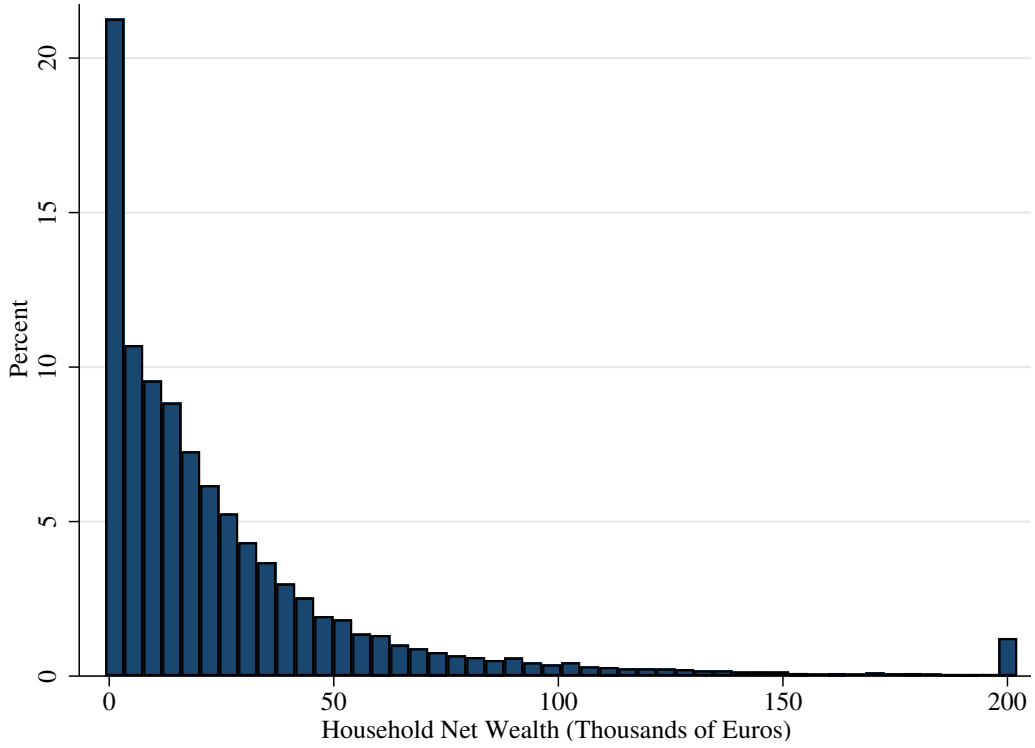
[10]Financial literacy has been shown to be a slow moving variable with depreciation rates to be estimated around 3-6% yearly (Lusardi et al. (2017))). In our study, we assume that individuals do not experience depreciation in their knowledge and maintain the same level of financial literacy as in a previous or following year. In the case of risk attitudes and time preferences, they are assumed to be constant over time.

[11]For more information on the imputation methodology please see De Luca et al. (2015).

[12]The terms "net household wealth", "household wealth" and "wealth" are used interchangeably in this study and they all refer to household net worth.

values are expressed in Euro currency[13]. Because the distribution of wealth is highly skewed and it also contains negative and zero values (as shown in Figure 1), we follow a standard practice suggested in the literature, to log-transform net wealth. Unlike other studies which treat negative values before the log transformation[14], we choose to exclude them from the analysis in order to avoid issues of stacking and mass outliers at the low end of the distribution (Friedline et al. (2015)).

Figure 1: Distribution of Net Household Wealth.



3.2.2 Financial Literacy

We create a measure of financial literacy from the set of numerical and financial questions, available in SHARE. Our financial literacy index is measured as the number of correct answers out of four questions, covering numeracy (one question), sales discount (two questions) and interest rate compounding (one question). The exact wording of the questions is given below:

Question 1: "If the chance of getting a disease is 10% how many people out of 1,000 would be expected to get the disease?".

[13]For the purpose of this analysis, PPP transformations are not necessary, as we are not proceeding to cross-country comparisons.

[14]This refers to a common strategy in the literature based on which all negative values are converted to positive by adding to each original value a sufficient amount (a started log), so as that the entire range becomes positive

Question 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?".

Question 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?".

Question 4: "Let's say you have 2,000 euro in a savings account. The account earns 10% interest each year. How much would you have in the account at the end of two years?".

Similar surveys in the US and the UK, such as the U.S. Health and Retirement Study (HRS) and the English Longitudinal Study on Ageing (ELSA), have delivered modules with similar questions and have been shown to measure both numeracy and financial literacy (Banks and Oldfield (2007); Stango and Zinman (2009); Lusardi and Mitchell (2009, 2011b)). An important advantage of SHARE's questionnaire is the open-ended format of the questions. This gives individuals the opportunity to answer spontaneously, something that allows us to capture the real level of numeracy and financial knowledge by eliminating potential bias from guessing the correct answer among a set of suggested responses. At the same time, the nature of the questions itself provides a good measure of basic economic and financial knowledge, without focusing on the kind of financial literacy that "elite" groups of the population with experience, for instance, on shares and financial assets are more likely to have.

We construct an index of financial literacy as follows: Respondents who answer the first question correctly are moved forward to a more demanding one (*Question 3*), while those who answer incorrectly, "Don't Know" or "Don't Answer" complete the test by answering an easier one (*Question 2*). If they manage to answer Question 2 correctly they get 1 point, otherwise 0. The last question (*Question 4*) is only asked of individuals who managed to provide a correct answer to Question 3 and is commonly regarded as a very good proxy for testing basic financial literacy (see e.g. Lusardi and Mitchell (2008); Atkinson and Messy (2010); Lusardi et al. (2010)). We create a financial literacy index by combining these questions into a single summary index, which shows the number of correct answers out of four questions.

Figure 2 presents the distribution of financial literacy responses across Europe in 2013. About 19% of the respondents answered correctly to all four questions while 5% did not manage to answer any question correctly. The majority of the individuals gave between two and three correct answers. In particular, 33.68% of the individuals answered correctly to three questions and approximately another 30% gave two correct answers. The remaining 13.13% managed to answer only one question correctly.

Figure 2: Distribution of financial literacy responses.

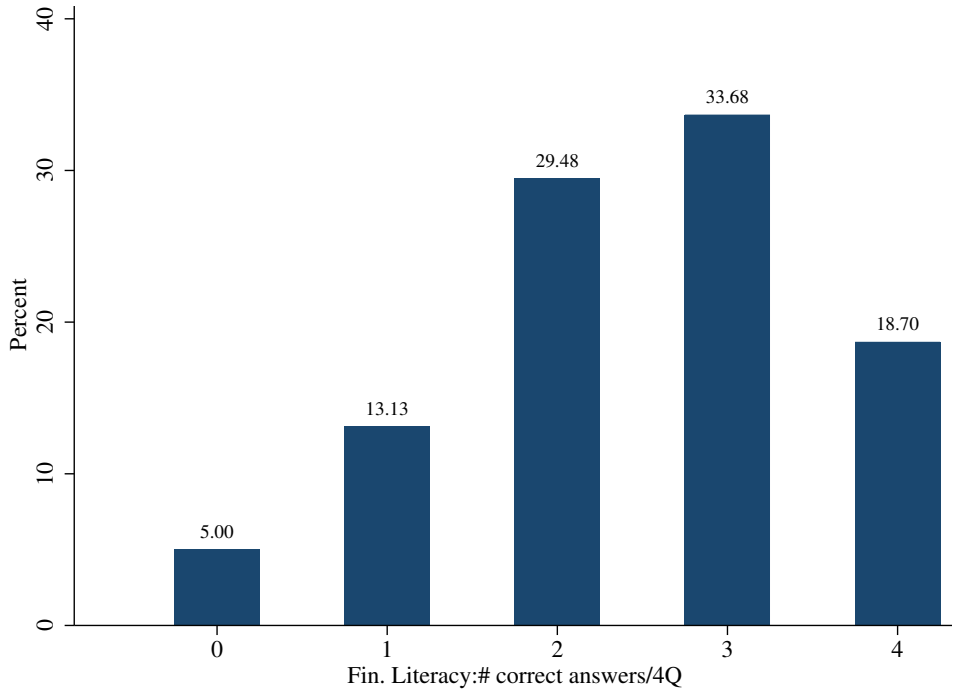


Table 2 presents the descriptive statistics for the basic financial literacy measures (Panel A) and for each of the four financial literacy questions (Panel B) asked in SHARE. The mean number of correct answers is around 2.5 out of 4 questions and about half of the respondents are considered to be "high literate"[15]. As shown in Panel B, the question with the biggest number of correct responses was the first one, with 81.87% of the respondents answering it correctly; All individuals who answered the first question correctly were promoted to Question 3 and almost 64% of them reported the correct answer. The second question was answered only by the individuals who failed to answer the first question correctly (around 12%) and concentrated about 73% of correct answers. A significant 11.53% declined to provide any answer. The last question, which is testing individuals' understanding of interest compounding, was asked only to those who answered Question 3 correctly. This question is of particular interest, as it is considered as a strong indicator of financial literacy. Around one third (35.70%) of the individuals gave the correct answer while the majority of them (63.75%) replied incorrectly.

[15]Following the literature, we define individuals who answer correctly to at least three out of four financial literacy questions as "high literate".

Table 2: Financial Literacy: Descriptive Statistics for the Full Sample and by Year

			Mean (1)	SD (2)	N (3)
Panel A: Financial Literacy measures					
#Correct	Mean number of correct answers out of four question.		2.48	(1.09)	54,628
#Wrong	Mean number of wrong answers out of four question.		1.43	(1.03)	51,826
#DK/DA	Mean number of DK/DA answers out of four question.		0.28	(0.92)	31,420
FL_High	Mean percentage of individuals who have answered at least three questions correctly.		52.39%	(0.50)	54,628
Panel B: Summary statistics-Financial Literacy					
Numeracy	*"If the chance of getting a disease is 10% how many people out of 1,000 would be expected to get the disease?"*	Correct	81.87%	(0.39)	54,628
		Incorrect	14.35%	(0.35)	54,628
		DK/DA	3.78%	(0.19)	54,628
Sales Discount 1	*"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?"*	Correct	72.39%	(0.45)	9,904
		Incorrect	16.07%	(0.37)	9,904
		DK/DA	11.53%	(0.32)	9,904
Sales Discount 2	*"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?"*	Correct	63.99%	(0.48)	44,722
		Incorrect	34.36%	(0.47)	44,722
		DK/DA	1.65%	(0.13)	44,722
Compound Interest	*"You have 2,000 euro in an account, which earns 10% interest each year. How much would you have at the end of two years?".*	Correct	35.70%	(0.48)	28,618
		Incorrect	63.75%	(0.48)	28,618
		DK/DA	0.55%	(0.07)	28,618

Table 3 presents the statistics for two groups of individuals, those with high and those with low levels of financial literacy. Column 3 shows the mean differences between the two groups and the asterisks indicate the level of significance. Our primary interest is the relationship between financial literacy and wealth inequality. Panel A indicates that there is a strongly positive relationship between higher levels of financial literacy and higher levels of wealth accumulation. Moreover, individuals in the first and second quantile of wealth are significantly more likely to belong to the low financial literacy group. The same observation occurs for individuals belonging in the third quantile of wealth, however, the difference in this case is not large. On the other hand, individuals belonging in the highest quantile of wealth are significantly more likely to be high literate.

As shown in Panel B, high literate individuals are more likely to be male and of greater age. They are also significantly more likely to have completed some level of higher education. In addition, high literate individuals are more likely to have a long - term planning horizon and to take more financial risks. It is also clear that married, employed (or self-employed) and higher income individuals are better informed. These observations are consistent with many other surveys on financial literacy all over the world, such as the HRS and other international surveys (see e.g. Lusardi and Mitchell (2011b), for an overview of financial literacy data in eight countries).

Panel C offers an insight into the differences in financial literacy by age-related variables: individuals who performed better in maths and language at the age of ten are significantly more likely to belong in the "high literacy" group. Similarly, individuals who were raised in household with a plethora of books and rooms are more likely to be high literate. By contrast, an increasing household size at the age of ten is negatively related with higher levels of literacy. Finally, high literate individuals are more likely to descent from better educated parents.

{Table 3 about here}

The same associations occur if we look at the correlation matrix (Table 7 in Appendix A).

3.3 Other Variables

Table 4 provides summary statistics for the variables used in the regression analysis. The reported statistics refer to the full sample for the year 2013. Panel A presents the

statistics for all the control variables used in the different regression specifications. The average age of our respondents is approximately 66 years[16], with a standard deviation of 10 years. In our sample, there is a slight female majority, with 55.66% of our respondents being females. The average schooling attainment is 11.21 years and the mean number of inherited items (value 5,000 or more) is 0.17.

In terms of personality traits, about one fourth of the respondents report that they are taking financial risks and 42.19% of them report that they have a long-term planning horizon. In our analysis, we also include a measure of mental health, depression scale, formed by variables measuring depression, pessimism, interest, irritability, concentration and enjoyment among others. Depression scale ranges from 1 to 12, with 1 indicating not depressed and 12 indicating highly depressed. The mean score in our sample is 2.30 and the standard deviation is 2.18.

With regard to traditional demographic characteristics, the big majority (73.81%) of the individuals are married. Approximately 27.5% of the individuals report excellent/very good health, about 38% say that they have good health and an important fraction of 34.5% report fair/poor health. Regarding job status, 56.39% of the respondents are retirees; 28.84% are employed or self-employed and about 15% are inactive (from which 2.65% are unemployed; 8.19% are homemakers; 2.93% are permanently sick/disabled and 1.01% report other). The average number of children per household is 2.14 and the average yearly total household income is just above 46,000 euro.

Panel B presents the summary statistics for the instrumental variables used in the analysis. The age-related variables come from the Mini Childhood module of SHARE which involves questions about individual's childhood, such as school performance, number of books in the residence, as well as the family's living conditions. The same questions are repeated in the fifth wave (2013) of the main questionnaire. In particular, individuals are asked to report their ability in Maths and Language when they were 10 years old. On average, about 33.5% of the individuals report that they did better/much better in Maths compared to the rest of their classmates and about 35% of the respondents say the same for Language. In another question individuals are asked to report the number of books available in the place they lived in when they were 10. Approximately, 17% of the individuals report that they were living in houses with enough books to fill two bookcases (101-200 books) or more (more than 200 books). The fourth and fifth candidate instruments have to do with the amount of rooms and people in the residence at the age of ten and could be

[16]The regression also includes a quadratic form of the age variable to account for potential hump-shaped life-cycle patterns of wealth holdings.

considered as indicators of economic background during childhood. As shown in Table 4, Panel B, the average number of rooms and people per household is 3.8 and 5.45 respectively.

Except for the age-related variables, we also consider some family background factors. In particular, we include in our analysis father's and mother's level of education as potential instruments for financial literacy. With regard to parental education, 11.51% of the individuals reported that their father completed post-secondary education or more, while just above 5% of them reported the same for their mother.

As is generally the case, it is hard to identify suitable and relevant IVs and especially ad hoc. However, SHARE dataset has been used for similar purposes in previous studies and therefore we have an indication for the suitability of specific variables in the context of instrumental variable analysis. For instance, Jappelli and Padula (2013) use SHARE data and propose mathematical skills at school age as a powerful instrument for financial literacy. In our study we consider a broader set of instruments, as described above, and we employ several statistical tests and diagnostics to verify the validity of our instruments, as recommended by Behrman et al. (2012). When the tests indicate to this direction, some of the candidate instruments -that do not appear to be independent of the second-stage disturbance term but do seem to affect household wealth- are included in the regression as control variables. The relevant diagnostics and the instrumental variable selection process are discussed analytically in the next section.

Table 4: Descriptive Statistics.

Variables	Mean	SD	Min	Max
Panel A: Control Variables				
I. Exogenous Indicators				
Male	44.34%	(0.50)	0	1
Age	65.91	(10.03)	30	100
Years of education	11.21	(4.35)	0	25
Number of inherited items (value 5000 or more)	0.17	(0.49)	0	5
II. Personality Traits				
Financial risk tolerance	25.85%	(0.44)	0	1
Long-term planning horizon	42.19%	(0.49)	0	1
Depression scale	2.30	(2.18)	0	12
III. Demographic Characteristics				
Number of children	2.14	(1.30)	0	15
Marital Status: Married	73.81%	(0.44)	0	1
≫: Single	5.38%	(0.23)	0	1
≫: Divorced	8.15%	(0.27)	0	1
≫: Widowed	12.66%	(0.33)	0	1
Health Status: Excellent	8.88%	(0.28)	0	1
≫: Very Good	18.55%	(0.39)	0	1
≫: Good	37.91%	(0.49)	0	1
≫: Fair	26.02%	(0.44)	0	1
≫: Poor	8.64%	(0.28)	0	1
Job Status: Retired	56.39%	(0.50)	0	1
≫: Employed or self-employed	28.84%	(0.45)	0	1
≫: Unemployed	2.65%	(0.16)	0	1
≫: Permanently sick/disabled	2.93%	(0.17)	0	1
≫: Homemaker	8.19%	(0.27)	0	1
≫: Other	1.01%	(0.10)	0	1
Total household income	46,176.08	(82114.85)	2,160.00	1,200,000.00
Panel B: Candidate First-Stage Instruments				
I. Age-Related Variables				
Better-much better performance in maths than the others	33.45%	(0.47)	0	1
Better-much better performance in language than the others	34.82%	(0.48)	0	1
Many books in the residence (enough to fill 2 bookcases or more)	16.97%	(0.38)	0	1
Rooms is the residence	3.84	(2.08)	0	50
People in the residence	5.45	(2.32)	0	50
II. Family Background				
Father's education: Post-secondary or more	11.51%	(0.32)	0	1
Mother's education: Post-secondary or more	5.15%	(0.22)	0	1
# Observations		54,628		

4 Empirical methodology

In this section, we describe our empirical strategy for identifying the effect of financial literacy on household wealth. We first introduce the equations to be estimated and then we briefly describe the estimation methods that we apply, i.e. ordinary least squares (OLS), unconditional quantile regression (UQR) (Firpo et al. (2009)) and a generalized quantile regression which offers an instrumental variable framework for unconditional treatment effects (IV-GQR) (Powell (2017)). Since UQR is not as common as the traditional conditional quantile regression (CQR), we also provide a brief comparison of these two methodologies in order to clarify the advantages of using UQR for the purposes of this study.

4.1 The wealth equations

To estimate the effect of one additional correct financial literacy question on wealth, we consider the empirical framework introduced by Behrman et al. (2012). This approach leads to the following first equation to be estimated:

$$ln(w_i) = \alpha_0 + \beta_{FL} * FL_i + \alpha_1 * C_i + \alpha_2 * E_i + \phi_i + u_i, \quad (1)$$

In equation (1), $ln(w_i)$ is the natural logarithm of net household wealth for individual i. C_i is a vector of observed characteristics[17], E_i is a vector of unobserved individual characteristics, ϕ_i denotes fixed country effects and u_i is an error term. The coefficient of interest is β_{FL}, i.e. the effect of one additional correct financial literacy question on wealth, which we expect to be positive and significant.

As is common in the literature, in the first specification we do not include any other determinants of wealth, such as personality traits, marital, job status, etc. as these variables might be endogenous and might not have a direct effect on wealth (Angrist (2008)). Therefore, Equation (1) posits that there are no other endogenous variables, beyond financial literacy, that directly affect wealth. We further posit that financial literacy is determined by a vector of observed individual characteristics C_i^*[18], by a set of variables Z_i which affect financial literacy but do not directly affect wealth, by unobserved individual characteristics E_i and an error term v_i:

[17] This vector includes exogenous demographic controls plus some of the candidate instruments of financial literacy that do not satisfy the conditions for a good instrument but are apparently strongly correlated with factors that have direct effect on wealth. A more detailed explanation is provided in the paragraphs which follow.

[18] This vector includes all the exogenous indicators, as they are discussed in the previous section (see also Table 4, Panel A)

$$FL_i = \eta_0 + \eta_1 * C_i^* + \eta_2 * E_i + \eta_3 * Z_i + v_i, \tag{2}$$

It is widely acknowledged that financial literacy is endogenous to wealth and therefore the estimates of the coefficinet of interest β_{FL} might not be consistent (Lusardi and Mitchell (2014)). As shown above, there might be unobserved factors E_i, which appear in both equations (1) and (2) and affect simultaneously financial literacy and our dependent variable, wealth. This implies that our estimates might suffer from omitted variable bias, which can lead to either overestimating or underestimating the effect of financial literacy on wealth.

We deal with this issue, by applying an IV approach to isolate the causal effects of financial literacy on wealth. The selection of suitable instruments is a topic of great debate and the literature on financial literacy has used several of them, such as: the financial experiences of siblings and parents (**?**), the financial situation of the oldest sibling (Alessie et al. (2011); Agnew et al. (2013)), temporal and geographic variations in U.S. laws regarding the implementation of financial education at schools (Lusardi and Mitchell (2009)) and the opening of a new university in a local area (Christiansen et al. (2008)). Over the last decade, some emphasis has been given to information on past education and age-related variables. In particular, van Rooij et al. (2012) instrumentalise financial literacy with the level of exposure to economics courses during schooling years. In another study, Jappelli and Padula (2013) use SHARE data to study the effect of financial literacy on wealth accumulation and choose the math literacy endowment at age of ten as an instrument for financial literacy. Finally, in a more recent study, Behrman et al. (2012) use a Chilean dataset and examine a plethora of age-dependent variables, personality traits and family background measures as potential instruments for financial literacy.

Following these latter strands of the literature, in our analysis we identify two categories of potential instruments (they have been analysed in detail in the previous section and are presented in Table 4, Panel B) which include (a) age-related factors such as mathematical and language skills at school age and (b) family background factors, such as parental education. From these instruments, Equation (2) includes only those, Z_i, which satisfy the relevant diagnostics tests[19]. The instruments which do not satisfy the conditions for a good instrument but are apparently strongly

[19]The diagnostic tests that we use are (a) the Angrist-Pische multivariate F test for excluded instruments, (b) the Kleibergen-Paap weak identification test and (c) the Sargan Hansen test for over-identification. These tests allow us to determine which of our instruments are sufficiently strong and whether they are correlated with the second-stage error term or not.

correlated with factors that have a direct effect on wealth, are included in the vector C_i of Equation (1).

To further investigate the relationship between household wealth and financial literacy, except for the basic regression of total net worth (as given in Equation (1)), we consider two more specifications, by successively including additional determinants of wealth (see e.g. Behrman et al. (2012) and van Rooij et al. (2012)). In particular, in the second specification, we add in the model personality traits, such as financial risk tolerance, planning horizon and mental health status; and in the third specification, we add other demographic characteristics X_i, including household composition (the number of children within the household and marital status and), job and health status of the individual and total household net disposable income.

We estimate Equation (1) and the other two specifications with both OLS and UQR to assess heterogeneous response to the increases of financial literacy among individuals. To isolate the causal effect of financial literacy on wealth, we use a 2SLS approach[20] and an IV-GQR, which offers an instrumental variable framework for unconditional treatment effects.

4.2 Unconditional Quantile Regression (UQR)

Introduced by Koenker and Bassett (1978), quantile regression models have been increasingly used in several studies to describe parsimoniously the entire distribution of an outcome variable. Unlike the conventional mean regression models, which can only address the conditional mean or the central effects of a covariate, quantile regression models yield coefficients for each quantile of the conditional distribution of the outcome variable. In the following, we present the basic difference between conditional and unconditional quantile regressions by giving a simple example in the framework of our study and then we describe analytically the model in use.

In the context of CQR, the coefficients represent the marginal effect of a covariate on the t^{th} quantile of the outcome distribution, conditional on mean values of the other covariates considered. This effect is called conditional marginal effect (CME) and is quite different than the unconditional marginal effect (UME), which is obtained by UCR and can be interpreted as the marginal effect of a covariate on the t^{th} quantile of the unconditional distribution of the outcome variable, regardless of the included covariates.

[20]This is done by firstly estimating the first-stage determinants of financial literacy in Equation (2) and then employing these estimates in the second-stage estimate of Equations (1) and the other two specifications.

In the case of OLS, the regression coefficients can be interpreted interchangeably as either CME, i.e. the impact of a covariate on the outcome variable, conditioned on the mean values of the other covariates or UME, i.e. the effect of a marginal change of a covariate on the distribution of the outcome variable in the population, regardless of the included covariates[21] (Firpo et al. (2009)). Therefore, in our study, an OLS estimate of the effect of financial literacy on log wealth of 0.10, for example, means that an extra correct answer would increase average wealth by 10%.

While the CME and UME are equal in the case of OLS regression, this equality does not hold, in general, for quantile regressions. This is due to the fact that CQR does not uncover estimates of marginal increases in the location of a covariate on the t^{th} quantile of the unconditional distribution of the outcome variable. Therefore, in the case of CQR the interpretation of a coefficient changes when different sets of covariates are included in the model. Similarly with the previous example, if the estimated effect of financial literacy (using CQR) on the conditional 90th quantile is 0.05, this does not mean that an extra correct answer would increase the unconditional 90th quantile by 5%. This estimate would only give us an idea about the within-group heterogeneity in wealth holdings due to financial literacy, where the groups are defined by the covariates included in the model. Therefore, given that we are interested in the *overall effect* of financial literacy on wealth inequality, we use UQR which provides estimates of effects on the unconditional quantile (Firpo et al. (2009)). For a numerical example, illustrating the difference between UQR and CQR, see Appendix B.

The UQR approach was introduced by Firpo et al. (2009). The authors estimate the model by using the so-called Recentered Influence function (RIF). This methodology allows regressing the influence function of the unconditional quantile of the outcome variable (in our case the logarithm of net household wealth) on all the covariates. In analytical terms, if the dependent variable Y is observed in the presence of covariates X, so that Y and X have a joint distribution $F_{Y,X}(.;.)$, then we can write the unconditional marginal distribution of Y as follows:

$$F_Y(y) = \int F_{Y|X}(y|X = \chi) * dF_X(\chi), \tag{3}$$

To develop their model, Firpo et al. (2009) define the RIF which is based on the concept of Influence Functions (IF). IFs are largely used in the robust statistics literature to address the impact of changes in the covariates on the value of a statistic

[21] This equality occurs due to the fact that OLS is a linear model and adheres to the law of iterated expectations.

$\nu(F_Y)$ (Hampel, 1974). The IF of the functional ν at F_Y for a given point y is given as follows:

$$IF(y;\nu,F_Y) = \lim_{\epsilon \to 0} \frac{\nu(1-\epsilon) * F_Y + \epsilon * \delta_y - \nu(F_Y)}{\epsilon}, 0 \leq \epsilon \leq 1 \tag{4}$$

where $\nu(F_Y)$ is the cumulative distribution function for Y and δ_y is the probability measure that gives mass 1 at the value y. By analogy with the IF, the first order approximation term is called RIF and is given as follows:

$$RIF(y;\nu,F_Y) = \nu(F_Y) + \lim IF(y;\nu) * d\Delta_y(y) = \nu(F_Y) + IF(y;\nu), \tag{5}$$

By normalizing the $RIF(y;\nu,F_Y)$, it can be written as $RIF(y;\nu)$[22]. For a quantile, the influence function can be written as follows:

$$IF(Y,q_\tau) = (\tau - I\{Y \leq q_\tau\})/f_Y(q_\tau), \tag{6}$$

where $I\{.\}$ is an indicator function, $f_Y(.)$ is the density of the marginal distribution of Y and $q_\tau = Q_\tau[Y]$ is the population $\tau-$quantile of the unconditional distribution of Y.

Subsequently, the RIF for quantiles is given as follows:

$$RIF(Y;q_\tau) = q_\tau IF(Y,q_\tau), \tag{7}$$

In the case of the simplest linear model, like the one we use in this study, we can write:

$$RIF(Y,\tau) = X\beta^{UQR} + \epsilon, \tag{8}$$

where, β^{UQR} is the UQR estimator and X is a vector of independent variables.

As explained by Firpo et al. (2009), β^{UQR} represents the effect of a small change in a covariate X on the location of the distribution of Y, leaving all other features of the distribution unchanged. In other words, the estimated effects of UQR correspond to the marginal effect of the covariate of interest (in our case financial literacy) on the

[22]This is a function with several interesting properties, which are extensively explained by Firpo et al. (2009).

$\tau-$quantile of Y, irrespective of the included set of control variables. Consequently, the estimated effects, β^{UQR} , yield these quantities that most policy oriented studies are interested to: $\partial F_Y(y)/\partial x$. For the estimation of the model we use a Gaussian Kernel estimator, as proposed by Firpo et al. (2009). The standard errors are derived with bootstrapping.

4.3 IV-Generalized Quantile Regression (IV-GQR)

In this paper we use IV-GQR, a method to instrumentilze financial literacy and estimate its causal effects on the unconditional distribution of the outcome variable, i.e. the logarithm of net household wealth. This framework was developed by Powell (2017) and offers a generalization of the tranditional instrumental variable quantile regression techniques, such as the IV-QR which was introduced by Chernozhukov and Hansen (2006) and is used in the case of conditional quantile treatment effects. The IV-QGR estimator comes with several advantages, as it allows for joint estimation of the treatment effects of multiple endogenous variables and it also allows for over-identification.

Following the notation of Powell (2017) we can write the specification of interest as follows:

$$Y = D'\beta(U^*), U^* \sim U(0,1) \tag{9}$$

where Y is the outcome variable of interest, D is the endogenous variable and U^* is the ability or proneness and is modelled as an unknown and unspecified function of observed ability, X, and unobserved ability, U, such as that:

$$U^* = f(X, U), \tag{10}$$

If we assume a more realistic model, which includes other covariates in the specification, then we can rewrite Equation (10) as follows:

$$Y = D'\tilde{\beta}(U) + X'\tilde{\delta}(U), U \sim (0,1), \tag{11}$$

From Equation (11), we can then derive the Structural Quantile Function to be estimated as follows:

$$S_Y(\tau|d,x) = d'\tilde{\beta}(\tilde{\tau}) + x'\tilde{\delta}(\tilde{\tau}), \tag{12}$$

where $\tilde{\tau}$ corresponds to the τ- quantile of U.

In the case of the traditional IV-QR, the addition of covariates, $x'\delta(\tilde{\tau})$ changes the SQF, in which the parameters are no longer assumed to vary by ability, but rather on the unobserved component of the disturbance term. In other words, when covariates are added in the model traditional IV-QR assumes that $U^*|Z \sim U(0,1)$ to estimate the SQF. By contrast, IV-GQR relaxes this assumption and estimates equation (12) assuming that $U^*|Z, X \sim U^*|X$, where the set of instrumental variables Z are only conditionally independent of U^*. The estimation procedure is straightforward and is based on Markov Chain Monte Carlo (MCMC) optimization technique, which is suitable for high dimensional data and yields more accurate results. Additional details about the estimation method can be found in Chernozhukov and Hong (2003).

5 Results

5.1 Baseline Results on Financial Literacy

In this section we present the results of the baseline estimates, focusing on the effect of financial literacy on net household wealth. We begin with a basic regression which includes exogenous only indicators and extend this specification by successively including additional determinants of wealth. Tables 5a, 5b and 5c in Appendix A report the results.

The mean regression estimates (Column 1, Table 5a) yield a financial literacy effect of 17.7%, which indicates that net household wealth rises by almost 18% on average with each extra correct financial literacy question. The effect is highly significant (at 1%) and is in line with many previous studies (see e.g. **?**Behrman et al. (2012); Jappelli and Padula (2013)).

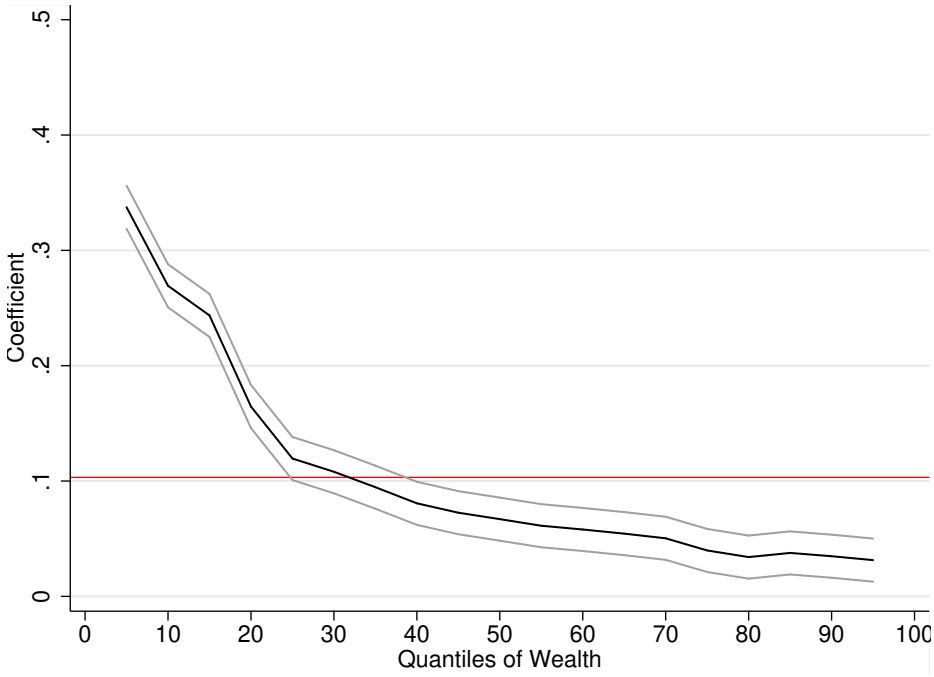
When we allow for heterogeneous effects of financial literacy across the wealth distribution, we obtain some interesting results. UQR estimates (Columns 2-10, Table 5a) show that the impact of financial literacy decreases over the unconditional quantiles of wealth. In particular, at the lowest decile of the wealth distribution (τ=10), the effect of financial literacy is 43.6%, which decreases to 11.6% at the median (τ=50), and reaches a low of 6.8% at the top decile (τ=90). These results suggest that the marginal effect of financial literacy falls across the wealth distribution and that the largest gains to additional financial knowledge accrue to individuals at the low end of the unconditional distribution of wealth. The results also reveal useful information about the effect of financial literacy on overall wealth inequality; As individuals get more financially literate the "90-50 gap" (the difference between the 90th and the 50th quantile of net household wealth) decreases by

about 5%, and, more importantly, the "50-10 gap" by 32%.

{Table 5a about here}

To provide a graphical illustration of these results, Figure 3 reports the quantile-specific effects of financial literacy from τ=5 to τ=95 and compares them against the mean regression estimate (depicted with red line).

Figure 3: Financial literacy effects, UQR estimates - 1st Specification.



The evidence from the next two specifications (Tables 5b and 5c) is similar, except for a slight drop in the effect of financial literacy as we introduce in the regression additional wealth determinants. In particular, the OLS regression estimates show that an additional correct financial literacy question increases, on average, net household wealth by 14.3% (Table 5b) and 10.3% (Table 5c) respectively. If we focus on the effects of financial literacy across the whole distribution (Columns 2-10, Tables 5b and 5c) a stylized fact comes out from the analysis: Financial literacy has significant heterogeneous effects on different quantiles of wealth and the marginal effect of financial literacy is substantially higher at the lower quantiles, following a decreasing trend across the unconditional distribution of wealth. Moreover, the effect of financial literacy on overall wealth inequality remains high and significant with the "50-10 gap" decreasing by 27% (Table 5b) to 20% (Table 5c) and the "90-50 gap" by 4.5% (Table 5b) and 3.2% (Table 5c), based on the specification.

{Table 5b and 5c about here}

A potential explanation of these results concerns how we interpret the quantile index. Following the interpretation originally described by Mwabu and Schultz (1996) (and since then adopted by many other authors, see e.g.Arias et al. (2001); Balestra and Backes-Gellner (2017)) we can interpret the quantile index as a measure of unobserved ability. Based on that, if ability and financial literacy are substitutes, then one would expect marginal effects of financial literacy to decrease with ability and hence financial literacy to contribute relatively more to low ability individuals. On the other hand, if ability and financial literacy are complements, then financial literacy would have an additional indirect effect that would results to higher returns for the more able individuals. In this setting, individuals with lower unobserved ability benefit more from an increase in their level of financial literacy. If, therefore, we accept that individuals with higher wealth are individuals with higher unobserved ability then the estimates suggest that the slope of their wealth-financial literacy profile is flatter than that of individuals at the lower deciles of wealth. An important detail in this interpretation, is the way we measure financial literacy. Given the specificities of our financial literacy index which is comprised by three basic numerical questions and a more difficult one capturing financial knowledge, one would say that the financial literacy measure used in the analysis is a measure for basic financial knowledge rather than sophisticated financial knowledge. Therefore, the estimated results are to the expected direction.

5.2 Results on other covariates

In this section, we analyse the results on some key control variables. To do so, we focus on the full estimates of the third specification which includes all the control variables, as shown in Table 5c in Appendix A.

The OLS coefficient on gender indicates that there is a negative association between net household wealth and being a male. Similar findings are reported by Behrman et al. (2012) who find a negative association between housing wealth and being a male. If we look at the UQR estimates (Columns 2-10, Table 5c), we observe that gender is not a relevant determinant of wealth accumulation at lower quantiles of wealth (between τ=10 and τ=30), however it becomes statistically and economically important for higher quantiles of wealth (for τ=40 or more).

Another traditional determinant of wealth is age. The UQR estimates (Columns 2-10, Table 5c) show that there is a progressively weaker association between age and net household wealth, as we move from lower to higher quantiles of wealth.

Special attention should be given to the next variable, years of education. As we can see from the OLS regression estimates (Column 1, Table 5c), an extra year of education increases net household wealth by 2.6%, on average. If we switch our attention to the effects of education across the distribution of wealth (Columns 2-10, Table 5c), two interesting findings can be observed: first, the effect of education over the wealth distribution is significantly lower than the effect of financial literacy across the distribution; Second, education moves to the opposite direction as compared to financial literacy, i.e. the marginal effect of education is higher at higher quantiles of wealth, following a increasing trend across the unconditional wealth distribution. Despite the lack of evidence regarding the heterogeneous returns of education over the wealth distribution, recent studies in labour economics have shed some light on the relation between schooling and wage inequality. Martins and Pereira (2004) utilize data from 16 countries and show that returns to schooling are higher for the more educated individuals. However, in a subsequent paper Balestra and Backes-Gellner (2017) conduct a similar empirical exercise and show that once endogeneity is taken into account, the results change and education actually yields higher returns at lowers quantiles of the wage distribution.

Regarding the effect of inheritance over the wealth distribution, we observe that there is a strong positive association between the no. of inherited items and wealth accumulation. UQR estimates (Columns 2-10, Table 5c) suggest that the impact of inheritance follows a downward trend until the 8th decile and then increases slightly at the top decile (τ=90). In particular, at the bottom decile (τ=10), the effect of inheritance is 54.80%, which decreases to 22% at the median (τ=50), and then increases slightly again to 31.90% at the top decile (τ=90).

Some interesting results occur in the case of family-background variables. In particular, in the case of father's education, the UQR estimates reveal two interesting findings: first, the effect of father's education is only present above a certain point of the unconditional wealth distribution. In particular, it becomes statistically and economically important only for higher quantiles of wealth (for τ=50 or more); and second, father's education affects positively wealth accumulation, however the effects are substantially lower at lower quantiles of the wealth distribution and increase gradually as we move towards higher quantiles of the distribution.

In addition, we estimate a strong association between financial risk tolerance and wealth accumulation as well as long-term financial planning and wealth accumulation. We find that willingness to take financial risks is positively related with wealth accumulation and has substantial heterogeneous effects across the unconditional wealth distribution: Bigger willingness to take financial risks boosts wealth

holdings of individuals at the lower tails of the distribution (10th decile) by about 53%; whereas, in the higher tails of the wealth distribution (90th decile) greater risk taking has a substantially smaller effect of about 39%. Similar patterns are observed for the planning horizon variable: longer planning horizons are associated with an increase in net household wealth and this effect is more intense for the lower quantiles of wealth and decreases as we move towards higher quantiles of wealth.

The results for the remaining controls, used in the third specification, are shown in Appendix A, Table 5c.

5.3 Causal effects of financial literacy

While it becomes clear that financial literacy has highly significant effects across the wealth distribution, we cannot evaluate the true impact of financial literacy on wealth without addressing the bias introduced by the endogeneity of financial literacy. Therefore, in the following we examine how financial literacy affects wealth holdings, by considering both heterogeneity and endogeneity simultaneously.

For the estimation of the IV models, we consider an extensive set of potential instruments and we use several diagnostic tests (such as F tests for excluded instruments, Kleibergen-Paap test for underidentification and Hansen J statistic for over-identification) to determine the validity of our instruments. Our candidate instruments, which are described in detail in the Data Section and are also presented in Table 4, Panel B, include (a) age-related factors and (b) family background variables. We find that only two out of the seven plausible instruments satisfy the conditions of good instruments, the *Performance in Maths at the age of 10* and the *Performance in Language at the age of 10*, and are, therefore, those which are selected for the IV estimation process. The rest of the candidate instruments – namely, *Books in the residence at the age of 10, Rooms in the Residence at the age of 10, People in the residence at the age of 10* and *Father's and Mother's Education*– do not seem to satisfy the null hypothesis of Hansen J test which requires them to be independent of the second-stage disturbance term. However, they do seem to affect wealth accumulation directly, in addition to indirect effects through financial literacy.

In particular, in all of the IV regressions (Panels A-C, Table 6), the F test of the instruments excluded from the second stage indicates that they are jointly significant with Prob $>$ F $=$ 0.0000 in predicting the endogenous regressor (i.e. financial literacy). Moreover, the p-values for the Hansen J statistic are by far larger than the usual 0.05 significance level and, therefore, the null hypothesis that the instruments are independent of the second, cannot be rejected. These diagnostics

suggest that our estimates are satisfactory and can actually isolate the causal effect of financial literacy on wealth.

Table 6 in Appendix A provides the results from the 2SLS estimates (Column 1) and the IV-GQR (Columns 2-10) estimates. In the following, we focus our analysis on Panel A, Table 6, which presents the results for the third specification, which includes the full set of covariates.

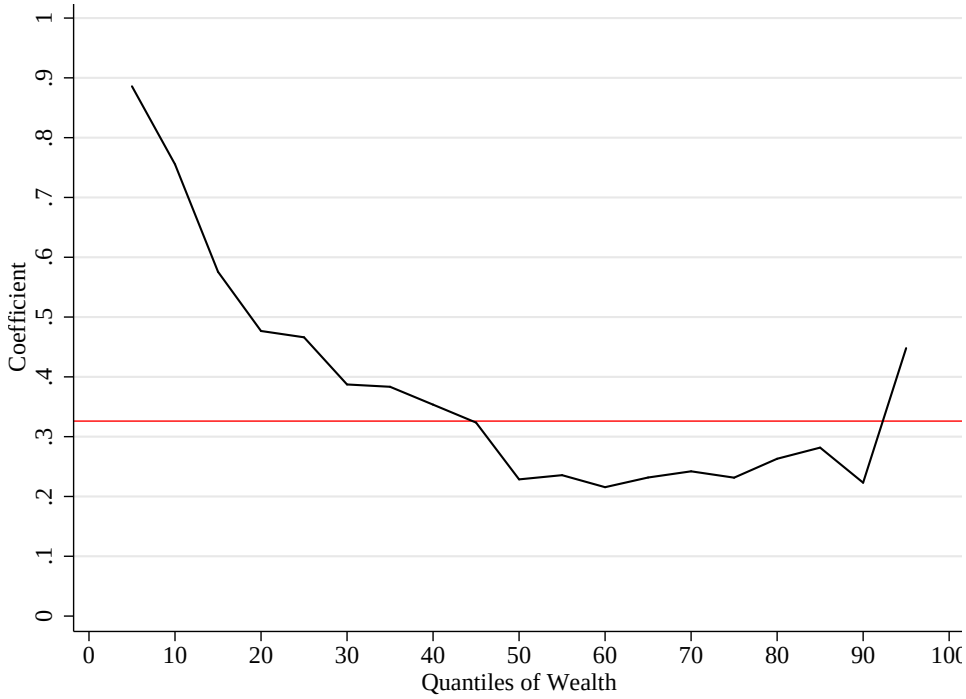
The 2SLS regression estimates reveal the true average effect of financial literacy on net household wealth: an extra correct answer could increase net household wealth by about 33% on average. Conditionally upon the validity of our instruments, this result suggests that the OLS estimates suffer from a downward bias.

When we allow for heterogeneity in the returns, like those of the UQR analysis, the IV-GQR results confirm a robust stylized fact: financial literacy has significant heterogeneous effects over the unconditional wealth distribution. However, the magnitude and the shape of the estimated effects is quite different, compared to the baseline results: the effect of financial literacy is big in the lower tail of the unconditional wealth distribution, drops sharply until the $50th$-$60th$ decile and then it increases slightly at the top. In particular, at the lowest decile (τ=10), an extra correct financial literacy question has the power to increase net household wealth by 75.90%; this effect decreases gradually to around 40% at τ=30, 35.6% at τ=40 and to around 23% at the median, in order to hit a low of 21.6% at τ=60. After that, the effect of financial literacy increases slightly and ranges between 24% and 26% for the upper tail of the wealth distribution. These results indicate that those who benefit most from additional accumulation of financial knowledge are individuals at the lowest end of the unconditional wealth distribution. If we now focus our attention on the between-quantiles effects of financial literacy, we see that as individuals become more financially literate there is a minor decrease in the "90-50 gap" by about 0.5%, but, more importantly, the "50-10 gap" decreases by about 50%. This suggests that financial literacy can improve substantially the position of individuals at the lower tail of the wealth distribution, who are those mostly in need, and therefore it can be a powerful tool for public policy against wealth inequality.

{Table 6 about here}

Figure 4 presents a graphical illustration of the results on the third specification, for the full distribution of wealth (from t=5 to t=95 with frequency equal to 5) and compares them against the estimates from the 2SLS model, which is shown in red.

Figure 4: Financial literacy effects, IV-GQR estimates - 3rd Specification.



6 Conclusions

In this paper, we use an IV generalized quantile regression technique (IV-GQR) to isolate the causal link between financial literacy and wealth at different quantiles of the unconditional wealth distribution, as well as to evaluate its implications for wealth inequality. Our estimates suggest that the true effect of financial literacy on the distribution of wealth is significantly heterogeneous. We provide significant evidence that no "unique" effect of financial literacy exists and that for individuals with different wealth profiles, the true effect of financial literacy may deviate considerably from these documented in the literature so far by mean regression estimates or two-stage least squares. Moreover, we provide evidence about the significant role of financial literacy in reducing wealth inequality.

In particular, we present two novel findings. First, financial literacy has significantly higher effects at lower quantiles of the wealth distribution, which drop gradually as we move across the wealth distribution. An increase in financial knowledge boosts wealth holdings of individuals at the top end of the distribution ($90th$ decile) by about 22%; whereas, in the lower tails of the wealth distribution (10th decile), financial literacy has a striking effect of almost 76%. Second, financial literacy can reduce wealth inequality. The results show that improvements in financial knowledge can decrease the "50-10 wealth gap" by almost 50%.

A potential explanation of these results concerns how we interpret the quantile index. If we interpret the quantile index as a measure of unobserved ability, based on which individuals with higher wealth are individuals with higher unobserved ability, then the estimates suggest that the slope of their wealth-financial literacy profile is flatter than that of individuals at the lower deciles of wealth.

Our findings may have important implications for both researchers and policy-makers. Our results indicate that wealthier individuals may acquire more financial literacy, not because they receive higher marginal benefits but because they face lower marginal costs. Therefore, given the significant role of financial literacy in reducing wealth inequality, public policy frontiers and official organizations across Europe should aim to provide targeted and subsidized access to these groups of individuals who can benefit most from investments in financial knowledge, i.e. the less-wealthy individuals.

Our work can be extended in several ways. First, the SHARE data that we are using in this study cover a specific cohort of European households, aged 50 and above. Therefore, our results cannot be generalized for younger households and this is something that researches could explore in the future.

Second, in this paper, we do not focus on cross-country comparisons. Although, our results have a pan-European character, it might be of interest for researches and policy-makers to look separately at the causal effects of financial literacy across different countries' wealth distributions, if they intend to design their policies based on the specificities of each country.

Overall, this study shows that the typical OLS estimates do not offer a parsimonious characterization of the impact of financial literacy on wealth holdings and cannot be used to draw conclusions about the pressuring issue of wealth inequality. More sophisticated tools -which allow for heterogeneity and at the same time control for endogeneity- should be used to inform public policy making. Our results suggest that (a) individuals at the lower quantiles of wealth are those who can benefit most from financial literacy and (b) as more individuals become financially literate, overall wealth inequality decreases.

7 Appendix A

Table 3: Mean differences between individuals with high and low financially literacy.

	FL_High (1)	FL_Low (2)	T-test (3)
Panel A: Net Household Wealth			
Average Net Household Wealth	342,342.78	244,729.40	31.19***
1st Quantile of Net Household Wealth: $[0-25]$	15.47%	21.32%	-17.75***
2nd Quantile of Net Household Wealth: $(25-50]$	22.23%	26.78%	-12.38***
3rd Quantile of Net Household Wealth: $(50-75]$	26.33%	28.16%	-4.8***
4th Quantile of Net Household Wealth: $(75-100]$	35.97%	23.74%	31.4***
Panel B: Control Variables			
I. Exogenous Indicators			
Male	50.32%	37.75%	29.77***
Age	64.49	67.48	-35.26***
Years of education	12.35	9.95	67.06***
No of inherited items (worth 5000 or more)	0.21	0.13	17.96***
I. Personality Traits			
Financial risk tolerance	33.31%	17.63%	42.51***
Long-term planning horizon	48.91%	34.81%	33.66***
Depression scale	1.95	2.68	-39.46***
II. Demographic Characteristics			
Number of children	2.12	2.17	-5.18***
Marital Status: Married	76.18%	71.2%	13.24***
$\gg$: Single	5.58%	5.16%	2.14**
$\gg$: Divorced	8.85%	7.37%	6.3***
$\gg$: Widowed	9.39%	16.26%	-24.25***
Helth Status: Excellent	11.05%	6.51%	18.69***
$\gg$: Very Good	22.75%	13.92%	.71***
$\gg$: Good	38.93%	36.79%	5.13***
$\gg$: Fair	21.79%	30.67%	-23.73***
$\gg$: Poor	5.48%	12.11%	-27.76***
Job Status: Retired	54.47%	58.5%	-9.5***
$\gg$: Employed or self-employed	35.04%	22.02%	33.9***
$\gg$: Unemployed	2.32%	3.02%	-5.1***
$\gg$: Permanently sick/disabled	2.3%	3.63%	-9.19***
$\gg$: Homemaker	5%	11.69%	-28.69***
$\gg$: Other	0.88%	1.15%	-3.19***
Total household income	52,645.62	39,057.85	19.38***
Panel C: Candidate First-Stage Instruments			
I. Age-Related Variables			
Performance in Maths at age of 10	43.97%	21.86%	56.22***
Performance in Language at age of 10	41.43%	27.34%	34.55***
Books in the residence at age of 10	22.8%	10.56%	38.56***

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Table 3 – *Continued from previous page*

	FL_High	FL_Low	T-test
	(1)	(2)	(3)
Rooms is the residence at age of 10	4.01	3.64	20.98***
People in the residence at age of 10	5.24	5.69	-22.48***
II. Family Background			
Father's education: Post-secondary or more	15.57%	7.05%	31.46***
Mother's education: Post-secondary or more	7.15%	2.96%	22.2***
# Observations	28,618	26,010	

Table 5a: Financial Literacy and Net Household Wealth: OLS and UQR estimates.
-1st Specification-

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fin. Literacy:# correct answers/4Q	0.177***	0.436***	0.278***	0.186***	0.142***	0.116***	0.102***	0.088***	0.072***	0.068***
	[0.008]	[0.029]	[0.016]	[0.010]	[0.007]	[0.006]	[0.006]	[0.006]	[0.006]	[0.008]
Male	0.110***	0.322***	0.192***	0.114***	0.075***	0.054***	0.036***	0.033***	0.032***	0.028*
	[0.014]	[0.049]	[0.028]	[0.019]	[0.014]	[0.012]	[0.012]	[0.011]	[0.012]	[0.014]
Age	0.144***	0.365***	0.220***	0.132***	0.101***	0.091***	0.081***	0.071***	0.062***	0.055***
	[0.009]	[0.032]	[0.018]	[0.011]	[0.008]	[0.007]	[0.006]	[0.006]	[0.007]	[0.008]
Age2	-1.120***	-2.885***	-1.747***	-1.048***	-0.794***	-0.704***	-0.615***	-0.533***	-0.458***	-0.393***
	[0.065]	[0.237]	[0.134]	[0.079]	[0.057]	[0.049]	[0.043]	[0.043]	[0.049]	[0.059]
Years of Education	0.048***	0.063***	0.057***	0.048***	0.043***	0.042***	0.043***	0.042***	0.041***	0.043***
	[0.002]	[0.006]	[0.004]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
No. of Inherited items	0.403***	0.752***	0.505***	0.387***	0.316***	0.288***	0.288***	0.312***	0.333***	0.386***
	[0.011]	[0.035]	[0.025]	[0.015]	[0.012]	[0.012]	[0.011]	[0.013]	[0.016]	[0.023]
No. of Rooms in Residence at age 10	0.067***	0.115***	0.079***	0.060***	0.055***	0.053***	0.053***	0.051***	0.053***	0.065***
	[0.005]	[0.015]	[0.009]	[0.005]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.006]
No. of People in Residence at age 10	-0.031***	-0.062***	-0.038***	-0.029***	-0.027***	-0.026***	-0.021***	-0.019***	-0.019***	-0.024***
	[0.004]	[0.012]	[0.007]	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.002]	[0.003]
Many Books in Residence at age 10	0.104***	0.152**	0.112***	0.067**	0.075***	0.074***	0.081***	0.081***	0.132***	0.166***
	[0.020]	[0.064]	[0.042]	[0.026]	[0.019]	[0.018]	[0.017]	[0.016]	[0.019]	[0.025]
Father's Education: Post-secondary or more	0.105***	0.064	0.054	0.008	0.041*	0.072***	0.100***	0.154***	0.196***	0.241***
	[0.024]	[0.082]	[0.049]	[0.031]	[0.025]	[0.021]	[0.020]	[0.021]	[0.022]	[0.034]
Mother's Education: Post-secondary or more	-0.015	-0.072	-0.02	0.009	-0.003	-0.012	0.009	0.023	0.027	0.057
	[0.033]	[0.103]	[0.063]	[0.043]	[0.033]	[0.028]	[0.028]	[0.029]	[0.032]	[0.046]

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Table 5a – *Continued from previous page*

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
(Pseudo-)R^2	0.1784	0.0508	0.1013	0.1528	0.1878	0.2015	0.2065	0.2007	0.1854	0.1479
# Observations	56,370	56,370	56,370	56,370	56,370	56,370	56,370	56,370	56,370	56,370

Table 5b: Financial Literacy and Net Household Wealth: OLS and UQR estimates.
-2nd Specification-

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fin. Literacy:#correct answers/4Q	0.143***	0.364***	0.224***	0.148***	0.113***	0.092***	0.080***	0.069***	0.050***	0.047***
	[0.008]	[0.031]	[0.016]	[0.01]	[0.007]	[0.006]	[0.006]	[0.006]	[0.006]	[0.008]
Male	0.017	0.127***	0.056**	0.019	0.002	-0.013	-0.027**	-0.027**	-0.023**	-0.034**
	[0.014]	[0.048]	[0.028]	[0.02]	[0.014]	[0.012]	[0.011]	[0.011]	[0.012]	[0.015]
Age	0.138***	0.345***	0.207***	0.128***	0.099***	0.088***	0.079***	0.071***	0.062***	0.056***
	[0.009]	[0.032]	[0.018]	[0.011]	[0.008]	[0.006]	[0.006]	[0.006]	[0.006]	[0.008]
Age2	-1.037***	-2.658***	-1.603***	-0.979***	-0.751***	-0.654***	-0.575***	-0.508***	-0.434***	-0.380***
	[0.065]	[0.24]	[0.132]	[0.08]	[0.059]	[0.047]	[0.043]	[0.042]	[0.044]	[0.056]
Years of Education	0.039***	0.046***	0.045***	0.039***	0.036***	0.035***	0.037***	0.036***	0.035***	0.036***
	[0.002]	[0.007]	[0.004]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
No. of Inherited items	0.367***	0.693***	0.444***	0.354***	0.289***	0.262***	0.261***	0.285***	0.307***	0.355***
	[0.011]	[0.033]	[0.022]	[0.016]	[0.013]	[0.012]	[0.012]	[0.013]	[0.015]	[0.022]
No. of Rooms in Residence at age 10	0.061***	0.106***	0.069***	0.055***	0.051***	0.047***	0.048***	0.046***	0.049***	0.059***
	[0.005]	[0.015]	[0.009]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.006]
No. of people in Residence at age 10	-0.03***	-0.057***	-0.036***	-0.028***	-0.026***	-0.024***	-0.021***	-0.018***	-0.017***	-0.022***
	[0.004]	[0.013]	[0.007]	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Many Books in Residence at age 10	0.087***	0.107	0.091**	0.055**	0.062***	0.067***	0.069***	0.071***	0.117***	0.144***
	[0.02]	[0.067]	[0.04]	[0.025]	[0.019]	[0.017]	[0.017]	[0.017]	[0.018]	[0.025]
Father's Education: Post-secondary or more	0.083***	0.019	0.029	-0.007	0.026	0.051**	0.087***	0.138***	0.181***	0.219***
	[0.024]	[0.079]	[0.046]	[0.032]	[0.022]	[0.020]	[0.019]	[0.020]	[0.023]	[0.035]
Mother's Education: Post-secondary or more	-0.03	-0.088	-0.028	-0.009	-0.007	-0.026	0.002	0.009	0.01	0.05
	[0.033]	[0.105]	[0.066]	[0.04]	[0.031]	[0.028]	[0.027]	[0.027]	[0.033]	[0.047]

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Table 5b – *Continued from previous page*

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Financial Risk Tolerance	0.414***	0.685***	0.524***	0.379***	0.328***	0.315***	0.334***	0.355***	0.376***	0.435***
	[0.015]	[0.054]	[0.033]	[0.021]	[0.016]	[0.014]	[0.014]	[0.015]	[0.016]	[0.022]
Long-Term Plan. Horizon	0.377***	0.942***	0.541***	0.376***	0.286***	0.238***	0.204***	0.185***	0.172***	0.173***
	[0.015]	[0.056]	[0.032]	[0.02]	[0.015]	[0.013]	[0.013]	[0.012]	[0.012]	[0.018]
Depression	-0.056***	-0.131***	-0.087***	-0.063***	-0.047***	-0.037***	-0.030***	-0.024***	-0.018***	-0.015***
	[0.004]	[0.013]	[0.008]	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
(Pseudo-)R^2	0.2047	0.0627	0.1165	0.1706	0.2047	0.2171	0.2222	0.2170	0.1999	0.1577
# Observations	54,966	54,966	54,966	54,966	54,966	54,966	54,966	54,966	54,966	54,966

Table 5c: Financial Literacy and Net Household Wealth: OLS and UQR estimates.
-3rd Specification-

MODELS	OLS	UQR								
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fin. Literacy:#correct answers/4Q	0.103***	0.269***	0.165***	0.108***	0.081***	0.067***	0.058***	0.050***	0.034***	0.035***
	[0.007]	[0.027]	[0.017]	[0.009]	[0.007]	[0.006]	[0.006]	[0.006]	[0.006]	[0.008]
Male	-0.024*	0.029	-0.009	-0.032	-0.034**	-0.036***	-0.044***	-0.040***	-0.031***	-0.037**
	[0.014]	[0.049]	[0.030]	[0.019]	[0.014]	[0.012]	[0.012]	[0.011]	[0.012]	[0.016]
Age	0.129***	0.308***	0.191***	0.114***	0.092***	0.083***	0.078***	0.075***	0.071***	0.080***
	[0.009]	[0.034]	[0.019]	[0.012]	[0.008]	[0.007]	[0.007]	[0.006]	[0.007]	[0.009]
Age2	-0.902***	-2.242***	-1.364***	-0.804***	-0.647***	-0.577***	-0.526***	-0.496***	-0.460***	-0.503***
	[0.068]	[0.250]	[0.135]	[0.083]	[0.059]	[0.051]	[0.048]	[0.047]	[0.052]	[0.062]
Years of Education	0.026***	0.021***	0.027***	0.027***	0.026***	0.026***	0.029***	0.029***	0.029***	0.031***
	[0.002]	[0.007]	[0.004]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
No. of Inherited items	0.302***	0.548***	0.355***	0.287***	0.241***	0.220***	0.220***	0.245***	0.269***	0.319***
	[0.010]	[0.032]	[0.020]	[0.015]	[0.012]	[0.011]	[0.012]	[0.013]	[0.014]	[0.022]
No. of Rooms in Residence at age 10	0.056***	0.098***	0.060***	0.049***	0.045***	0.042***	0.044***	0.042***	0.044***	0.055***
	[0.004]	[0.015]	[0.008]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]
No. of people in Residence at age 10	-0.027***	-0.051***	-0.031***	-0.023***	-0.023***	-0.022***	-0.019***	-0.017***	-0.017***	-0.023***
	[0.003]	[0.012]	[0.007]	[0.004]	[0.003]	[0.003]	[0.003]	[0.002]	[0.002]	[0.003]
Many Books in Residence at age 10	0.086***	0.120*	0.095**	0.051**	0.054***	0.059***	0.063***	0.061***	0.106***	0.126***
	[0.019]	[0.064]	[0.042]	[0.025]	[0.019]	[0.016]	[0.016]	[0.015]	[0.019]	[0.025]
Father's Education: Post-secondary or more	0.078***	0.045	0.026	-0.019	0.021	0.042**	0.076***	0.124***	0.164***	0.196***
	[0.022]	[0.078]	[0.046]	[0.030]	[0.023]	[0.019]	[0.019]	[0.020]	[0.023]	[0.033]
Mother's Education: Post-secondary or more	-0.026	-0.089	-0.027	0.004	0.001	-0.023	0.003	0.011	0.01	0.052
	[0.031]	[0.105]	[0.060]	[0.038]	[0.031]	[0.026]	[0.026]	[0.028]	[0.031]	[0.046]

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Table 5c – *Continued from previous page*

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Financial Risk Tolerance	0.344***	0.537***	0.422***	0.305***	0.275***	0.264***	0.289***	0.311***	0.332***	0.392***
	[0.014]	[0.053]	[0.032]	[0.021]	[0.016]	[0.014]	[0.014]	[0.014]	[0.015]	[0.023]
Long-term planning horizon	0.290***	0.737***	0.408***	0.291***	0.218***	0.182***	0.155***	0.142***	0.135***	0.137***
	[0.014]	[0.056]	[0.028]	[0.019]	[0.015]	[0.013]	[0.012]	[0.012]	[0.013]	[0.017]
Depression scale	-0.015***	-0.033**	-0.023***	-0.020***	-0.014***	-0.010***	-0.008***	-0.005*	-0.002	-0.004
	[0.004]	[0.014]	[0.008]	[0.005]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]
No. of children	-0.050***	-0.157***	-0.074***	-0.052***	-0.041***	-0.032***	-0.022***	-0.012***	0.007*	0.017***
	[0.006]	[0.020]	[0.011]	[0.007]	[0.006]	[0.005]	[0.004]	[0.004]	[0.004]	[0.006]
Marital Status (Ref: Single)										
	[0.006]	[0.020]	[0.011]	[0.007]	[0.006]	[0.005]	[0.004]	[0.004]	[0.004]	[0.006]
≫: Married	0.707***	1.753***	1.003***	0.685***	0.493***	0.413***	0.388***	0.347***	0.287***	0.267***
	[0.039]	[0.144]	[0.071]	[0.047]	[0.034]	[0.029]	[0.024]	[0.023]	[0.025]	[0.031]
≫: Divorced	-0.156***	-0.647***	-0.384***	-0.180***	-0.106***	-0.086***	-0.038	-0.027	-0.049*	-0.047
	[0.048]	[0.179]	[0.086]	[0.059]	[0.039]	[0.032]	[0.029]	[0.027]	[0.029]	[0.036]
≫: Widowed	0.275***	0.601***	0.296***	0.233***	0.183***	0.166***	0.152***	0.127***	0.096***	0.094***
	[0.045]	[0.158]	[0.078]	[0.056]	[0.037]	[0.032]	[0.027]	[0.026]	[0.028]	[0.034]
Health Status (Ref: Poor)										
≫: Excellent	0.412***	0.728***	0.522***	0.390***	0.370***	0.321***	0.283***	0.282***	0.276***	0.259***
	[0.038]	[0.137]	[0.073]	[0.047]	[0.034]	[0.030]	[0.028]	[0.028]	[0.031]	[0.043]
≫: Very Good	0.338***	0.720***	0.483***	0.327***	0.262***	0.230***	0.200***	0.178***	0.167***	0.117***
	[0.034]	[0.131]	[0.068]	[0.043]	[0.031]	[0.026]	[0.025]	[0.022]	[0.025]	[0.031]
≫: Good	0.242***	0.530***	0.342***	0.242***	0.210***	0.157***	0.117***	0.096***	0.056***	-0.016
	[0.032]	[0.121]	[0.064]	[0.040]	[0.028]	[0.023]	[0.021]	[0.019]	[0.021]	[0.025]
≫: Fair	0.112***	0.279**	0.122**	0.078**	0.084***	0.063***	0.034*	0.023	0.01	-0.006
	[0.032]	[0.117]	[0.059]	[0.038]	[0.028]	[0.021]	[0.019]	[0.018]	[0.019]	[0.022]

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Table 5c – *Continued from previous page*

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Job Status (Ref: Retired)										
≫: Employed or self-employed	0.080***	0.221***	0.153***	0.053*	0.027	0.009	0.023	0.037**	0.040**	0.110***
	[0.021]	[0.074]	[0.045]	[0.028]	[0.021]	[0.018]	[0.017]	[0.018]	[0.020]	[0.027]
≫: Unemployed	-0.556***	-1.703***	-0.710***	-0.439***	-0.325***	-0.306***	-0.193***	-0.131***	-0.070**	0.001
	[0.057]	[0.193]	[0.100]	[0.064]	[0.046]	[0.037]	[0.036]	[0.032]	[0.030]	[0.039]
≫: Permanently sick/disabled	-0.376***	-1.118***	-0.451***	-0.370***	-0.269***	-0.206***	-0.120***	-0.095***	-0.109***	-0.006
	[0.053]	[0.191]	[0.105]	[0.063]	[0.042]	[0.037]	[0.033]	[0.031]	[0.030]	[0.039]
≫: Homemaker	0.119***	0.312***	0.271***	0.113***	0.053*	0.053**	0.076***	0.078***	0.082***	0.135***
	[0.029]	[0.100]	[0.058]	[0.036]	[0.028]	[0.024]	[0.023]	[0.022]	[0.023]	[0.030]
≫: Other	-0.049	-0.235	-0.028	-0.004	-0.03	0.015	0.084	0.159***	0.204***	0.317***
	[0.086]	[0.275]	[0.146]	[0.086]	[0.069]	[0.059]	[0.053]	[0.055]	[0.059]	[0.087]
ln(Income)	-8.682***	-1.359	4.907**	-1.732	-6.740***	-11.658***	-15.964***	-19.041***	-20.932***	-23.742***
	[1.221]	[4.518]	[2.280]	[1.481]	[0.957]	[0.837]	[0.834]	[0.811]	[0.999]	[1.461]
ln(Income)2	0.954***	0.472	-0.229	0.327**	0.756***	1.192***	1.579***	1.847***	1.998***	2.227***
	[0.114]	[0.418]	[0.211]	[0.138]	[0.090]	[0.079]	[0.080]	[0.078]	[0.096]	[0.141]
ln(Income)3	-0.033***	-0.024*	0.001	-0.014***	-0.027***	-0.039***	-0.051***	-0.059***	-0.062***	-0.068***
	[0.004]	[0.013]	[0.006]	[0.004]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]	[0.005]
cons	29.501***	-15.171	-25.810***	4.406	25.329***	44.443***	60.722***	72.678***	80.796***	91.939***
	[4.329]	[16.059]	[8.173]	[5.265]	[3.369]	[2.928]	[2.896]	[2.786]	[3.409]	[4.974]
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
(Pseudo-)R^2	0.2695	0.0998	0.1573	0.2125	0.2441	0.2562	0.2577	0.2499	0.2270	0.1775
# Observations	54,636	54,636	54,636	54,636	54,636	54,636	54,636	54,636	54,636	54,636

Table 6: Financial Literacy and Net Household Wealth: 2SLS and IV-GQR estimates.

MODELS	OLS	UQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Exogenous Indicators (1st Specification)										
Fin. Literacy:#correct answers/4Q	0.492***	1.029***	0.777***	0.574***	0.473***	0.358***	0.319***	0.297***	0.320***	0.319***
	[0.038]	[0.035]	[0.041]	[0.033]	[0.023]	[0.017]	[0.020]	[0.013]	[0.019]	[0.016]
Cons	5.491***	6.495***	8.454***	9.775***	10.525***	11.172***	11.549***	11.888***	12.145***	12.645***
	[0.294]	[0.149]	[0.117]	[0.093]	[0.077]	[0.048]	[0.045]	[0.032]	[0.042]	[0.037]
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
# Observations	55,156	55,156	55,156	55,156	55,156	55,156	55,156	55,156	55,156	55,156
F-statistic of excluded instruments	1035.69***									
Kleibergen-Paap (LM statistic)	1948.519***									
Hansen J statistic	0.001									
Endogeneity test	76.641***									
Panel B: Exogenous Indicators & Personality Traits (2nd Specification)										
Fin. Literacy:#correct answers/4Q	0.397***	0.873***	0.647***	0.469***	0.381***	0.293***	0.254***	0.261***	0.283***	0.255***
	[0.039]	[0.042]	[0.041]	[0.036]	[0.020]	[0.025]	[0.017]	[0.012]	[0.015]	[0.009]
Cons	5.562***	7.051***	8.938***	10.058***	10.736***	11.316***	11.715***	11.987***	12.256***	12.723***
	[0.295]	[0.156]	[0.071]	[0.092]	[0.058]	[0.052]	[0.036]	[0.025]	[0.035]	[0.011]
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
# Observations	53,885	53,885	53,885	53,885	53,885	53,885	53,885	53,885	53,885	53,885
F-statistic of excluded instruments	980.27***									
Kleibergen-Paap (LM statistic)	1846.438***									
Hansen J statistic	0.022									
Endogeneity test	46.819***									

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Table 6 – *Continued from previous page*

MODELS	2SLS	IV-GQR							
VARIABLES		τ=10	τ=20	τ=30	τ=40	τ=50	τ=60	τ=70	τ=80	τ=90
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel C: Exogenous Indicators, Personality Traits & Demographic Characteristics (3rd Specification)										
Fin. Literacy:#correct answers/4Q	0.326***	0.759***	0.475***	0.388***	0.356***	0.229***	0.216***	0.242***	0.264***	0.224***
	[0.038]	[0.046]	[0.040]	[0.032]	[0.028]	[0.019]	[0.016]	[0.011]	[0.012]	[0.016]
Cons	29.192***	7.402***	9.314***	10.232***	10.831***	11.440***	11.813***	12.039***	12.332***	12.818***
	[4.370]	[0.142]	[0.194]	[0.072]	[0.069]	[0.038]	[0.040]	[0.036]	[0.028]	[0.050]
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
# Observations	53,559	53,559	53,559	53,559	53,559	53,559	53,559	53,559	53,559	53,559
F-statistic of excluded instruments	946.94***									
Kleibergen-Paap (LM statistic)	1787.899***									
Hansen J statistic	1.344									
Endogeneity test	38.427***									

Note: This table presents the marginal effects and the robust standard errors from 2SLS estimates (Column 1) and IV-GQR estimates (Columns 2-10). Panel A presents the results for the first specification, which includes only exogenous indicators (i.e. *Male, Age, Age2, Years of Educations and No. of Inherited Items*). Panel B shows the estimates from the second specification, in which we add personality traits (i.e. *Financial Risk Tolerance, Long-Term Plannning Horizon and Level of Depression*). The results from the third specification are presented in Panel C, in which we add demographic characteristics (i.e. *No. of Children, Marital Status, Health Status, Job Status, Ln(Income), Ln(Income)2 and Ln(Income)3*). Finally, five more variables (i.e. the *No. of Rooms in Residence at age 10*, the *No. of People in Residence at age 10*, the *No. of Books in the Residence* as well as *Father's and Mother's Education*) out of the set of the seven plausible instruments , which do not satisfy the conditions of good instruments, are included in the above specifications as control variables. The excluded instruments are two: *Performance in Maths at age of 10* and *Performance in Language at age of 10*.

Table 7: Correlation Matrix.

	Ln(Wealth)	FL_Correct	Male	Age	Years of Educ.	Inher. Items	Maths_age 10	Lang._age 10	Books_age 10	Rooms_age 10	People_age 10	Father's Educ.	Mother's Educ.
Ln(Wealth)	1												
FL_Correct	0.1609*	1											
Male	0.0674*	0.1485*	1										
Age	-0.1005*	-0.1966*	0.0394*	1									
Years of Educ.	0.1676*	0.3266*	0.0646*	-0.2348*	1								
Inher. Items	0.1719*	0.0923*	0.0162*	-0.0964*	0.1503*	1							
Maths_age 10	0.0948*	0.2599*	0.0663*	0.0023	0.2139*	0.0411*	1						
Lang._age 10	0.0633*	0.1570*	-0.1077*	0.0094*	0.2226*	0.0372*	0.3893*	1					
Books_age 10	0.0897*	0.1803*	-0.0227*	-0.1184*	0.2802*	0.0834*	0.1257*	0.1860*	1				
Rooms_age 10	0.1962*	0.1095*	0.0099*	-0.0944*	0.1473*	0.1249*	0.0576*	0.0631*	0.1919*	1			
People_age 10	-0.0309*	-0.1092*	-0.0000	0.0622*	-0.1581*	-0.0383*	-0.0271*	-0.0718*	-0.0691*	0.2559*	1		
Father's Educ.	0.0839*	0.1442*	-0.001	-0.0598*	0.2280*	0.0790*	0.0833*	0.1241*	0.3409*	0.1489*	-0.0604*	1	
Mother's Educ.	0.0518*	0.1001*	-0.0152*	-0.0807*	0.1783*	0.0480*	0.0650*	0.0945*	0.2621*	0.0985*	-0.0440*	0.3598*	1

Note: * indicate significance at 0.05.

8 Appendix B

To explicitly illustrate the differences between UQR and CQR, let us consider a simple example in which we are interested in the heterogeneous effects of financial literacy, FL_i, on the logarithm of wealth, $ln(w_i)$. Assume that the model includes only country fixed effects, γ_i, as control variables and it can be written as follows:

$$ln(w_i) = \alpha_0 + \alpha_1 * FL_i + \gamma_i + \epsilon_i \tag{13}$$

The distribution of wealth varies considerably across countries. Table 8 presents the mean wealth holdings (Column 1) and the average wealth holdings for the $1st$, $2nd$, $3rd$ and $4th$ quantile for the total sample and for each country separately. As shown in Table 8, Austria and Sweden are two countries with very different wealth distributions: Austria has one of the lowest average wealth holdings (214,148 Euro) and Sweden has the one of the highest levels of wealth accumulation (388,859 Euro) among all countries, on average. In the case of Austria, the $1st$ quantile (Q=1) holds on average 10,987 Euro, while the $1st$ quantile (Q=1) in the case of Sweden holds on average 16,096 Euro. For the whole population, the $1st$ quantile (Q=1) holds on average 13,302 Euro.

Table 8: Distribution of net household wealth across countries.

	Mean	Q=1	Q=2	Q=3	Q=4
	(1)	(2)	(3)	(4)	(5)
Austria	214,148.72	10,987.86	92,315.44	214,884.49	616,093.45
Belgium	399,312.66	11,493.42	94,126.93	233,308.56	640,242.79
Czech Republic	94,973.60	17,876.32	82,258.23	200,802.03	448,536.68
Denmark	417,929.11	13,763.00	91,154.21	218,555.77	779,841.55
Estonia	100,932.92	15,338.96	76,356.78	208,771.86	441,343.53
France	328,269.52	10,045.46	95,518.53	224,090.10	608,362.36
Germany	243,330.51	12,541.70	87,071.26	220,808.15	635,163.88
Italy	270,355.95	8,332.69	97,965.76	216,281.12	589,770.15
Luxembourg	796,608.98	9,063.87	77,404.86	243,328.98	973,893.69
Netherlands	273,671.27	10,596.74	89,811.96	222,652.34	626,678.76
Slovenia	171,297.54	14,364.33	89,036.00	207,103.63	466,683.60
Spain	255,960.06	12,706.98	94,994.84	213,327.86	681,704.61
Sweden	388,859.13	16,096.97	91,019.63	221,967.38	750,509.58
Switzerland	609,427.01	14,556.51	81,435.63	228,257.47	966,048.75
Full Sample	342,342.78	13,302.24	88,197.30	218,556.25	704,794.60

When we include in the regression country fixed effects, the CQR $1st$ quantile

estimator produces an estimate of an increase in financial literary on individuals who hold on average 9,063 Euro in Luxembourg, 12,706 Euro in Spain, 14,556 in Switzerland, 17,876 in Check Republic, and many other values in between for the rest of the countries. Thus, the individuals who belong in the $1st$ quantile in Switzerland have very different wealth profiles than the individuals who belong in the $1st$ quantile in Spain, for instance; and the $1st$ quantile of wealth for each of these countries might also deviate considerably than the 1st quantile of wealth for the total sample. On the other hand, the UQR $1st$ quantile estimator yields the impact of financial literacy on wealth holdings for those who belong in the $1st$ quantile of wealth in the total sample and hold on average 13,302 Euro, regardless of the country of residence.

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