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Financial Literacy and Stock Market Participation in Sweden

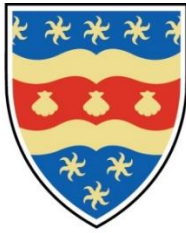
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UNIVERSITY OF PLYMOUTH

FINANCIAL LITERACY AND STOCK MARKET PARTICIPATION IN SWEDEN

by

DMITRIJ KATKOV

A thesis submitted to the University of Plymouth

in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

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Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed a part of any other degree either at the University of Plymouth or at another establishment.

A programme of advanced study was undertaken, which included training for research philosophy and methodology.

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Abstract

FINANCIAL LITERACY AND STOCK MARKET PARTICIPATION

Dmitrij Katkov

Global pension reforms and an ever-increasing sophistication of financial markets have led many households to take more personal responsibility for their own wealth accumulation and investment choices. Previous research has demonstrated that most of households worldwide do not invest in stocks despite the tenets of portfolio and lifecycle theories. This dissertation aims to explore one of the key explanations behind low levels of stockholding – a lack of financial literacy. Previous research has indicated that globally, most households lack financial literacy. The literature, however, has several shortcomings: a lack of a cohesive definition of financial literacy, the concept is operationalised inadequately, and many research papers have poor controls for endogeneity bias. To redress these shortcomings, this thesis takes a mixed methods approach. First, a comprehensive financial literacy test is developed and analysed using item response theory: the survey included 1554 respondents who are the customers of a large Swedish bank. The determinants of financial literacy were identified by a regression analysis, and the link between objective and self-reported financial literacies was explored. Instrumental variable probit regression was conducted to explore the effect of financial literacy on both direct and indirect stockholdings. Interviews with financial advisors were conducted in order to acquire more information on household motivation and how financial literacy is acquired. The findings suggest that there is an adequate level of financial literacy among the Swedish population, and there is a disconnect between objective financial literacy and a subjective one, thus rendering the latter a poor proxy. One's level of financial literacy turned out to be a significant predictor of direct stockholding, but the effect was weaker for indirect stockholding. The financial literacy test developed here can be used in subsequent research and can include other financial instruments. The link between financial literacy and financial education and/or financial advice can be further explored.

Keywords: Financial literacy, stockholding, household

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List of Abbreviations

CTT	Classical Test Theory
FA	Financial Advisor
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
HFNC	Household Finance and Consumption Network
ICC	Item Characteristic Curve
ID	Item Discrimination
IF	Item Facility
IRT	Item Response Theory
MiFID	Markets in Financial Instruments Directive
OFL	Objective Financial Literacy
OLS	Ordinary Least Squares
SCF	Survey of Consumer Finances
SFL	Subjective Financial Literacy

Chapter 1: Introduction to the Study

The purpose of this study is to enhance our understanding of financial literacy and to evaluate its influence on the stockholding decision by households. The first section of this chapter explains why households should own stocks within their financial portfolios, the macroeconomic implications of limited participation, and an overview of stockholding. The second section relates the phenomenon of low levels of stockholding to financial literacy. The third section presents the research gap that this study aims to fill. The fourth section explains the purpose of the study. The fifth section provides an overview of significance of the study. Finally, in the sixth section, the organisation of the dissertation is outlined.

1.1 Limited Stockholding Conundrum

1.1.1 Rationale for Holding Stocks

Each household must make continuous decisions about how to allocate its income: while a portion of it will inevitably be consumed, the remaining portion may be used to accumulate wealth. There have been several attempts to describe what may drive such an allocation. One of the earliest theories was proposed by Keynes (1936), which stipulates that the marginal and total propensity to save increases as income rises; accordingly, a family's level of consumption is related to and dependent on income. During the 1950s, Modigliani, Brumber and Ando (1953) developed the life-cycle theory of consumption, with its underlying premise that the level of savings is dependent on the age and income of a household; as income increases during middle age, the utility-maximising household ought to save a portion of that income in order to sustain consumption during the retirement phase when income is reduced or halted. Under this model, wealth accumulation follows a hump-shaped pattern that peaks during middle age and is significantly lower throughout youth and retirement. Although the theory has drawn multiple criticisms — for not incorporating the bequest motive, for example (Baranzini,

2005) — it is now widely accepted that the “hump-shaped” wealth accumulation profile is followed by a majority of households (Campbell, 1986; Deaton, 2005; Hamilton and Hepburn, 2017).

Wealth accumulation can be achieved through a wide variety of financial instruments, including cash, savings accounts, bonds, stocks, art and others. All of these financial instruments carry a varying level of expected return and risk.

Table 1.1 summarises the various rates of return as well various risk measures for four main asset classes for the USA in the period 1928 to 2019.

Table 1.1
Rates of Return and Risk Measures

	Nominal Returns				Real Returns			
	S&P 500	3-m. T.Bill	US T. Bond	Baa Corporate Bond	S&P 500	3-m. T.Bill	US T. Bond	Baa Corporate Bond
Mean return	11.57%	3.40%	5.15%	7.22%	8.41%	0.43%	2.17%	4.22%
Geometric mean	9.71%	3.35%	4.88%	6.96%	6.65%	0.37%	1.85%	3.87%
Standard deviation	19.58%	3.03%	7.67%	7.56%	19.62%	3.57%	8.13%	8.63%
Mean excess return	3.40%		1.75%	3.82%				
Observations	92	92	92	92	92	92	92	92

Note. S&P 500 returns assume reinvestment of dividends. Data are from Damodaran, 2020

According to Jorda et al. (2019), stocks comprised 25.9% of all investable assets throughout developed economies in 2015; contrast that with housing at 19.4% or bonds at 7.7%. Since stocks dominate the investable asset universe and provide a higher rate of return than bonds, this begs the question of whether households should hold stocks in their portfolios and if so, in what proportions.

Various portfolio construction theories have been proposed over the years that try to create an optimal portfolio, one which would achieve the highest possible return at the lowest level of risk. Ground-breaking work on the subject was published by Harry Markowitz in 1952,

for which he later received the Nobel Prize in economics in 1990. His underlying assumption is that investors are risk-averse, and risk here is defined in terms of variances of returns. Investors, he argues, prefer a high rate of return with a minimal level of risk, and their investment decisions are primarily based on these two considerations. However, instead of concentrating on individual asset parameters as his predecessors did, Markowitz focused on how the risk and return parameters change and interact within an entire portfolio. He discovered that although the expected return of a portfolio is the weighted average of the returns of its individual components, the portfolio variance was not. Asset returns are typically not perfectly correlated: combining securities in portfolios leads to a portfolio variance that is lower than the weighted average of the variances of its components. This insight is the core of the diversification principle that guides the investment decisions of many investors today.

By combining various financial instruments in various proportions and observing the resulting variances (mean-variance optimisation process), it is possible to create several efficient portfolios that would maximise the expected return for a given level of risk. The utility-maximising investor would choose one of those efficient portfolios that best fits his or her risk-aversion level. It is also possible to identify the portfolio that would exhibit the highest return per unit of risk (tangency portfolio) and combine it with the risk-free instrument. By changing the proportion of wealth invested in the risk-free asset, an investor can easily adjust the level of risk of the overall portfolio.

While mean-variance analysis has been a great success in practice, it relies on the assumption that investors' foremost concern is the distribution of wealth one period ahead. To broaden this, Mossin (1968), Samuelson (1969) and Merton (1969) pioneered multi-period (long-term) portfolio choice models. Recently, advances in theoretical approaches and numerical methods have made it possible to find solutions to complex long-term portfolio choice problems – for example, intertemporal hedging demands and non-tradable labour

income (see e.g. Brennan, et al., 1997; Campbell and Viceira, 2002; Cocco et al., 2005; Kim and Omberg, 1996; and Viceira, 2001). In the early 90s, Rom and Ferguson (1994) created software that used measures of downside risk (e.g. Sortino ratio) instead of variance, and adjustments for volatility skewness instead of normal distribution, giving rise to post-modern portfolio theory.

Further advances and refinements made to the Modern Portfolio Theory allowed investors to create balanced diversified financial portfolios capable of generating higher rates of return with less risk, as opposed to holding a few assets individually. Even highly risk-averse investors could benefit from a certain percentage of risky assets in their portfolios due to the benefits that come from diversification. Stocks can perfectly represent such risky assets because they have desirable characteristics such as moderate to high liquidity, good inflation-hedging potential, cash flow stream in the form of dividends (for certain types of stock), and a favourable tax environment in many countries.

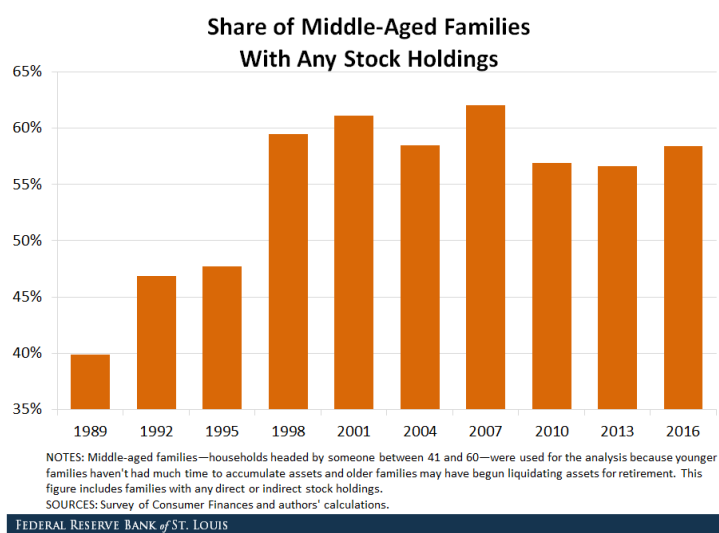
1.1.2 Overview of Stockholding

According to Markowitz Portfolio Theory, including stocks in portfolios is desirable as it can enhance portfolio return without a substantial increase in the amount of risk. This advice, however, is rarely followed in practice. This section provides an overview of stock market participation rates across the globe.

According to the 2016 Survey of Consumer Finances (SCF), a triennial study administered by the USA Federal Reserve, 16.9% of households owned stocks directly and 51.9% either directly or indirectly (i.e. through mutual funds, exchange-traded funds, retirement accounts, and managed accounts). Stocks were most commonly held in the form of tax-deferred retirement accounts (87.8%), followed by direct holdings (26.9%), pooled investment funds (18.9 %), and managed investment accounts (7.3 %) (Bricker et al., 2017).

It is worthwhile to explore changes in stock market participation over the past few decades. Ravikumar (2018) has examined stock market participation rates for middle-aged families (defined as 41 to 60) since the very first survey administered in 1989; the results are presented in the Figure 1.1. The stock market boom of the late 90s attracted many first-time investors, while during the same period, technological developments led to a proliferation of discount brokerages which significantly reduced transaction costs and grew the number of stockholders.

Figure 1.1
Stockholding of Middle-Aged Families in the USA



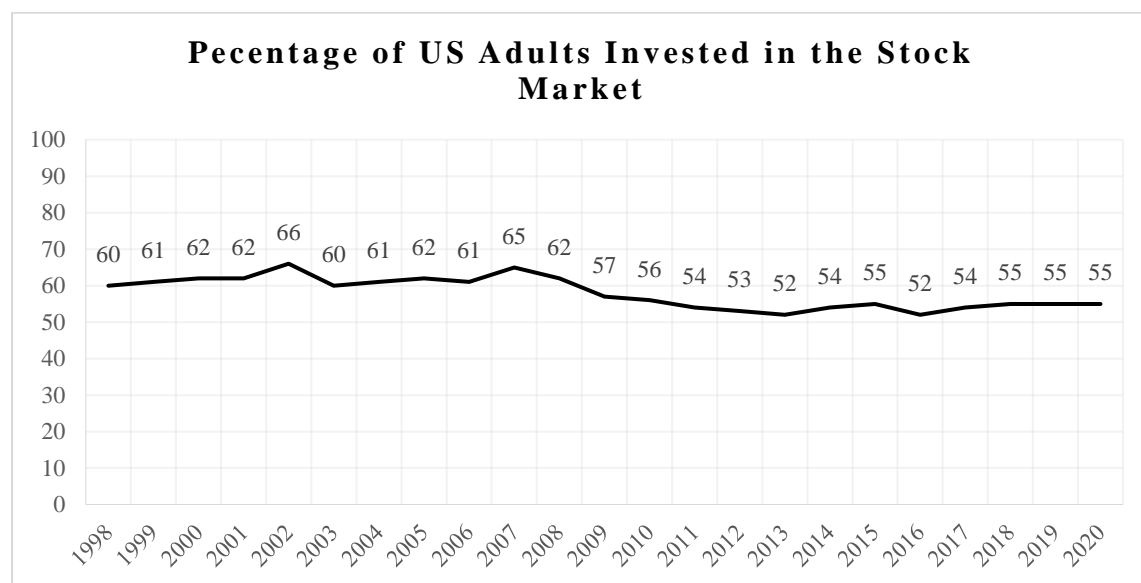
Source: Ravikumar, 2018

Gallup conducts an annual Economy and Personal Finance survey among the US population, and its most recent report of April 2020 revealed that 55% of Americans held stocks indirectly. 27% of respondents also agreed that stocks or stock mutual funds are the best long-term investment instruments while 35% favoured real estate, 15% savings accounts, and 14% gold.

Since the Gallup survey is conducted on an annual basis (as opposed to SCF, which is triennial), it can also be used to evaluate changes in the number of stockholders. The percentage of adults holding stocks have significantly decreased from 65% in the pre-crisis year of 2007

to 55% in 2020. Further stratification of data has revealed that the financial crisis had the single largest impact on the stockholding patterns by younger people: in the years of 2006-2007, 52% of the people aged 34 or under held stocks, while in 2018 this rate has fallen significantly to just 37%. Although stock markets have completely recovered since the 2008 crash, the younger generation remains hesitant to invest in this financial instrument (Gobell, 2019). This may be explained by an increase in risk-aversion stemming from a lack of trust in the financial system (Guiso, 2012). Another potential explanation is the lack of knowledge on how financial markets work; Zhou, 2020 reported that less-educated households were much more likely to cease investing in the stock market.

Figure 1.2
Share of the US Adults Invested in the Stock Market



Note. 2020 survey was conducted from 1 to 14 April, 2020. Data from Gallup Analytics, 2020.

The US hosts the most developed and some of the oldest stock markets in the world, and it stands to reason that Americans have higher stock market participation rates than what could be expected in Europe. The European Central Bank has recently published the results of the second wave of the Household Finance and Consumption Network Survey carried out in 2013-2015. This was the first systematic survey of households' financial position and behaviours, and surveyed more than 84,000 households throughout the Eurozone's twenty countries. While

the overall participation rate for the countries surveyed was 8.8%, one of the survey's most significant findings was the wide range of participation rates across countries; Table 1.2 provides a summary.

Table 1.2
Participation Rates in Various Financial Asset Classes (in %) in the EU

	euro area	BE	DE	EE	IE	GR	ES	FR	IT	CY	LV	LU	HU	MT	NL	AT	PL	PT	SI	SK	FI
Has financial assets	97,2	97,9	99,4	98,8	94,1	74,6	99,6	99,6	93,3	82,7	80,2	97,1	82,8	95,4	99,2	99,8	88,9	96,3	94,6	88,7	100
Has deposits	96,9	97,5	99	98,6	93,9	73,9	99,6	99,6	93,2	76,3	78,5	96,7	81,1	95,2	98,6	99,7	82,8	96,1	93,3	88,2	100
Has mutual funds	9,4	21	13,1	3,2	3,3	0,5	5,7	8,6	5,9	1,4	0,1	14,6	7,4	7,8	13,3	10	4,2	3	5,6	2	27
Has bonds	4,6	7,8	4,2	0,1	4,5	0,3	2,1	1,2	13	0,6	0,3	2,6	7,3	22,4	3,8	4	1	0,7	0,7	0,3	0,9
Has shares (publicly traded)	8,8	11	9,6	3,6	13,1	0,8	11	11,7	3,7	20,4	0,8	9	1,3	16,4	8	5,4	3,5	5,7	8	2,1	21,4
Has voluntary pensions/whole life insurance	30,3	44,4	46,3	19,8	10	1,3	24,5	38,5	9,3	19,5	8,9	32	15,3	26	35,3	14,5	51,3	17,2	14	15,5	23,6
Has other types of financial assets	7,5	3,4	14,5	3,6	1,5	0,3	2,3	9,9	2,7	1	1	4,4	0,5	2,1	4,1	1,5	2,2	1,5	0,9	3,6	15,8

Source: European Central Bank 2016 data.

The highest level of participation rates were reported in Finland, Cyprus, Malta and Ireland, however, given that Cyprus and Malta host a relatively large number of wealthy residents that do not permanently reside in the European Union, the overall participation rate could be even lower.

On the other end of the range, Nordic countries have traditionally had higher stock market participation rates than mainland Europe. Hagman (2015) examined the data from the fifth wave of the Survey of Health Ageing and Retirement in Europe (SHARE) and estimated the stockholding rate for Denmark to be 34.7%, and Sweden 39.3%.

Other developed countries have participation rates between the US and EU averages. The UK had a participation rate of 30% (Giannetti and Koskinen, 2010), Australia 31% (ASX Exchange, 2017), and Japan 15.5% (Aoki et al., 2016). China, a country that experienced a phenomenal rate of growth over the last decade, has a relatively low participation rate of 17.5% (Wang and Liao, 2013). According to Baker and Ricciardi (2014), studies of stockholding participation rates in developing countries are very rare but it is reasonable to expect that rates are low.

Based on the above surveys and estimates, it is clear that global stock market participation rates are fairly low. As a result, accumulated levels of wealth are lower than they otherwise could be, given the superior returns of stocks over bonds. Households may not be accumulating enough money for their retirement needs, leading to lower standards of living.

1.1.3 Equity Premium Puzzle and Stock Market Participation

The previous section documented low levels of stockholding around the world. While non-participating households are missing out on returns from this asset class, the generally low participation rate has wide-reaching implications beyond personal finance, one of the most significant of which is its impact on the equity premium.

Equity risk premium is a differential or a spread between a return on an equity index and a risk-free Treasury instrument. It is generally expected that equities carry some risk premium, simply because of the riskier nature of equity v. debt. According to Ilmanen (2012), the arithmetic risk premium over the period 1802 - 2009 was equal to 4.17%. Standard asset pricing theories suggest that this is the premium for assuming non-diversifiable aggregate risk. In 1985, Mehra and Prescott pointed out that the observed historical equity premium is larger than what traditional neoclassical finance model would predict: according to their estimation, it should not be more than 1%. Lucas (1978), meanwhile, derived the maximum possible equity premium of 0.35% by utilizing a consumption-based asset pricing model. That discrepancy between the observed historical risk premium and the one derived from the models was termed the 'risk premium puzzle'.

Several attempts have been made to explain this phenomenon. Some researchers have attributed it to market imperfections such as borrowing constraints, informational deficiencies, and idiosyncratic risks (Basak and Cuoco, 1998), while others have focused on modifying assumptions on preferences and utility functions or have resorted to consumption data modifications (Campbell and Cochrane, 1999). Some behavioural theories, including myopic

loss aversion (Benartzi and Thyer, 1995) and the House Money effect by Barberis and Huang (2001), were also developed to explain the phenomenon.

Low covariance between aggregate consumption growth and returns on equities is the major obstruction in justifying such a large risk premium as it requires disproportionately high levels of risk aversion. One the major reasons why households invest into financial assets is to hedge against consumption risk. Investors might see stocks a poor hedge against such risks as stock returns covary more with the consumption growth in comparison to government bonds. Nevertheless, empirical tests reported that this covariance is too low to justify such high risk premium because it would imply a disproportionately high level of risk aversion. (Kocherlakota, 1995) Mankiw and Zeldes (1991) were the first to point out that both the CAPM and Consumption CAPM models rely on the condition that households hold assets in optimal proportions. However, not everyone is a stockholder (which annuls the premise of holding optimal portfolios) and some categories of people are inframarginal stockholders (think of entrepreneurs where their wealth is invested in private equity). According to Mankiw and Zeldes (1991), the consumption patterns of stockholders are more volatile and more correlated with stock market performance than those of non-stockholders. Their model, while it could not fully account for the higher equity risk premium, it has successfully explained a significant portion of it.

Constantinides et al. (2002) have further refined Mankiw's and Zeldes' model by incorporating a life-cycle of personal finance. Under this, households are understood to pass through three distinct periods: human capital acquisition (low income), employment (higher income, but subject to uncertainty), and retirement/consumption. According to their model, young people would prefer to become stockholders (partially due to an attractive equity premium) but simply cannot do so because of their lack of funds. Moreover, they are constrained from borrowing since they have no collateral. Human capital is simply not

conceived of as sufficient collateral in the eyes of bankers, due to the potential of moral hazard. Middle-aged people, on the other hand, can afford to participate in the stock market and should also realise that their future income is heavily dependent on their current financial portfolio. Upon reaching retirement age, people are once again effectively shut out from equity markets due to their loss of income and the resultant need to use the proceeds of their investments to support themselves. Within this life cycle, then, middle-aged consumers hold the majority of investment risk, which in its turn prompts a higher equity premium. Under the model of Constantinides et al. (2002), the elimination of a borrowing constraint led to an increase in the mean bond return from 5.1% to 9%, while also resulting in a modest increase of equity return from 8.4% to 10.2% causing elimination of a major part of the equity premium. However, although the model can explain the non-participation of younger households, it is not well suited to address the non-participation of middle-aged households. That said, and most importantly, the major contribution of Mankiw and Zeldes (1991) and Constantinides et al. (2002) was their emphasis on low stock market participation, which has encouraged many researchers (including this one) to investigate the phenomenon further.

1.2 Problem Statement

Researchers have taken three main approaches to explain the low levels of stockholding globally. The first is a macroeconomic approach that focuses on aggregate consumption data and intertemporal substitution (Guo, 2004; Schmidt and Toda, 2019; Vissing-Jørgensen and Attanasio, 2003). The second identifies various constraints to stockholding, such as entry costs (Alan, 2006), borrowing costs (Constantinides et al. 2002; Melcangi and Sterk, 2019), and transaction costs (Paiella, 2001). The third approach, which has grown in popularity over the past two decades, starts with the recognition that households are heterogeneous and influenced by various sociodemographic and behavioural factors (refer to Section 2.6 for more details). One such factor is a lack of, or low level of, financial literacy, which may impede households

from investing in the stock market: there is a positive association between financial literacy and the decision to invest in stocks (Haliassos et al., 2020; Lusardi and Mitchell, 2014; Thomas and Spataro, 2018; Zou and Deng, 2019).

Low financial literacy has its clearest impact on household economic outcomes, including money management practices (Mandell and Klein, 2009; Sundarasan et al., 2016; Zulaihati et al., 2020), debt management (Gathergood, 2012; Lusardi and Tufano, 2015), insurance demand (Nesleha and Urbanovsky, 2016), and portfolio choice (Van Rooij et al., 2011; Lusardi and Mitchell, 2017; Klapper et al., 2013; Cupák et al., 2020).

Low financial literacy also has wide-reaching implications beyond personal finance. Most countries aim to create and maintain efficient financial markets, and the presence of developed financial markets is widely perceived to aid in economic development (Ito and Krueger, 2006). A developed financial market is considered as such if it possesses depth and breadth (i.e. many financial instruments with various characteristics) on the supply side and a large market participants' base on the demand side. Financial market participants must continuously make decisions that relate to the optimal savings decision, asset allocation, securities selection, portfolio diversification level and portfolio rebalancing. Due to the inherent information asymmetry in financial markets, however, households inevitably make sub-optimal decisions, simply because they do not possess complete information about a transaction, other participants, or possible alternatives. It is worth noting the role of the internet: it has greatly increased the amount of financial data available to households and thus has the potential to lessen information asymmetry. Nevertheless, online information is generally fragmented and dispersed, making relevant information harder to find. This, then, makes it even more critical that a household is financially literate: it will lessen the time needed to sort through and process the readily-available information.

While the primary beneficiaries of financial literacy are households, financial institutions also stand to gain. Financially literate clients require less attention and support from financial service providers, making the provision of such services more cost efficient. Furthermore, financially literate households are better at security analysis, valuation, and risk assessment, and are less likely to participate in speculative bubbles. In short, informed investors allow markets to better perform one of their most important functions – the price discovery mechanism, which in turns helps companies raise capital in a sustainable and efficient manner.

1.3 Identification of Research Gaps

There are several research gaps that this thesis aims to fill. First, researchers have developed and applied numerous definitions of financial literacy and associated concepts. Along with them, several financial literacy tests have been designed, varying quite widely in their complexity, domains and length, and the components of many of these instruments overlap. Very few, however, have specifically been tested for validity and reliability.

Second, as discussed in section 2.4.1, some studies have utilised subjective financial literacy measures as a crude proxy for objective financial literacy tests. The varying results of correlational studies (Agnew and Szykman 2005; Nejad and Javid 2018; Tang and Baker; 2016) support the conclusion that subjective financial literacy is of limited value in studying household financial behaviour. However, Graham (2009) and van Rooij (2011) point to the important role of subjective financial literacy in influencing financial behaviour, which suggests that perhaps subjective financial literacy was dismissed by most researchers too hastily. At the very least, more effort is needed to explore the precise relationship between objective and subjective financial literacies and their impact on stockholding.

Many of the studies reviewed in this chapter rely on household survey datasets provided by central banks and other governmental organisations, however, a majority of these were not designed to assess financial literacy and/or do not provide any insights on its impact on

portfolio choice. Due to the inherent limitations of such surveys, very few questions on financial literacy are typically included. Meanwhile, tests administered to college students (convenience sampling) tend to be more comprehensive and extended. They too have their limitations, however. First, they only cover a small stratum of the population. Second, the purpose of most of these tests is simply to evaluate one's level financial literacy alone, without linking it to how one's literacy may influence investment behaviour or possible financial outcomes. In short, then, neither household surveys nor tests administered to college students provide sufficient data to more broadly understand the determinants and outcomes associated with levels of financial literacy.

1.4 Research Purpose and Objectives

The purpose of this study is to enhance our knowledge about the level of financial literacy of households, and to investigate the relationship between financial literacy and stockholding. The objectives are as follows:

- 1. To operationalise the concept of financial literacy and to propose a valid measurement instrument.*

Many researchers used the term financial literacy, numeracy, financial capability, education, and awareness, almost interchangeably. (Fernandes et al., 2014; Huston, 2010) The existing financial literacy test scales ranged from three questions to fifteen, and oftentimes very crude measures such as level of education were used as a substitute for financial literacy tests. Survey questions often have very little discriminative power, and although they may be suitable to measure basic financial literacy, they are not necessarily able to determine levels of investment literacy. As a result, it is important to develop a reliable financial literacy measurement instrument.

2. To investigate the relationship between subjective (SFL) and objective (OFL) financial literacies.

Financial literacy can be measured subjectively or objectively. Objective financial literacy assessment requires a person to undergo a financial literacy test or a quiz. The subjective financial literacy is a self-reported or perceived measure. (Bellofatto et al., 2018; Hung et al., 2009). Very often researchers are keen to use the second measure due to its simplicity and convenience, but questions have been raised about its overall validity primarily because households may tend to overestimate their knowledge (overconfidence bias). Accordingly, I compare the results from the administered financial literacy test to the self-reported measure in order to determine whether subjective financial literacy is a reliable proxy that can be used by researchers.

3. To explore the determinants of financial literacy.

There are a few demographic and psychographic variables that may have an impact on levels of objective financial literacy. An ordinary least squares regression was performed in order to test the association between objective financial literacy score and major demographic variables such as age, gender, income, wealth, level of education, living with a partner, having children, being self-employed, being a homeowner and some psychographic variables such as risk tolerance, tracking household spending, thinking about old age.

4. To evaluate the impact of objective financial literacy on direct and indirect participation in the stock market.

An instrumental variable probit regression is used to assess the impact of financial literacy on both direct and indirect stockholding. Special attention is paid to addressing the endogeneity problem that has weakened previous research.

5. To evaluate the role of financial advisors in transferring financial knowledge and mitigating the effects of low financial literacy.

To further understand the motivations of becoming more financially literate and to invest in the stock market, interviews with financial advisors are conducted to provide insights into households' decision making that even a very thorough extended questionnaire can not.

1.5 Research Contribution to Knowledge

The thesis aims to contribute to the body of research on household financial behaviour in several ways. First, the determinants of financial literacy levels and the ways they interact are poorly understood. While a majority of studies (Almenberg and S  ve-S  derbergh, 2011; Al-Tamimi, 2009; Hogarth and Hilgert, 2002; Kadoya and Khan, 2019; Klapper et al., 2015; Mu  noz-Murillo et al., 2020) provide some stylised facts about financial literacy or examine the impact of financial literacy on certain financial outcomes, very few try to synthesise the determinants of financial literacy and/or determinants of stockholding into a coherent framework. To remedy this, the quantitative analysis of this thesis utilises an expanded and comprehensive set of explanatory variables while focusing on demand side of the financial literacy (refer to section 2.8).

Second, the concept of financial literacy has thus far been poorly operationalised. Although previous studies have developed a wide variety of tests – varying in length and complexity, and which cover various domains – they have not, in general, been designed with an eye to operationalisation. This thesis, then, develops a literacy test that is both comprehensive – it incorporates components from several of the most respected frameworks – and its validity and comparability are demonstrated using the Classical Test and the Item Response Theory.

The third contribution is the adoption of a sequential explanatory design, which is uncommon in studies of household financial behaviour. The overwhelming majority of studies include only quantitative analysis, primarily using the regression approach. In this thesis, however, the survey is supplemented by qualitative interviews with market participants, which adds several valuable insights: it confirms the validity of the proposed financial literacy test, it suggests motivations behind households' acquisition of financial literacy, and it helps explain the effects of various variables proposed in the conceptual framework in more detail.

The fourth contribution lies in *where* the study is conducted: Sweden. Sweden, aside from being a developed country that hosts well-developed financial markets, has a pension system that is based on a defined contributions privately managed financial account scheme, one that many countries are aspiring to develop. The results of the study, then, provide a glimpse into the future behaviour of households within countries that are on the pathway towards adopting or further developing defined contribution pension systems.

1.5 Significance of the Study

The financial environment has changed significantly since the turn of the 21st century. Many countries have introduced pension reforms that disproportionately rely on a defined contributions model, and such arrangements shift the responsibility of wealth accumulation from the state or employer to the household. Under such conditions, financial literacy is critical: pension plan holders must process more information and make complex decisions that will significantly impact their future wealth, and financial literacy could both reduce the costs of information processing and lead to preferential financial outcomes.

The first decade of the 21st century was turbulent for financial markets, witnessing one of the largest financial crises in history. According to Gomez (2017), stock holdings form a considerable part of household wealth, especially in developed countries. As a result of the financial crisis of 2008, not only the value of household portfolios plummeted, but also

countless retirement and future consumption decisions were delayed. According to Ricci and Caratelli (2017) - and reinforced by interviews conducted with financial advisors in the preparation of this thesis - many (particularly younger) households have developed mistrust towards financial markets and the financial system as whole. It is likely that such mistrust at least partly stems from a general lack of understanding of how financial markets function and the risk-reward profile of various financial instruments.

It has become widely recognised that financial literacy is valuable knowledge that ought to be incorporated into the curriculums of high schools and even universities. While this dissertation focuses more narrowly on financial literacy within the context of risky assets, a financially literate person is also likely to exhibit better performance in all other areas of personal finance, ranging from daily money management, mortgage and debt management, insurance, all the way to investing. Large resources are currently spent by central banks, regulatory bodies, and even private initiatives on promoting financial literacy, however, some research has demonstrated rather limited results, proving some programmes to be cost inefficient (Kaiser and Menkhoff, 2017; Fernandes et al., 2014; Mandell, 2009) Could it be due to the lack of motivation of the target participants? Or could it be because we, as researchers, cannot properly define and measure the outcomes of such programmes? The financial literacy test developed in chapter 3 includes all of the standard questions employed in previous research (Lusardi and Mitchell, 2011a) to ensure comparability, but adds several other questions with good discriminating ability, targeted to test advanced investment literacy. Such a test can be used by educational bodies to identify gaps in students' financial literacy, or be used as a test measure at the end of a module. While this test certainly gives insights about the level of knowledge, it does not provide much information about the process of acquiring that knowledge. Accordingly, this thesis also explores the ways in which financial knowledge is acquired by households and their motivations to gain financial literacy.

This thesis may also have commercial applications. Financial institutions are keen to provide additional complimentary services to consumers to increase profits and retain them within their networks. Such cross-selling has become even more important recently with the advent of fintech companies like Revolut, Curve or Monese, which operate entirely online and are able to reduce costs significantly, thus offering cheaper services and posing a threat to traditional banking institutions. Target marketing has become critical for banks' success, and the probit model developed in this dissertation can be used by financial institutions to evaluate the likelihood of a particular household to invest in a risky asset. As more data becomes available and is becoming cheaper to store and process, the probit model can serve as a starting block in training artificial intelligence programs to calculate probabilities of investing into other asset classes and which can incorporate other sets of variables. Furthermore, financial institutions that are able to distinguish between financially literate and illiterate consumers could significantly reduce the time spent on educating their customers.

1.6 Organization of the Thesis

Following the introductory chapter, chapter 2 presents the relevant research on financial literacy. Numerous definitions and concepts used in the literature are explored, such as financial awareness, capability, numeracy and sophistication. The poor state of financial literacy across the world is documented, followed by an analysis of how financial literacy has been measured in previous studies and an identification of gaps in measurement accuracy. A short overview of financial education and its impact on financial literacy is provided, and the chapter concludes by linking financial literacy to low levels of stockholding.

Chapter 3 outlines the methodological pathway to study the financial literacy of households. The rationale for using a mixed methods approach, more specifically a sequential

explanatory design, is given, the structure of both the quantitative and qualitative aspects of the analysis is laid out, and the data sample and data analysis techniques are described.

Chapter 4 provides an overview of the quantitative analysis. It starts with a detailed overview of households' performance on the financial literacy test by employing Item Response Theory. The validity and suitability of the questions are discussed. The chapter proceeds with a descriptive analysis of the sample; the correlation between objective and subjective financial literacies is explored, followed by a regression analysis of the determinants of objective financial literacy. The chapter concludes with a discussion of the probit model to establish a link between financial literacy and stock market participation.

Chapter 5 analyses the same issues as the preceding chapter, this time using qualitative analysis methods. It describes the insights and observations that were collected during interviews with eight financial advisors, and emphasis is placed on the behavioural links and motivations for gaining financial literacy and stockholding.

Chapter 6 adds to the results from the quantitative and qualitative methods used in the preceding chapters within a mixed methods research paradigm. The results are discussed within the context of the literature and the research questions are addressed.

Chapter 7 offers suggestions on how to improve levels of both financial literacy and stockholding, and the limitations of the study and suggestions for further research are presented.

Chapter 2: Literature Review

2.1 Introduction

This chapter first provides a contextual overview of Sweden, where this research was carried out. The definitions and the use of the concept of financial literacy are then traced through several decades of academic research. Next, it turns to the ways in which financial literacy has been measured and operationalised, and offers a critique of the standard approaches. Finally, the most important determinates of financial literacy are explained, and the chapter concludes by stating the theoretical framework of the thesis along with a formulation of the hypotheses.

2.2 Sweden. Contextual Background

As explained in Section 3.7.1.8, the data sample used in this study was provided by one of the largest banks in Sweden. This section presents some background information on the country, household wealth and financial markets.

Sweden is a developed country with a competitive economy. Its gross domestic product (GDP) per capita was equal to 433,640 Swedish kronor (42, 901 EUR) in 2020. According to the Worldbank, this ranks Sweden in seventh place in Europe in 2019. Despite a GDP decline of 2.9% in 2020, DG ECFIN forecasts the Swedish economy will grow 2.7% in 2021 (DG ECFIN, 2021). Significant output is produced by engineering, telecommunications and automotive industries, and the economy is export oriented.

As of January 2021, the labour force participation rate is 71.3% (down from 72.8% in January 2020). This is significantly higher than the European Union's average of 57.70% (Statistics Sweden, 2020). It is important to note that the Swedish economy is mixed and it has a significant welfare state element following the distinctive 'Nordic model' (Esping-Andersen, 1990) which became an expression of national identity (Kuisma, 2016). The Nordic model is characterised by guaranteeing a living wage, the government being involved in employment

promoting policies, welfare state universalism and a large social service sector (Ryner, 2007). Undoubtedly, such a model has an impact not only on the wealth of households but also on their interaction with financial markets and institutions. Sweden has a well-developed financial intermediation system and financial markets that employ around 2% of the country's workforce and that generates 3.8% of Sweden's GDP. (Svenska Bankföreningen, 2020). According to the Statistics Sweden (2021), the median disposable income in Sweden was 380,000 kroner (37,300 EUR) per household in 2019. According to OECD (2021) data, 15.8% of disposable income is saved. Average household total net worth in Sweden was equal to 1,088,675 kroner (106,558 EUR) in 2019.

According to OECD data (2021), Swedish households held 13.1% of their financial assets in deposits, 36.7% in equity, 9.5% in mutual funds, 30.5% in pension funds and 6.9% in life insurance reserves in 2019. Notably, the percentage of assets held in deposits was the lowest in the EU, and the percentage of assets held in equity and pension funds was the third highest in the EU.

Sweden's central bank did not participate in the European Household Finance and Consumption Survey, making it difficult to determine household investment portfolio composition variation. In fact, in 2017 the Sveriges Riksbank made a proposal to start collecting statistics on household assets and liabilities. The rationale for the proposal included Riskbank concern for the level of indebtedness of households and the elevated macroeconomic risks caused by this phenomenon (Sveriges Riksbank, 2017).

Lundberg and Waldenstorm (2018) made an extensive overview of the changes in Swedish household wealth from the 2000 to the 2012 by utilizing the household Longitudinal Individual Panel Database LINDA that included 3.35% of the population. They noted that the richest 10% of the population owned 65.9% of the wealth and reported considerable heterogeneity in the composition of their portfolios. Notably, the share of negative wealth is

much higher in Sweden in comparison to other European countries. The authors believe that this could be due to country-specific borrowing patterns and the ability of Swedish households to utilise mortgages for consumer loans.

The Swedish population is one of the most educated in Europe – 83% of adults have completed upper secondary education. The government consistently invests more funds into education (6.8% of GDP in 2020) than the OECD average (5.6%). Despite this, as discussed in 2.3.4.2, higher investment into education and good academic performance does not necessarily translate into greater financial literacy (Almenberg and SaveSaudeberg, 2011; Bucher-Koenen and Lusardi, 2011).

Chapter 6 will revisit the Swedish studies mentioned here and compare their findings with those from the administered survey.

2.3 Financial Literacy Concept

Literacy has long been understood to mean the basic ability to read and write. Historically it is a skill that was the preserve of a privileged minority; the invention of the printing press upended that, while mass education has progressively expanded the number of literate people. As literacy expanded, categories developed to describe different types of, or degrees of, literacy: for instance, functional literacy refers to that which is used to reach a particular goal, while critical literacy refers to one's ability to interpret a text.

In the late 1980s, 'New Literacy Studies' began to see literacy from a socio-cultural perspective, viewing it as a social practice which reflects the attitudes, beliefs and values of individuals as members of a society (Gee, 2007). This spurred an intellectual debate on how social context may influence literacy, and two main standpoints emerged. Proponents of the so-called 'autonomous model' hold that literacy is an independent activity that influences one's context and social practices. Proponents of the 'ideological model', on the other hand, argue that literacy is shaped and influenced by one's social and cultural context (Gee, 2007; Street,

1997; Reder and Davila, 2005). This debate has also given a rise to identifications of context-specific literacies that include, but are not limited to: information or digital literacy (Bawden, 2008; Spires et al., 2019); health literacy (Neter and Brainin, 2019; Speros, 2005); and technology, media, legal, scientific, family, civic, political, environmental, emotional and financial literacies (Mkandawire, 2015).

2.3.1 Financial Literacy in the Multiliteracy Context

Alongside an understanding of literacy as a situated social practice, the concept of ‘multiliteracies’ acknowledges that modern society is in many ways a ‘knowledge society’, characterised by not only vast arrays of information, but also many types. Operating in such a society requires people to develop a *set* of literacies to accommodate these types; Gelfand and Lin (2013), for example, identify 30 distinct literacies. Financial literacy could be considered to be one such literacy, and it has been suggested that it be categorised as a subgroup of information literacy (Špiranec et al., 2012; Wolfe-Hayes, 2010).

2.3.2 Defining Financial Literacy

A working definition of financial literacy is a necessary precondition for operationalising and measuring it, but more often than not, the concept has been imprecisely and inconsistently defined. For instance, there have been several initiatives and institutions set up by governments to improve financial literacy; to name just a few: Office of Financial Education by the US Department of Treasury set up in 2006; National Strategy for Financial Capability in 2003 by FSA in the UK; National Steering Committee on Financial Literacy in Canada in 2017. However, while each of these initiatives pursue one common goal– the improvement of households’ financial literacy – that common goal is, perhaps surprisingly, poorly defined.

Much of this confusion stems from the unsettled academic literature itself. Attempts to synthesise the academic use of the term have been made before: Hung et al., 2009; Huston, 2010; Faulkner, 2015; Remund, 2010; Stolper and Walter, 2017; Warmath and Zimmerman, 2019. Each of these have stressed just how poorly defined, or how diverse, meanings of the concept appear to be. Huston (2010), for example, reported that of the 71 studies that utilised 52 different datasets, 72% of them neglected to include a definition of financial literacy altogether. She also reported that financial knowledge, financial literacy and financial capability terms were frequently used almost interchangeably. Operationalisation and measurement were also problematic: a majority of studies (88%) failed to include any explanation on how to interpret their measurements, and several failed to provide the questionnaires or questions that were used in their surveys. Similar omissions and inconsistencies were also reported by Robb (2011) and Bay et al. (2014). To redress this, several researchers (Marcolin and Abraham, 2006; Lusardi, 2008; Remund, 2010; Schuchardt et al., 2009) have advised their successors to make a concerted effort to find and settle on a more precise definition and measurement of financial literacy.

Much of the confusion can be attributed to the disparate and uncoordinated ways in which the meaning of the concept has evolved over the past few decades: the chronological order of various definitions, as they appeared in the academic literature, is presented below. Notably, most of the research conducted after 2012 has simply adopted definitions from other researchers or simply combined components of existing definitions. One can not help but immediately notice the extent to which these definitions vary in sophistication and scope. In the next section, these definitions will be categorised according to various dimensions, followed by a discussion of their development.

Table 2.1
Chronological Order of Definitions of Financial Literacy

OECD, 2015	“A combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial wellbeing” (p. 5).
Lusardi and Mitchell, 2014	“People’s ability to process economic information and make informed decisions about financial planning, wealth accumulation, pensions and debt” (p. 2).
Huston, 2010	“Measuring how well an individual can understand and use personal finance-related information” (p. 306).
Remund, 2010	“Financial literacy is a measure of the degree to which one understands key financial concepts and possesses the ability and confidence to manage personal finances through appropriate, short-term decision-making and sound, long-range financial planning, while mindful of life events and changing economic conditions” (p. 284).
Dvořáková, 2009	“The financial literacy is a set of knowledge, skills and attitudes of citizens necessary to financially secure themselves and their family in contemporary society. They are actively performing in the market of financial products and services. Financially literate citizens are well versed in issues of money and prices, and are able to responsibly manage their personal or family budget, including the management of financial assets and financial liabilities with regard to changing life situations” (p.1).
Howlett et al., 2008	“Possessing knowledge and craft in order to handle money well” (p. 231).
Servon and Kaestner, 2008	“... a person’s ability to understand and make use of financial concepts” (p. 273).
Lusardi, 2008	“ <i>Knowledge</i> of basic financial concepts, such as the working of interest compounding, the difference between nominal and real values, and the basics of risk diversification” (p. 2).
The President’s Advisory Council on Financial Literacy (PACFL, 2008)	“Financial literacy: the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being” (p. 4).
ANZ Bank, 2008	“The <i>ability to make informed judgments</i> and to take effective decisions regarding the use and management of money” (p. 1).
Mandell, 2007	“The <i>ability</i> to evaluate the new and complex financial instruments and <i>make informed judgments</i> in both choice of instruments and extent of use that would be in their own best long-run interests” (p.163).
Jump\$tart Coalition 2007, later adopted by President’s Advisory Council on Financial Literacy	“Financial literacy is the ability to use knowledge and skills to manage financial resources effectively for lifetime financial security” (p. 1).
European Commission (2006) as cited in Habschick et al., 2007	“... the capability of consumers and small business owners to understand retail financial products with a view to making informed financial decisions” (p. 8).
Emmons, 2005	“At a minimum, consumers must be able to keep track of their cash resources and all payment obligations, know how to open an account for saving and how to apply for a loan, and have a basic

	understanding of health and life insurance. A financially savvy consumer compares competing offers and can plan for future financial needs, such as buying a house, sending a child to college, and retirement” (p. 335).
National Council on Economic Education, 2005	“ <i>Familiarity</i> with basic economic principles, knowledge about the U.S. economy, and <i>understanding</i> of some key economic terms” (p. 3).
OECD, 2005	“... the process by which financial consumers/ investors improve their understanding of financial products and concepts and, through information, instruction and/or objective advice, develop the skills and confidence to become more aware of financial risks and opportunities, to make informed choices, to know where to go for help, and to take other effective actions to improve their financial well-being” (p. 26).
Courchane and Zorn, 2005	“Consumer literacy, defined as self-assessed financial knowledge or objective knowledge” (p. 6)
Hilgert et al., 2003	“Financial knowledge” (p. 1).
FINRA, 2003	“The understanding ordinary investors have of market principles, instruments, organizations and regulations” (p. 2).
Moore, 2003	“Individuals are considered financially literate if they are competent and can demonstrate they <i>have used knowledge</i> they have learned. Literacy is obtained through practical <i>experience</i> and active <i>integration of knowledge</i> ” (p. 29).
Bowen, 2002	“Financial knowledge is defined as understanding key financial terms and concepts needed to function daily in American society” (p. 1).
Vitt et al., 2000	“Personal financial literacy is the ability to read, analyse, manage and communicate about the personal financial conditions that affect material well-being. It includes the ability to discern financial choices, discuss money and financial issues without (or despite) discomfort, plan for the future and respond competently to life events that affect everyday financial decisions, including events in the general economy” (p.12).
Mason and Wilson, 2000	“Individual’s ability to obtain, understand and evaluate the relevant information necessary to make financial decisions, with a focus on the awareness of the likely financial consequences” (p. 31).
Noctor et al., 1992 (also used by US Financial Literacy and Education Commission as well as National Foundation for Educational Research in the United Kingdom)	“Ability to make informed judgments and informed decisions regarding the use and management of money” (p. 4).
Graham, 1980	“... the ability to interpret, communicate, compute, develop independent judgment, and take actions resulting from those processes in order to thrive in our complex financial world” (p. 49).

Source: compiled by the author

2.3.3 Financial Literacy Dimensions

A starting point for defining financial literacy is to simply break it down to its components: literacy and finance. The Oxford English Dictionary defines literacy as an ability to read and write, as well as competence and knowledge in a specific area. The National Assessment of Adult Literacy (NAAL) 2003 notes that the concept has two distinct forms: task-based and skill-based. Task-based literacy can be measured in absolute terms (for example, whether a person can read a text), while determining skill-based literacy requires a more sophisticated assessment (for example, whether a person can make logical conclusions upon reading a text).

Turning to financial literacy, and as can be gleaned from Table 2.1, definitions range from purely theoretical (i.e. financial knowledge of a fact/relationship) to applicative (i.e. using the knowledge to achieve a desired outcome). Conceptually, the definitions in Table 2.1 can be helpfully grouped into three categories:

- a) Definitions that focus on relevant *financial knowledge*. Unsurprisingly, most of the definitions (FINRA, 2003; Hilgert et al., 2003; Howlett et al., 2008; Lusardi, 2008; National Council on Economic Education, 2005) fall under this category; a financially literate person will possess relevant knowledge and understanding of key financial concepts in order to effectively manage matters of personal finance.
- b) Definitions that focus on *ability and skills*. This is a higher order concept: a financially literate person will not only possess a necessary stock of knowledge, but also be able to apply that knowledge to derive some benefit for one's household (Jump\$tart Coalition, 2007; Lusardi and Mitchell, 2014; Remund, 2010; Servon and Kaestner, 2008).
- c) Definitions that focus on *application (usage/apptitude)*. This meaning has surfaced only a few times (Emmons, 2005; OECD, 2005; PACFL, 2008), and is premised on the

observation that although an individual may be knowledgeable and possess certain skills, one may not necessarily apply it or use them (Christiansen et al., 2008).

Quite a few definitions combine or conflate these categories, and Huhmann and McQuitty (2009) stress the subsequent need to disentangle financial literacy from financial capacity, which refers to the ability to process and understand information and financial knowledge, namely, knowledge of various financial instruments/concepts and how they work. In other words, whereas financial capacity places its emphasis on skill, financial literacy is a knowledge or a memory-based attribute that is closely related to or in fact even dependent on financial knowledge. One important implication of this is that additional exposure to various products and service may increase financial literacy.

Huhmann (2014) identifies three components of financial literacy: financial capacity (the ability to identify and process information), knowledge (of financial concepts, services and products), and proficiency (in optimising financial decisions and managing financial resources). In terms of capacity, each household has different innate cognitive abilities to logically process and make use of financial information, and a low level of capacity to filter information may in turn impede knowledge attainment. Knowledge may also be incorrect or biased if acquired from dishonest advertising or unreliable sources. Proficiency, according to Huhmann (2014), as a function of both financial capacity and knowledge, is therefore limited by low capacity or inaccurate knowledge.

Drawing on the aforementioned distinction between autonomous literacy and ideological literacy, Bay et al. (2014) stress the need to analyse one's financial literacy within a context, or as being 'situated' (e.g. Ahrens and Chapman, 2007). Under this approach, the literacy of a particular person should be understood as being situated within a given context of time and within particular geosocial surroundings. One distinct advantage of this approach is

the possibility to separate and analyse three key moments: endowed literacy level, literacy educational events, and improved financial literacy.

Xu and Zia (2012) were the first to highlight disparities between financial literacy in developed and developing countries: in developed countries, financial literacy is frequently viewed as complimentary to consumer protection, whereas in developing countries, most financial products are only available to a select few customers, and targeting literacy in developing countries should therefore focus on microenterprises and business skills.

Some researchers (Dolezalova, 2005; Zvarikova and Majerova, 2014) stress the dynamic aspects of financial literacy: according to Kovalčíková et al. (2011) “Financial literacy is the indication of the state of constant development which allows each person to respond effectively to new personal facts and constantly changing economic environment” (p.1107). Bernheim and Garrett (2003) also stress the fact that financial literacy should not be viewed in isolation from economic literacy. Notably, the definitions within the Table 2.1 proposed by FINRA, 2003; National Council on Economic Education, 2005; Remund 2010; and Vitt et al. 2000 all incorporate some elements of economic literacy. While one may argue that the presence or absence of economic literacy does not directly impact household assets or liabilities, it is important for the development of financial markets and for the formation of trust in the financial system.

2.3.4 Relation to Other Constructs

Financial literacy is very frequently used interchangeably with financial awareness, capability, numeracy, and even education (Hung et al., 2009; Huston, 2010; Remund, 2010; Santini et al., 2019; Warmath and Zimmerman, 2019). This section attempts to isolate these meanings and provides an overview of these constructs.

2.3.4.1 Financial Literacy v. Numeracy

Hung et al. (2009) suggest that it is important to distinguish between financial literacy and numeracy, as these are separate skills. Almenberg and Widmark (2011) argue that literacy is more “knowledge based, involving familiarity with financial concepts and products, whereas numeracy is more directly related to cognitive ability, in particular, ability to process numerical information and perform simple calculations” (p. 3). Although numeracy may nevertheless act as a necessary condition for financial literacy, several studies are careful to distinguish between the two and include numeracy as a separate cognitive variable, for example Almenberg and Dreber (2015); Huhmann and McQuitty (2009); Jayaraman et al., 2018; Lusardi (2012); and Lusardi and Mitchell (2011a).

2.3.4.2 Financial Literacy and Financial Education

The OECD (2005) defines financial education as the “process by which financial consumers/ investors improve their understanding of financial products and concepts and, through information, instruction and/or objective advice, develop the skills and confidence to become aware of (financial) risks and opportunities, to make informed choices, to know where to go for help, and to take other effective actions to improve their financial well-being and protection“(p. 3). The emphasis here is on the process, through which information and skills are transmitted to and acquired by the individual. Therefore, financial education acts as an enabling or even empowering mechanism to encourage financial literacy.

Levels of household financial literacy are not constant over a lifetime; consistent with the autonomous approach described earlier, levels of financial literacy can be increased through education in personal finance. The following section provides a short overview of some key financial education programmes, highlights some of the research that has evaluated their effectiveness, and discusses who tends to benefit from them.

Several government entities, non-governmental institutions and corporations offer some sort of financial literacy enhancement programmes. In the US, which has the largest share of the world's investors, five federal agencies are involved: US Department of the Treasury; US Department of Labour; Federal Reserve System; Securities and Exchange Commission; and the Federal Deposit Insurance Corporation. Of these, perhaps the Treasury is the national leader in financial education: it established the Financial Literacy and Education Commission in 2003, tasked with developing a national strategy on financial education. The strategy included such goals as determining core financial competencies, increasing access to effective financial education, and improving education infrastructure. Currently it pursues more than 40 programmes related to financial education for various age groups (U.S. Department of the Treasury, 2020). According to Fox et al. (2005), a majority of financial literacy programmes can be categorised into three categories: programmes directed at enhancing general financial literacy (usually focusing on budgeting, saving, and credit management); specific training in retirement and savings (usually offered by employers); and programmes focusing on home buying and credit.

Programmes in the first category are usually administered by governmental entities and are striving to incorporate personal finance within the curriculum of public education. Bernheim and Garrett (2003) found that adults, five years after high school graduation, who studied in a state which had incorporated financial education into its curriculum, had a 1.5% higher savings rate. To the contrary, Tennyson and Nguyen (2001) evaluated financial literacy levels of students from 65 different schools and found that students who had received financial literacy education achieved an average 56.9% mark on the test, compared to 56.5% for those who did not, implying that other characteristics such as race, parents' income and gender were more significant influencing factors. Amagir et al. (2018) conducted a review of 36 studies that quantitatively evaluated the short-term effect of the financial literacy education programmes

for young adults and children, and concluded that while the majority of the programmes had a positive short-term effect, they noted a large difference in how those studies defined what a desired outcome of such financial education interventions was; out of those 36, six relied on self-reported financial knowledge, 27 on assessed financial knowledge, ten on self-reported financial behaviour, nine on actual or intended financial behaviour, while 19 evaluated attitude and confidence. Such diverse intended outcomes significantly reduce the comparability of the studies.

Of particular interest are studies that evaluate the longer term effects of financial education, although they are rare. Kaiser and Menkhoff (2019) conducted a meta-analysis of 37 financial education interventions and were able to identify only two studies that measured the effects after 12 months. They reported a positive impact but claimed that the long-term effects are uncertain. Bruhn et al. (2013) have found only a very small effect (Cohen's d of 0.2) in knowledge and behaviour 1.5 years after a personal finance education programme was completed. On the other hand, Mandell (2009) found no long-term effects on knowledge or behaviours in his longitudinal study.

Bernheim and Garrett (2003) undertook a review of employer-sponsored financial education and found that the presence of such programmes has a positive and statistically significant influence on retirement wealth (although not on total wealth), total savings. Interestingly, they also revealed that many people have used these programmes as a primary source of information on retirement planning, over friends, family or even financial advisors. Such a displacement effect of authoritative sources poses some ethical challenges to the administrators of those programmes to ensure that they are not exercising their position of trust to the advantage of any particular company or financial institution.

Clark and D'Ambrosio (2003) evaluated the financial literacy of retirement planning seminar participants before, immediately after, and three months after, the seminar. They found

a significant change in retirement goals immediately after the seminars, but only a very small change during the follow-up period. It should be noted that caution must be exercised in the interpretation of this survey as the population had a very high level of education (e.g. 27% of the participants had a PhD degree) in comparison to the general population.

Fernandes et al. (2014) conducted, by far the largest, metastudy of 201 academic papers that have included financial education interventions. They reported that financial literacy education could only explain a very negligible 0.1% of the variance in financial behaviours. They also reported that more rigorous study designs, such as true randomised experiments, reported smaller effect sizes in comparison to pre-post designs. Financial literacy education programmes have weaker effects in low-income population samples as opposed to the general population sample. Consistent with Clark and D'Ambrosio (2003), they also noted the effects of inertia and that financial education effectiveness decays over time. They also examined various types of interventions and found “statistically significant but practically small differences among: counselling, exposure to information about financial education, financial education in high school, multiple sources of financial education, participation in seminars or workshops, and participation in a programme of financial education. These intervention forms explained, respectively, 0.14%, 0.05%, 0.15%, 0.12%, 0.18%, and 0.10% of the variance in the financial behaviours studied” (Fernandes et al., 2014, p. 1865).

The financial education effect decay documented by Fernandes et al. (2014) could be remedied by providing a “just in-time” education, required to meet a particular financial need. Fort et al. (2016) examined the effectiveness of bank information policies and found that Italian households who used banks that voluntarily provide more information about their products demonstrated a 10% higher literacy level than those whose bank did not. Bank information policies have had the most pronounced effect on those over 60 years of age and low levels of education. The authors recommend administering financial literacy interventions to this

particular subsample: one standard deviation increase in financial literacy within that subsample leads to an almost 8,000 EUR increase in household total wealth. This observation calls for a more tailored, perhaps even surgical approach in identifying target samples for financial literacy education.

The last few decades have witnessed a remarkable growth in the private sector's role in promoting financial literacy. According to the Center of Retirement Research, over 4.000 web resources on personal finance existed in 2010, which included: financial data aggregators, financial decision modelling tools, online communities, and simulations (Blanton, 2011). At the time of writing, a Google search for personal finance yields more than 1.5 billion webpages. Gale and Levine (2010) attribute the increased popularity of such resources to the usage of psychological heuristics and because they present information less formally and more accessibly. Hoffmann and Otteby (2018) researched the effectiveness of financial blogs as a financial literacy transmission mechanism and found that people who are susceptible to information influence, and who trust information communicated by others, are more likely to use personal finance blogs and consider them helpful. It is unclear how much added value they bring for raising financial literacy more generally: the study also found that people with the highest levels of financial literacy are the most likely to use them. It is also worth mentioning that these private sector tools to enhance financial literacy might be biased, as the financial incentives of the source of information make it highly likely that the tools are geared towards marketing specific products or services.

2.3.4.3 Financial Literacy and Financial Awareness

Quite a few academic papers have used the term financial awareness interchangeably with financial knowledge (George-Jackson and Gast, 2015; Guiso and Jappelli, 2005; Simon et al., 2015). While the definitions of knowledge and awareness are very similar, a few subtleties warrant discussion. Awareness usually refers to something positive, to something that

it is beneficial to promote and encourage, and which is empowering (e.g. Financial Awareness Foundation and its initiatives); take ‘cancer awareness’, for example. Awareness also has a more personalised, internalised aspect, manifesting in the form of perceptions, experiences and familiarity. One important consequence of this is that, to measure awareness, one would require a set of psychometric testing tools.

2.3.4.4 Financial Capability

Financial capability is a broader term that encompasses two dimensions of financial literacy, namely knowledge and skills, and includes “attitudes, and which [the financial capability concept] takes into account the impact of the surrounding environment on people’s ability to achieve positive outcomes” (Kempson et al., 2013, p2). Under this definition, financial capability includes behavioural aspects that are lacking in definitions of financial literacy. Financial capability also stresses the application of financial knowledge and skills, along with decision-making. For example, Johnson and Sherraden (2007) define a financially capable person as one who is: “able to understand, access, act in their best financial interest” (p. 124). Accordingly, “to be financially capable, people must be more than financially literate, they must have access to financial products and services that allow them to act in their best interest” (Birkenmaier et al., 2013, p. 3). Such a notion is strongly grounded in the capabilities theory developed by Sen (1992) and which was initially applied to human development by Nussbaum (2011). Simply put, it takes into account the role of external conditions in the development of capabilities: government regulation, financial education, and better access to financial services, will all enhance the financial capabilities of households. Not surprisingly, this is the term that is most frequently adopted by national strategies; by, for example, the Financial Capability Strategy by FSA in the UK or the National Financial Educators Council in the USA.

Lusardi (2011) describes the financial capabilities of Americans as encompassing four main areas: “making ends meet; planning, choosing and managing financial products; financial literacy and self-assessed skills” (p. 6). This is, again, a much broader view that understands financial literacy as a sub-dimension of financial capability.

2.3.4.5 Financial Literacy and Financial Advice

Previously it was pointed out that financial education programmes tend not to be very efficient, especially once some time has passed. An alternative to financial education is forming a relationship with a financial advisor, who can suggest a financially sound course of action that is consistent with best practices informed by personal finance theory. Haslem (2010) notes that financial advisors can support people in the decision-making process by helping them overcome anxiety, validating decisions, and even mediating spousal disagreements on financial decisions. Engelmann et al. (2009) analysed MRI brain scans to reveal that, for those who received financial advice, their decision-making process required less cognitive load.

Could offers of personalised financial advice increase general levels of financial literacy? A majority of studies suggest there is an only limited effect on financial literacy. Bhattacharya et al. (2012) document an experiment conducted by a large European brokerage house where nearly all of its customers were given an opportunity to enrol into a free financial advice programme: the majority of them did not take them up on the offer, while those that did also happened to have the highest levels of objective financial literacy. Confirming this trend, Anderson et al., 2017; Calcagno and Monticone (2015), Debbich (2015) and Hackethal et al. (2012) established that more experienced and knowledgeable investors tend to utilise financial advice more often than their less knowledgeable counterparts. The latest research from Migliavacca (2020) finds that working with a financial advisor positively correlates with advanced financial literacy of clients. This effect was even more prevalent for those working with an independent financial advisor as opposed to non-independent. This could possibly be

explained by the notion that an independent financial advisor has to work harder to justify his or her fees, thus is more interested in educating his or her client more.

Robb et al. (2012) have specifically researched the motivations for engaging with a financial advisor, taking into account different types of households and types of advice. They found that those aged 25-34 tended to utilise debt counselling advice most often, while individuals who were 65 and older sought advice on savings and investments. Marital status did not influence the likelihood of seeking financial advice on savings and investments, although women were more likely to seek any type of advice by up to 34%. Interestingly, both subjective and objective financial knowledge (defined in 2.4) was positively associated to utilising all types of advice, except for debt counselling where this association was negative.

A few studies have evaluated whether financial advice improves financial outcomes. Marsden et al. (2011) reported that engaging with a financial advisor results in better portfolio diversification and more confidence in the markets, as well as a feeling of better retirement preparedness; however, it had no impact on retirement savings or portfolio asset value and returns. Kramer (2016) analysed the investment returns of more than 16,000 Dutch households over 52 months: he discovered a staggering heterogeneity of portfolios in terms of diversification, churn rate and trading strategies, but found no evidence of outperformance by those who utilised the services of a financial advisor. Hackethal et al. (2012) reported that households who used a financial advisor achieved lower total and excess returns with a higher churning rate than other households.

One should not forget that financial advice is also costly. For example, Bluethgen et al. (2008) determined that, while being a recipient of financial advice increases portfolio diversification, it also reduces a proportion of equity investments within a portfolio and has increased portfolio turnover as well as fee expenses. Interestingly, they also revealed that financial advisors generally do a good job steering clients to international equities, thereby

reducing the domestic stock ownership bias. Unfortunately, due to a lack of data, the authors were not able to reach a definitive conclusion as to whether households that receive financial advice are able to generate higher returns to offset those costs.

Working with a financial advisor entails a principal-agent relationship that requires a significant amount of trust. Given that the majority of advisors in many countries are fee-based rather than commission-based, there is a natural incentive to recommend investments that fetch the highest fees (Chalmers and Reuter, 2020). Also, while several previously mentioned studies have used aggregate data on returns and portfolio characteristics, very little research is available about the quality of advice received by financial advisors. Mullainathan et al. (2012) conducted 284 client-visits in the Boston area, where an auditor pretended to be a client, with various amounts of investable assets, seeking investment advice. They found that the local financial advice markets did not work as efficiently as desired. First, nearly half of the advisors encouraged a switch from an efficient index portfolio to actively managed funds. Second, the majority of advisors failed at “de-biasing” their clients; for example, clients who came with trend-chasing portfolios, or ones who had a high employer stock concentration instead of a more efficient one, were not encouraged towards new asset allocation. Third, although a majority (75%) of advisors collected demographic and risk-tolerance data, few acted upon it: advisers often recommended minimal exposure to equities for those with low amounts to invest, clients’ age profiles were almost always ignored, and the same portfolio allocation was offered to various age groups. Similar results were obtained by Oehler and Kohlert (2009), who documented a poor quality of information exchange between financial advisors and their clients in Germany. They attributed those results not only to information asymmetry and bad incentives (i.e. commissions), but also to the fact that German banks have been forced to reduce costs because a majority of retail clients generate negative profit contributions, and because

financial advisers are forced to spend much of their time on administrative tasks rather than working directly with clients.

The biggest problem facing financial advice is that households do not have any mechanisms to mitigate the information asymmetry and moral hazard inherent in financial advice. Customers who do not know much about financial markets are vulnerable to soliciting advisors who might overstate his/her credentials and skills, or who set unrealistic expectations about portfolio performance. Clients have no opportunity to observe the work of the financial advisor – i.e. how much time and effort is put into research and providing recommendations. Furthermore, a majority of clients (even financially sophisticated ones) have no ability to discern whether the returns generated by an advisor can be attributed to skill or luck. Financial market shocks can be used to mask poor performance, allowing advisors to shelter behind that which they cannot control. All in all, and perhaps paradoxically, it seems that a client must have financial literacy to successfully work with a financial advisor.

2.4 Operationalisation of Financial Literacy in the Literature

In previous studies, the concept of financial literacy has been poorly operationalised, and this is one of the key deficiencies in the literature that this thesis attempts to remedy. This section explains how the concept of financial literacy has thus far been operationalised in the literature, along with detailed critiques of the most common measures.

2.4.1 Subjective Financial Literacy

One key measurement approach is to determine an individual's own perception of their level of financial literacy, often called subjective (SFL) or self-reported financial literacy, which is used by several researchers including Perry and Morris (2005); Riitsalu and Murakas (2019); and Van Rooij et al. (2007).

The fundamental question about this approach is how trustworthy it is. Quite a few studies have tried to compare the subjective with objective financial literacy (OFL), which is measured by applying the knowledge tests to be discussed in the following section 2.5.2. The comparison is made to see if SFL has any predictive ability, but the results have been quite inconsistent. For example, Guiso and Jappeli (2008) found a very weak relationship between OFL and SFL in their tabulated sample of 1686 individuals in Italy: 15% of the people who scored well on the literacy test perceived themselves to be unknowledgeable about finance, while 50% with poor financial literacy perceived themselves to be above-average; the authors therefore attributed much of the asymmetry to overconfidence. A more moderate deviation was reported by Xia et al. (2014). In their sample of Chinese households, 23.9% of respondents were overconfident in their financial literacy skills while 19% were underconfident. Similar results were obtained by Agnew and Szykman (2005), who found a median correlation of 0.49 between OFL and SFL; 0.21 by Nejad and Javid (2018); and 0.14 by Tang and Baker (2016). The findings suggest that subjective financial literacy may serve as a limited proxy for objective financial literacy within the study of various financial outcomes.

A few recent studies have specifically explored overconfidence in financial literacy. De Salvatore et al. (2018) found that a quarter of respondents in Italy underestimated their financial literacy; in other OECD countries, while overconfidence is prevalent among men and highly educated individuals in Italy, in the majority of other countries (especially Germany and the Netherlands) it was more prevalent among women and less educated individuals. Meanwhile, however, de Zwaan et al. (2017) did not find any gender differences in their sample of Australian students.

Although these studies showed only a modest correlation between OFL and SFL, it may be premature to dismiss SFL altogether. A growing body of literature has argued that while it

is logical to assume that OFL will impact the quality of financial decisions, SFL might impact financial behaviour itself. For example, van Rooij et al. (2011) stress that both SFL and OFL increase an individual's propensity to invest in the stock market. Graham et al. (2009) state that individuals exhibiting higher levels of SFL trade more often and diversify their portfolio better. Interestingly, Bannier and Neubert (2016) find that SFL is associated with holding riskier asset classes in one's portfolio, while OFL serves as a better predictor for less risky asset classes. Both OFL and SFL have predictive power in assessing both the propensity to save (Babiarz and Robb, 2014; Henager and Mauldin, 2015) and to engage in retirement planning (Parker et al., 2012).

2.4.2 Objective Financial Literacy

This section describes and critiques the test-based measures of financial literacy found in the literature.

2.4.2.1 “Big 3” and “Big 5” Questions

A good starting point to address the question of how best to operationalise financial literacy are three survey questions used by Lusardi and Mitchell (2011a) for the Health and Retirement Survey of 2004, which are reproduced in Table 2.2 below. The first two questions test the concept of compound interest (the time value of money): the first one also requires a respondent to calculate the accumulated amount in a savings account, while the second requires an understanding of the basic concepts of inflation and nominal v. real values. The third question is more advanced, requiring knowledge of diversification and risk.

Table 2.2

“Big 3” Financial Literacy Questions Introduced by Lusardi and Mitchell

1) Suppose you had \$100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? More than \$102 Exactly \$102 Less than \$102 Do not know Refuse to answer
2) Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? More than today Exactly the same Less than today Do not know Refuse to answer
3) Please tell me whether this statement is true or false. —Buying a single company’s stock usually provides a safer return than a stock mutual fund. True False Do not know Refuse to answer
* Correct answers in bold.

Source: Lusardi and Mitchell (2011a) pp.17-39.

Four criteria were employed by the authors to design those questions (Lusardi and Mitchell, 2011a): (i) *simplicity* – questions should measure fundamental knowledge; (ii) *relevance* to the day-to-day aspects of financial management; (iii) *brevity* – a small number of questions; and (iv) *capacity to differentiate* between knowledge levels.

The same three questions were later used in the National Longitudinal Survey of Youth of 2007/2008 (Lusardi et al., 2010), the American Life Panel in 2008 (Lusardi and Mitchell, 2011b), the Financial Capability Study of 2009 (FINRA, 2011), along with several others. Then it quickly gained even wider acceptance, used by Almenberg and S  ve-S  derbergh (2011); Behrman et al. (2012); Bucher-Koenen and Lusardi (2011); Carpena et al. (2011); Crossan et al. (2011); Fornero and Monticone (2011); Klapper and Panos (2011); Sekita (2011). Now, these questions are commonly referred to in the academic literature as the “Big 3”.

Two more questions were added to the “Big 3” in the 2009 National Financial Capability Survey, reproduced in table 2.3 below. The first question tests one’s knowledge of the inverse relationship between interest rates and bond prices, and the second one an understanding of interest as applied to mortgage payments.

Table 2.3

Additional Financial Literacy Questions Introduced by Lusardi to Form a “Big 5”

4) If interest rates rise, what will typically happen to bond prices? They will rise They will fall They will stay the same There is no relationship between bond prices and the interest rates Do not know Refuse to answer
5) Please tell me whether this statement is true or false. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. True False Do not know Refuse to answer
* Correct answers in bold.

Source: Bumcrot, Lin and Lusardi, 2011, p6.

It is notable that neither of these two questions attracted immediate widespread use in other surveys, most likely because they attempted to measure a more advanced level of the financial literacy that many researchers may have deemed gratuitous for their purposes. Nevertheless, they have started to appear more often in recent studies (see Table 2.4), including in this thesis.

2.4.2.2. Extended Tests

Although the Big 3 questions have become something of a ‘gold standard’ in the literature, it is easy to argue that they do not provide a sufficiently comprehensive measure of financial literacy (as will be discussed in the following section, on critiques of existing measures). In light of this, multiple other tests and indexes have been developed that either incorporate the “Big 3” questions or have used an entirely different set of questions altogether.

For instance, a far more comprehensive set of questions was used in the DNB household survey, run among the Dutch population, which was developed in 2007 by Van Rooij, Lusardi and Alessie (2011). It included 16 questions, separated into two subsets: basic literacy questions (the “Big 5”) and sophisticated literacy questions (11 questions). Notably, authors report that the second set of questions presented more difficulty for respondents relative to the basic literacy questions. For example, the percentage of “do not know” responses was in the range of 3 to 8% for basic financial literacy question, but saw a range of 11% to 38% for advanced literacy questions (Van Rooij et al., 2011). A special module of ten questions that cover knowledge of capital markets, risk diversification, mutual fund fee knowledge, and numeracy was added to the Health and Retirement Study in 2008 (Lusardi et al., 2014). More questions allowed for more granularity in the obtained data, however the overall literacy assessment results were similar to the studies that utilised the “Big 3” and “Big 5” questions.

Upon analysing various studies that utilised extended tests, a considerable amount of heterogeneity was found to exist, both in terms of the length of FL tests and the dimensions tested. Table 2.4 presents a summary of various instruments:

Table 2.4
Overview of Financial Literacy Instruments

Research	Country/target population	Sample size	Type and Length	Constructs/ dimensions	Comments
Alexander et al., 1997	USA mutual fund investors, 2000	2,000	9 TF	SI only	
Chen and Volpe, 1998	USA 924 college students	924	36 MC	N, B, C, SI, P	
Bernheim, 1998	USA, general population, 806	806	13MC	B, SI	
Vitt et al., 2000	USA general population, 1000	1,000	14 MC	B, SI, P	Study commissioned by the Fannie Mae Foundation
SIPC, 2001	USA, general population	2,063/635 used	8 MC	SI only	
Tennyson and Nguyen, 2001	USA, high school seniors, Jumpstart Coalition for Personal Financial Literacy	1,634	31	B, C, SI, P	
Vanguard Group, 2002	USA general population	1,000	20 MC and TF	SI (also taxation)	
Bowen, 2002	USA, students and parents	64	19 MC	B, C, P	
John Hancock Financial Services, 2002	USA, general	801	5 MC + self-reported	SI only	The first survey that included question

					on self-reported measure
Volpe et al., 2002	USA, investors	530	10	SI only	Included advanced questions like beta and fin ratio analysis
Beal and Delpachitra, 2003	Australia, college students	789	26 MC	B, C, SI, P	
Hilgert et al., 2003	USA, general	1,004	28-item knowledge test, true/false	B, C, SI, P	
Moore, 2003	USA, Washington state residents, general	1,423	26 MC and T/F		Includes financial behaviour questions
O'Neill and Xiao, 2003	USA, general	642	20 T/F	B, C, SI, P	Survey of financial behaviour, not knowledge
Bernheim and Garrett, 2003	USA, general household survey, sample of 38-48 year olds	2,055	No info	B, SI	
Wilcox, 2003	USA, mutual fund investors only	50	To MC and T/F	SI only	Focuses on mutual fund investing concepts
FINRA, 2003	USA, investors	1,086	10 MC	SI	NASD Investor Literacy Research
Ray Morgan Research, 2003	Australia, general population	3,548	26 MC and TF	B, C, SI, P	
Danes and Haberman, 2004	USA, students who have been exposed to the personal finance curriculum	5,329	14 MC	B, C, SI, P	Few questions on financial behaviours
Agnew and Szykman, 2005	USA, general public, most participants are college employees	398	10 MC and TF	SI	Includes self-reported measure
Avard et al., 2005	USA college freshmen	407	20	B, C, SI, P	
Chen and Volpe, 2005	USA, HR professionals	212	68	B,C,P	Indirect. Asks HR professionals about knowledge possessed by employees
Perry and Morris, 2005	USA, general population 1999 Freddie Mac Consumer Credit Survey	10,997	5	C, SI	All questions are on self-reported basis
Tan, 2005	Singapore, general	2,023	18 TF	B, P	By Monetary Authority of Singapore
Manton et al., 2006	USA, college freshmen	407	20	B, C, SI, P	
Cude et al., 2006	USA, College students	1,891	10		Only financial behaviour, not knowledge
Godsted and McCormik, 2007	USA, general population	805	None to test knowledge	N/A	Self-assessed only
Lusardi and Mitchell, 2007	USA, Rand American Life Panel	812	16 (same as above)	B, SI	
Lyons et al., 2007	USA general population	1,578	45	B, C	
Borden et al., 2008	USA, college students	93	7	B, C	
Guiso and Jappelli, 2008	Italy, general, Unicredit Customers' Survey 2007	1,686	5	B,SI	
Cole et al., 2009	India and Indonesia, general	3,360 +1,500	BIG3 adapted + 1 on borrowing	B, C, SI	
Al-Tamimi, 2009	UAE, investors	290	18	B, SI, P	
Muller and Weber, 2010	Germany, mutual fund investors	3,000	8	SI	Assess factual knowledge of

Gathergood, and Weber, 2014	UK, YouGov Debt Tracker	2,584	3 MC	C	Study self-control in relation to borrowing
Xia et al., 2014	China, The China Center for Financial Research survey	3,122	6 MC + subjective FL	SI, Eco	Focus on overconfidence
Sarigül, 2014	Turkey, college students	1,099	22 MC	N, B, C, SI	
Clark et al., 2014	USA, working population, used bank records	3,520	5 MC, incl. BIG3	B, SI, Pension	Used bank's data
Grohmann et al., 2014	Thailand, general	500	BIG3	B, SI	
Lusardi and Tufano, 2015	USA, general	1,000	3 MC	B, C	Focuses on debt only
Almenberg and Dreber, 2015	Sweden, general	1,300	12 MC incl. BIG 5	N, B, C, SI	
Von Gaudecker, 2015	Netherlands, general Dutch household survey	1,604	16 MC incl. BIG5	N, B, C, SI	
Tokar, 2015	USA, general 2012 National Financial Capability Study	25,509	BIG5	N, B, C, SI	
Grohmann et al., 2015	Thailand, Bangkok residents, general	530	4 MC incl. BIG 3	B, SI	
Ali et al., 2015	Malaysia, general	1,957	10 MC	N, B, C, SI	
Mouna and Jarboui, 2015	Tunisia, investors only	256	11 MC, incl. BIG 5	N, B, C, SI	
Yu et al., 2015	Hong Kong, general	1,005	BIG 3	B, SI	
Silgoner et al., 2015	Austrian population, general (part of OECD initiative)	2,000	11 MC incl. BIG 3	N, B, C, SI	
Arrondel et al., 2015.	France, general population	2,172	BIG 3	B, SI	
Arif, 2015	Pakistan, individual investors	154	18 T/F	N, B, C, SI	
Allgood and Walstad, 2016	USA, 2009 National Financial Capability Study	28,146	BIG5	B, C, SI	
Bannier and Neubert, 2016	Germany, general; 2009 SAVE panel	2,047	9 MC incl. BIG5	N, B, C, SI	
Henager and Cude, 2016	USA, general ;2012 National Financial Capability Study	23,727	BIG 5	B, C, SI	
Hsu, 2016	USA, the elderly; 2008 Cognitive Economics Survey	748	24 MC incl. BIG 5	N, B, C, SI	
Driva et al., 2016	Germany, high school students	418	BIG 5	B, C, SI	Focus on gender differences
Murugiah, 2016	Malaysia, general population	2,500	12 MC incl. BIG 5	N, B, C, SI	
Ates et al., 2016	Turkey, general population	596	20 MC incl. BIG 5 and Knoll and Houts, 2012 scale	N, B, C, SI	
Moure, 2016	Chile, general population	14,500	BIG 3	B, SI	
Kadoya and Khan, 2017	Japan, general population	1,948	BIG 5	B, C, SI	
Finke et al., 2017	USA, 60+ age	3,873	20	B,C,SI,P	Focuses on old age
Anderson et al., 2017	LinkedIn users	5,814	BIG 5	B, C, SI	
Sivaramakrishnan et al., 2017	India, middle-income families	506	14 MC incl. BIG 3	N, B, C, SI	
Liao et al., 2017	China, general population 2014 China Survey of Consumer Finances	3,921	20 MC incl. BIG 5	N, B, C, SI	
Morgan and Trinh, 2017	Cambodia and Viet Nam general population, OECD initiative	1,035 and 1,000	BIG 5	B, C, SI	
Kadoya and Khan, 2017	Japan, general population; Bank of Japan Survey 2016	16,345	5 MC	N, B, C, SI	
Hsiao and Tsai, 2018	Taiwan, Literacy Survey	2,523	8 MC, one from BIG 5	N, B, SI, P	Participation in derivatives
Agyei, 2018	Ghana, general	398	21 MC, incl. BIG5	N, B, C, SI	

Skagerlund et al., 2018	Sweden, general	2,063	4 MC, incl. BIG3	N, SI	
Bianchi, 2018	France, clients of a bank	511	7 MC, incl. BIG3	N, B, C, SI	
Grohmann, 2018	Bangkok, middle class	500	3 MC (all are BIG3) + naming of banks	N, B, SI	
Kalmi, and Ruuskanen 2018	Finland, general population, OECD survey	1,477	8 MC and T/F, incl. BIG3	B, N, SI	
Kawamura et al., 2019	Japan, general	4,968	10 MC, incl. BIG3	N, B, C, SI, P	
Bettin and Scaturro, 2019	Italy, general, Survey on Household Income and Wealth by the Bank of Italy	3,849	10 MC, incl. BIG5	N, B, C, SI	
Hastings and Mitchell, 2020	Chile, general population	14,000	6 MC, BIG3	B, N, SI	Included “chance of a disease” question.
Cupak et al., 2020	USA, general population, SCF	6,248	BIG3	B, N, SI	

MC – multiple choice, N – numeracy, B – basics, C – credit, SI – savings and investments, P – planning; Source: Author

The prevalence of a few recurring but distinct approaches can be inferred from this table. First, there are those studies that focus on basic or general principles, and the “Big 3” questions certainly fall into this category. The main rationale for adopting these is that the aforementioned questions are widely relevant; for example, the effect of compound interest is important both to an investor (as it increases the stock of wealth) and the borrower when the interest is paid out. Similarly, the question regarding inflation can be applied to various domains including spending/consumption, saving and investing (as it erodes future purchasing power and is also a component in the nominal rate of return), and borrowing (as it decreases the real value of debt). According to Nicolini et al. (2013) such an approach is most effective when the aim is to measure financial behaviour (e.g. stock market participation, savings rate, purchase of insurance, etc.).

The second approach incorporates multidimensional aspects, taking into consideration that is likely that an individual may be more knowledgeable in one or more domains while less knowledgeable in others. Such an approach, then, allows for the creation of more sophisticated financial literacy indices and more detailed data; knowledge of specific domains can also be matched with an analysis of a behaviour within that domain. Three major content/domain areas appear in the various financial literacy tests: budgeting (managing funds on a daily basis); borrowing; saving and investing. A few works also explore insurance (Chen and Volpe, 2002;

Morton, 2005), and some into the even narrower concept of investment literacy (Volpe et al., 2002; Müller and Weber, 2010; Putri et al., 2019). Those domains coincide with the major competency areas obtained from the analysis of the major financial literacy frameworks discussed in Section 2.8.

The majority of questions are structured as multiple-choice questions with an occasional true-or-false one. There are two main aggregating measures used to create a financial literacy index found in the literature. The first is a simple addition of correct answers which are dichotomised and with each answer carrying equal weight; this method is very straightforward accounts for why it is the most widespread. The second method is also a sum of correct answers, but each answer is assigned a different weight depending on the complexity of the question; the level of difficulty is either pre-determined based on an estimation of the knowledge/skill level required to solve a particular question, or it is inferred after the responses are tabulated by various statistical techniques, including factor analysis (Lusardi, Mitchell and Curto, 2014; van Rooij et al., 2012). The merits of each method are discussed in more detail in section 3.7.1.5.

2.4.2.3 Critique of Test-based Measures

Although test-based measures have been widely used, one should nevertheless be aware of the inherent shortcomings of such an approach. According to Hastings et al. (2012), one limitation is the lack of incentives that a participant receives for providing correct answers on item-tests. Nor do survey participants typically have access to any resources during testing; under normal circumstances, of course, people will have recourse to information obtained via the internet, financial advisor, or even social interaction through friends and family.

Questions on any test in any domain are also sensitive to framing bias. Lusardi and Mitchell (2011a) estimate that the percentage of correct answers to their third question has

increased twofold when it was rephrased. Another important consideration is the possibility of guessing, which inevitably cause measurement errors. One suggested remedy is to eliminate true/false questions, as those are easier to guess correctly. Hill and Perdue (2008) stress the importance of including the “do not know” answer option, as it allows researchers to differentiate between a wrong answer obtained by guessing and a lack of knowledge, thus reducing overstatement or understatement of financial literacy.

Carpena et al. (2011) have stressed the contextual dimension; according to them, it is important to distinguish between what is measured in a developed country v. in the developing world as “it may be important to assess financial literacy based on knowledge of bank account opening requirements, as opposed to ability to calculate interest rates” in an informal economy (p. 8). This view is also supported by the authors of the “Big 3” questions themselves: Lusardi and Mitchell (2017) point out that it is “imperative to expand the range of measures of financial literacy, so as to better evaluate the types of problems that people find most difficult” (p. 6).

2.4.2.4 Critique of “Big 3” Questions

Since so many studies have used all three or at least one of the “Big 3” questions, the ability to compare across countries is thankfully possible. Still to address, however, is the question of what exactly these questions measure. A handful of researchers have even expressed concerns about their ability to accurately measure financial literacy outright. Hastings et al. (2012) note that “The question of how best to assess the desired behavioural capabilities remains open, both in terms of establishing whether survey questions are best-suited for the task or which questions are most effective” (p. 11).

A few research projects have used Classical Test Theory and Items Response theory (both are discussed in detail in sections 4.2.1.1 and 4.2.2.1) to evaluate the validity of the “Big 3” questions. Kunovskaya et al. (2014) used the Rasch model to evaluate the construct validity and reliability of the first two questions and reported only “acceptable reliability with

limitations in the instrument's ability to measure the targeted concept" (p. 527). However, Knoll and Houts (2012) were able to validate the "Big 3" questions with an application of a two-parameter logistic model under the premise of Item Response Theory. Hung et al. (2009) also tested the construct validity of the questions in the RAND American Life Panel (the one which has both basic and advanced components) and found that the answers to the questions possess high test-retest reliability. Unfortunately, the research into validity of the test-based measures is scarce and none of the authors who employed extended questionnaires provide any information on pre-testing of the questions (whether focus groups were employed or interviews with participants were conducted).

2.4.2.5 Proxies or Related Variables

Some research works have employed proxies of financial literacy; the most commonly used are the socio-demographic proxies as they are thought to closely correlate with the test-based measures. The most common is education (Calvet et al., 2007; Christiansen et al., 2008; Vissing-Jorgensen 2004), followed by income and wealth (Dhar and Zhu, 2006), and professional status (Calvet et al., 2007), IQ (Grinblatt et al., 2011). Unfortunately, a study by Muller and Weber (2010) demonstrated a weak relationship between the measures and the proxies, and recommended a move away from such an approach.

Another cluster of research has bypassed the test-based measures altogether in order to avoid their limitations and instead opt for outcome-based proxies. Under this approach, particular traits of household financial behaviour are observed, such as the level of diversification (Goetzman and Kumar, 2008; Grinblatt and Keloharju, 2001), portfolio composition (Genesove and Mayer, 2001; Goetzman and Kumar, 2008), and disposition effect (Calvet et al., 2009). An index of financial capability is then constructed and used to predict other financial outcomes. One of the key advantages of this approach is that it is consistent with the extended definitions of financial literacy (i.e. knowledge + skills + aptitude); however,

given the lack of a universal definition of financial capability and subjective understandings of what precisely constitutes exemplary financial behaviour, and add to that limited data, this approach has serious shortcomings.

This section documented a considerable heterogeneity in the operationalisation of financial literacy within the literature. Researchers have used test-based measures ranging from three to 25 questions and sometimes utilised subjective financial literacy or very crude proxies. Research into the validity of the test-based measures appears to be scarce. The following section summarises the findings of research that has used test-based measures.

2.5 Financial (il)Literacy Around the World

Most studies report and indicate widespread financial illiteracy in both developed and developing countries. One of the earliest studies, aimed at determining the level of financial literacy in the United States, was conducted by Hilgert and Hogarth (2003); the researchers attempted to estimate the degree of financial literacy among US families by conducting phone interviews with 1,004 families from the four main geographical regions of the continental US. The survey consisted of 28 true-or-false questions covering six domains of financial knowledge; namely, cash flow management, credit management, savings, investments, mortgage, and other financial management topics. The results indicated that adult families in the US were only able to answer 67% of the questions correctly, with questions related to mortgage scoring the highest at 80% correct.

Following this effort, Lusardi and Mitchell (2017) designed an internet-based survey to test both basic and sophisticated financial literacy of adult Americans aged 18 and above. The survey questions consisted of two sets of questions: five questions aimed at measuring basic financial literacy (the “Big 5”) and the second set included eight questions to measure sophisticated financial literacy. Results from the 989 respondents varied significantly between the two sets of questions: for the “Big 5”, only 44% of respondents were able to answer all five

correctly, with the “numeracy” question scoring highest and “compound interest” scoring lowest. As for the second set of questions, although a high percentage of respondents answered a question correctly, only 16.5% were able to answer all eight questions correctly, which was lower than expected. The obvious conclusion was that financial literacy among adult Americans is low and not widespread.

To confirm the results of these two studies, Lusardi and Mitchell (2011c) conducted one of the most comprehensive studies to date. The researchers simplified the survey to three questions (“Big 3”) which, recall, measure the financial literacy of adult Americans on the topics of interest rate, inflation, and risk diversification. After phone interviews with 1,200 respondents, the percentage of financially literate adult Americans was indicated to be low, as only 30.2% of the respondents were able to answer all three basic questions correctly.

Low levels of financial literacy are not limited to US adults; as Lusardi and Mitchell (2011b, p. 13) note, “financial literacy is very low around the world, irrespective of the level of financial market development” and is exhibited in highly developed countries like Germany, Sweden, Japan, and New Zealand (Lusardi and Mitchell, 2014). These widespread low levels of financial literacy have been documented in various studies; one of the most comprehensive global studies was commissioned by the OECD and carried out by Atkinson and Messy in 2012. Their aim was to determine the financial knowledge of populations throughout 14 different countries between 2010 and 2011, using a sample of 1,000 people per country, which included: Albania, Armenia, British Virgin Islands (BVI), Czech Republic, Estonia, Germany, Hungary, Ireland, Malaysia, Norway, Peru, Poland, South Africa, and the United Kingdom. The study also extended financial literacy beyond knowledge domain to include financial behaviours and financial attitudes; to do so, they designed three separate questionnaires to test these three aspects of financial literacy, then combined the scoring of all three to estimate the level of financial literacy in each participating country. The first questionnaire, which tested financial

knowledge, consisted of eight questions to cover: division, time-value of money, interest paid on a loan, interest plus principal calculation, compound interest, risk and return, inflation, and risk diversification. In addition, the second questionnaire tested financial behaviour through a set of four questions, while the third tested financial attitude through three questions. For the EU countries, only 58% of respondents demonstrated a good level of financial knowledge, meaning that 42% of the respondents would stand to benefit from financial knowledge education. The average financial behaviour score in the EU countries was 5.2 out of 9, while the average financial attitude score was 3.2, where 3 represented a satisfactory score. Finally, the researchers summed the three component scores and assigned an overall financial literacy score out of a maximum of 22 points: for the EU countries, the overall financial literacy score was around 14.5, which comes up significantly short of the maximum value. The main takeaway from this is that although these countries are well developed financially, nearly half of their populations lack an adequate level of financial literacy. Furthermore, when looking at some of the emerging markets covered in the study, for example, Albania, Peru, and South Africa, it was determined that respectively, 55%, 59%, and 67% of respondents should receive financial knowledge education, even though their scores in financial behaviour and attitude were just above average.

Further studies on financial literacy in EU countries have confirmed the OECD's findings that the level of financial literacy is relatively low. Lusardi and Mitchell (2014), for example, presented results from several other studies across the EU that used the same three questions as Lusardi and Mitchell (2011b). Only 44.8%, 53.2%, 24.9%, and 30.9% of the respondents in the Netherlands, Germany, Italy, and France, were able to answer the three questions correctly, reflecting an alarmingly low financial literacy rate in these countries. In 2017, Lusardi reported that according to Standard & Poor's Global Financial Literacy Survey, conducted in 2014 and which included 150,000 adults in 140 countries, only 65% to 75% of

the adults in Germany, Denmark, Sweden, the Netherlands, and the United Kingdom can be classified as financially literate. Meanwhile, only 25% to 50% of adults in 16 countries, including Spain and France, can be classified as financially literate (Klapper et al., 2017).

One interesting factor in across-country differences is the influence of economic conditions unique to each country; for instance, Lusardi and Mitchell (2013) report that citizens of countries that have experienced high inflation (e.g. Italy) tend to provide more correct answers to inflation questions than do those in low-inflation countries (e.g. Japan). Similarly, people from East Germany or Russia are less likely to provide a correct answer on the question about diversification since there were few financial instruments available in the market for a long time.

Finally, low levels of financial literacy are not confined to developed markets; they also appear across emerging markets. For instance, Klapper and Panos (2011) used the same three questions as Lusardi and Mitchell (2011b) to test financial literacy in Russia, conducting face-to-face interviews with 1,400 adult participants, and astonishingly found that only 3.07% of them were able to answer the three correctly. Similarly, according to Standard & Poor's Global Financial Literacy Survey conducted in 2014, one of the largest emerging economies in the world, China, had a financial literacy score of only 28, while Africa had a score of 33, and Latin America and the Caribbean had 29 (Batsaikhan and Demertzis, 2018). Roberts et al. (2014) conducted a survey of 2,972 adults in South Africa to assess their degrees of financial literacy; they divided financial literacy into four components, namely: (i) financial control; (ii) financial planning; (iii) choosing financial products; and (iv) financial knowledge. They found that the mean scores of the four, out of 100, were respectively 58, 53, 45, and 56, while the overall financial literacy score was 54, meaning that around half of South Africa's population are financially illiterate.

To summarise, researchers have used various measures to assess financial literacy, but the generally consistent finding is that financial illiteracy is pronounced and widespread in both developed and developing countries and it is particularly prevalent in specific domains (budgeting, savings and investments, credit).

2.6 What do we Know About Financial Literacy?

2.6.1 Stylised Facts and Related Variables

Financial literacy is a necessary precondition to make sound financial decisions. However, levels of financial literacy are uneven across several demographic groups, including gender, age, education, income, wealth and others (Almenberg and Sävje-Söderbergh, 2011; Al-Tamimi, 2009; Hogarth and Hilgert, 2002; Kadoya and Khan, 2019; Klapper et al., 2015; Muñoz-Murillo et al., 2020). One of the driving factors behind this growing body of research is to question widely held and perhaps erroneous general beliefs that, for instance, men are more financial literate than women, or that educated people are more financial literate than less. The value of this line of inquiry is primarily for policy purposes: policymakers wish to target specific demographic populations when formulating policies. Overall, most studies have discovered that financial literacy varies across educational level, gender, income, and age.

High level of education corresponds to high financial literacy

Education level is one of the major factors believed to significantly affect one's level of financial literacy. Among US adults, Hogarth and Hilgert (2002) demonstrated that low levels of educational attainment correspond closely with less financial knowledge. Among those whose English proficiency is low, the United States Government Accountability Office (2010) reports that education is an influential factor affecting financial literacy level. The report also notes that the Board of Governors of the Federal Reserve System have found a statistically significant relationship between respondents' education level and their financial knowledge.

Behrman et al. (2012) discovered that, when interacting with financial literacy, education level also shows a positive relationship with wealth.

The link between education and financial literacy has also been confirmed elsewhere: in Sweden by Almenberg and S  ve-S  derbergh (2011) and Brown and Graf (2013); in Chile by Garcia and Tessada (2013); in Tunisia by Mouna and Jarboui (2017); and in India by Aggarwal and Gupta (2014). In Italy, using the 1996 and 1998 Bank of Italy surveys of households' income and wealth, Guiso and Jappelli (2005) established that financial awareness is positively correlated with education, household resources, long-term bank relations, and proxies for social interaction.

Among investors, and controlling for socioeconomic and behavioural differences between them, Abreu and Mendes (2010) found that investors' education level positively corresponds to their degree of financial literacy. Vig (2017) found that among Indian investors, education was one of the most influential variables affecting financial literacy; Bhushan and Medury (2013) found the same, but added to the list of factors gender, income, nature of employment and place of work.

Women are generally less financially literate than men

The role of gender is also implicated in affecting levels of financial literacy: most studies find that women are in general less financially literate than men. A handful of studies in developed countries have established this link: Al-Tamimi (2009) by focusing on individual investors in the United Arab Emirates; Volpe et al. (2002) by sampling individual online investors in the US; and Almenberg and S  ve-S  derbergh (2011) in Sweden.

These findings are also widespread in developing countries. In Brazil, women, but especially single women, tend to be less financially literate than men (Potrich et al., 2018). In India, male respondents answer more questions correctly than their female counterparts (Aggarwal and Gupta, 2014), and rural women in Tamil Nadu tend to be financially illiterate

(Mathivathani and Velumani, 2014). In Pakistan, most female workers conduct transactions without understanding the reasons for it, or simply deposit money in order to gain some return from interest, with very little broader understanding of financial markets (Bhabha et al., 2014). In Malaysia, young males tend to have higher financial literacy than young females, while the level of financial illiteracy among women varied depending on whether they lived in rural areas (Nga et al., 2010).

Klapper et al. (2015), based on a multinational survey across 140 countries, found that women are more financially illiterate than men, and this is just as true in developing countries as it is in advanced countries with more developed financial markets; they estimate the gender gap to be approximately 5%. They also noted that the gender gap was similar in both the developed and developing countries except for South Africa and China where both men and women were equally financially illiterate. This finding is consistent with an assertion that financial illiteracy is not related to the stage of economic development of the country, i.e. it is also widespread even in developed economies (Lusardi and Mitchell, 2011b).

Several theories have been proposed to explain this gender gap. According to Luhrmann et al. (2015), the gender gap in financial literacy starts to develop very early and already exists by the age of 13 to 15 years old. Driva et al. (2016) attribute the gap to gender-biased and stereotypical beliefs that lead to an underinvestment in the financial knowledge among teenage girls. Grohmann (2016) argues that financial literacy is strongly associated with numeracy, and therefore gender differences in educational attainment and educational systems may go some way in explaining the financial literacy gap.

The magnitude of the gender gap can also be a product of research methodology. For instance, Smith et al. (2010) report that when a household is the unit of analysis of a survey, men are more likely to be selected as the financial representative of the household. It is also worth noting that women tend to answer questions with “I do not know” more often than men,

and are generally more conservative in their subjective financial literacy assessment (Bucher-Koenen et al., 2016). This important observation implies that the financial literacy gender gap may decrease if men's greater tendency to guess questionnaire answers is factored in.

Middle age individuals are more financially literate than younger and older people

When analysing financial outcomes, age is often included as a control variable, together with gender, income and education. In general, most studies indicate that financial literacy is highest for middle age individuals rather than for younger or older people. Pinto et al. (2001) found low levels of financial literacy among high school students in the US, which corresponds to the trend studied by Hogarth and Hilgert (2002) that younger (and older) individuals tend to be less financial literate than those who are middle age. A low level of financial awareness among young people is most likely due to a lack of interest in financial matters in the absence of employment.

In Sweden, Almenberg and S  ve-S  derbergh (2011) reveal that financial literacy levels are lower among older people. Finke et al. (2017) discovered that financial literacy scores decrease by approximately 2% with each additional year after the age of 60. They attribute this to the general decline in cognitive abilities. Interestingly, although many studies found that older people tend to be less financially literate, Lusardi and Mitchell (2011b) demonstrate that they rate themselves as highly financially literate on self-assessment tests. This is to be expected: according to Finke et al. (2017), one's confidence in one's financial decision-making abilities does not decline with age.

There could be several explanations as to why middle-age individuals are the most financially literate age group. One popular account notes that a segment of middle age people are in the midst of their career; they are already accustomed to employment and an income stream, and this stimulates them to actively participate in financial markets, especially to accumulate wealth in order to prepare for retirement. Moreover, they already have some

experience with financial products such as savings and mortgages while younger adults have not. Similar conclusions were made by Klapper et al. (2015): across 140 countries, the highest percentage (63%) of financially literate people were found within the 35 to 50 age group in advanced economies, followed by 15 to 35 years, then 50 to 65 years, and the lowest were those over 65. Perhaps surprisingly, the results were entirely different within emerging economies: the highest percentage (32%) of financially literate people were found within the 15 to 35 age group, followed by 35 to 50, then 50 to 65, and the lowest were those over 65. These observations could be attributed to the growing middle class as well as to greater access to education within those countries.

High-income level and wealth correspond to high financial literacy

Several studies have found a significant relationship between income and financial literacy (Al-Tamimi, 2009; Lusardi and Mitchel, 2011b; Mouna and Jarbouï, 2017). The general finding is that high-income individuals tend to be more financially literate than those with lower incomes (Almenberg and Sävje-Söderbergh, 2011; Hogarth and Hilgert, 2002).

Klapper et al. (2015) determined that financial illiteracy is most often found among poor individuals within both developed and emerging countries.

Van Rooij et al. (2012) reported a strong connection of financial literacy to wealth. The relationship was especially strong once answers to the advanced financial literacy questions were compared to answers from the basic questions, among participants with various wealth levels. In addition, Monticone (2010) highlights the strong association between wealth levels and financial literacy; it rests on the hypothesis that wealthier households tend to invest more into gaining financial knowledge due to a need to manage their endowed wealth. Kadoya and Khan (2019) also argue that younger individuals would be more interested in acquiring financial literacy if their parents are able to pass on a bigger inheritance. Other studies that document a positive correlation between financial literacy and wealth, although not elaborated

on the nexus of causality, include: Bannier and Schwarz (2018); Ottaviani and Vandone (2018); Schmeiser and Seligman (2013); Xue et al. (2019).

Housing wealth is the most significant component of household wealth within the European Union (Wind et al., 2017). Fornero and Monticone (2011) also report that homeowners tend to exhibit higher level of financial literacy than those who rent. Moreover, those who make mortgage payments tend to have even higher financial literacy levels than those who do not; this could be explained by the fact that those who take out the mortgage must beforehand evaluate various alternatives, be more aware of the current financial environment, and understand loan amortization calculations and interest rates.

Being self-employed

Fornero and Monticone (2011) report that the self-employed (both small business owners and freelancers) have a higher level of financial literacy; this is explained by the fact that they are either wealthier or must personally make many financial (including business) decisions. Van Rooij et al. (2012) note that the self-employed in the Netherlands are nearly twice as likely to plan for retirement since they are not covered by employer pension plans, which will undoubtedly lead them to seek more knowledge on investments and to be more aware of the current financial environment. In Romania, the self-employed have higher levels of financial literacy than the employed; the self-employed also have a higher level of savings (Beckmann, 2013). Ćumurović and Hyll (2019) have found a strong link between entrepreneurship and financial literacy, and the causal nexus may be working in both directions: self-employed people have greater incentives to gain financial literacy, but greater financial literacy — the ability to evaluate business and financial risks, knowing where to obtain financing and at a lower cost — can serve as an encouragement to decide to become self-employed.

Lusardi and Mitchell (2011b), however, have reported a negligible difference in financial literacy between self-employed and employed persons, suggesting that this is due to heterogeneity. Fornero and Monticone (2011), on the other hand, reported a more pronounced difference, most likely because of their larger sample size.

Marital status and number of dependants

Some empirical studies have confirmed that married persons tend to exhibit higher levels of financial literacy than single persons. Among US adults, single respondents are less financially knowledgeable (Hogarth and Hilgert, 2002). A similar result was found in Brazil: women are less financially literate than men, but the effect is more profound on single women (Potrich et al., 2018). One potential reason why married women are generally more financially knowledgeable than single ones is their responsibility as a parent whom must invest for their children's future needs such as education, home, and health care.

A few studies have included the number of dependants. Potrich et al. (2015) suggest that those who have children will likely be more concerned with the financial well-being of their family and thus be more financially literate. According to Bharucha (2017), having children was positively associated with levels of financial literacy. Mahdzan and Tabiani (2013) reported that having children increases the propensity to save, and that the trait was more prevalent among financially literate respondents.

Although Bucher-Koenen et al. (2016) did not specifically test the association between financial literacy and number of children; they reported no effect on financial planning that was highly correlated with financial literacy. Similarly, Mottola (2013) found that families with no children reported higher levels of financial literacy. Interestingly, Servon and Kaestner (2008) recorded that families with one child demonstrated lower financial literacy than those with two or more.

Risk tolerance

Yu et al. (2015) examine the relation between financial literacy and risk tolerance, finding a statistically significant positive relationship; they argue that households with higher risk tolerance tend to invest in more sophisticated assets, which necessitates acquiring greater financial knowledge. Sjöberg and Engelberg (2009) examined the risk-taking attitudes of Swedish students and found that these were higher among more financially-literate students. Bajo et al. (2015) evaluated more than 38,000 MiFID questionnaires filled in by the customers of an Italian bank and found that subjective (i.e. self-reported) financial literacy was strongly associated with risk tolerance. The study incorporated a financial experience variable into the analysis, which was also positively correlated with risk tolerance levels, and they also reported a significant gender gap in risk tolerance with women tending to exhibit more risk-averse behaviour.

Other facts: Immigration and language proficiency

One's immigration status has been found to affect the level of financial literacy in individuals. Hogarth and Hilgert (2002) demonstrate that less financially knowledgeable respondents are commonly found in minority groups. In Switzerland, immigrants have lower financial literacy scores, as do those with low proficiency in the native language (Brown and Graf, 2013). Language matters as it triggers individual confidence to interact with financial institutions; that is, non-native speakers tend to avoid interacting with financial service providers. In the U.S., the Government Accountability Office notes that lack of English proficiency creates significant barriers to financial literacy and conducting daily financial affairs (Cackley, 2010). Individuals with low English proficiency face significant challenges in completing account applications, understanding contracts, and making complaints. Also, the study also emphasises that immigrants in the U.S. are less financially literate, not being familiar

with the U.S. financial system and its products, which often differ considerably from those in their native countries.

2.6.2 Endogeneity Concerns

When interpreting studies that link financial literacy to various economic outcomes one should be mindful of endogeneity bias. Endogeneity comes from three sources: omitted variables, reverse causality, and model misspecification. Omitted variables are ones that have an influence on the dependant variable but are not included among the independent variables in the regression analysis. The problem lies in the fact that the impact from such variables appears in the error term, which distorts the estimators and decreases the reliability of the analysis. It is highly possible that some people who are financially literate may also happen to have a higher motivation to excel in personal finance (Bucher-Koenen and Lusardi, 2011), be more patient (Hastings and Mitchell, 2020), or are intelligent or future-oriented (Meier and Sprenger, 2010). Fernandes et al. (2014) conducted a meta-analysis of 168 papers that link financial literacy and/or financial education to financial behaviours, finding that studies which employed instrumental variables revealed smaller effects than studies which only used ordinary least square regressions. However, Lusardi and Mitchell (2013) state the exact opposite – studies that employed instrumental variables resulted in larger effect-size estimates.

Another important consideration is the possibility of reverse causality. Could a particular situation or particular financial behaviour influence one's level of financial literacy? For example, an individual who inherits a large amount of money may become interested in how investments work in order to better manage their newfound wealth; the same individual might then seek the advice of a financial advisor and thereby increase their stock of financial literacy as the relationship progresses. According to Hilgert et al. (2003), personal experience was the most frequently mentioned source of financial learning (with friends and family being the second) which lends legitimacy to the reverse causality argument.

The third source of endogeneity is measurement error, which can result from administering a test that does not have construct validity; i.e. does not properly measure what it is purported to measure. This is further discussed in sections 3.7 and 4.2 in this thesis.

This section identified some associations between financial literacy and various demographic variables. Regrettably, most of the studies only document relationships but do not elaborate on the nexus of causality as they are primarily designed to study the outcomes of financial literacy as opposed to its antecedents. The studies that did, often did not address the endogeneity concerns which are prevalent in constructs that try to explain human behaviour.

2.7 Factors Affecting Household Portfolio Choice

This section focuses on one of the consequences of financial literacy – financial portfolio construction. It begins by exploring the financial environment in which households have to operate, links financial literacy to stockholding, and concludes with an analysis of other variables that impact portfolio choice.

2.7.1 Changing Environment Causing Changes in Portfolio Allocation

According to Guiso et al. (2003a), the increase in shareholder base has been much more rapid and visible in European countries than in the United States over the last two decades of the 20th century, attributable mainly to a rise in indirect stockholding. This largely stemmed from the changing macroeconomic environment and innovations in the financial industry: lured by high yields in the 1990s many non-participant households were compelled to enter stock markets but left immediately after the bust. A similar increase in stock market participation was documented by Zhou (2020) in the years preceding the financial crisis of 2008, while stock market participation rate declined by 5.9% in 2009.

Nevertheless, there were many permanent shifts that influenced stockholding rates. One was the marked change in developing countries' demographic compositions; ageing

populations created a considerable disproportion between the inflows (made by young workers) and outflows (pensions paid to the retirees) into the pensions and social security funds of numerous developing countries. Many governments responded to the problem by providing tax deferral incentives for households to invest for their retirement so as to induce private contributions. Guiso (2018) documents an inverse relationship between the presence of large social security systems (notably Germany, France and Italy) and the amounts of those contributions, while countries with the highest stockholder base (the US, the UK, Sweden and the Netherlands) also tend to provide only basic retirement benefits, thus indirectly supporting this trend.

Explored later on in this thesis, but which should be briefly mentioned now, is the trend towards higher levels of financial awareness of stocks and stock markets in general, prompted by structural changes within the financial environment. In the U.S., for example, the introduction of defined-contribution schemes (which replaced defined-benefit schemes) allowed investors to accumulate stocks (and other “exotic” assets like managed forex accounts or futures) as a part of their retirement investment portfolio. Such allowances have spurred general interest in stocks and other risky assets. Celerier et al. (2016) report that the proliferation of retail structured products enticed newcomers to the stock market. Many educational campaigns initiated by governments and employers (discussed in 2.2.4.2 section) have also raised awareness about stock market investing.

The proliferation of the mutual fund as an asset class has allowed many investors to participate in the stock market without directly purchasing individual securities. Holding investments in several funds, with various strategies and investment geography, effectively means people can easily develop a well-diversified portfolio. Mutual funds also lower entry barriers: individuals can entrust their money to professional fund managers for a very low cost.

While the growth of mutual funds and private pension funds have mostly influenced indirect stockholding, direct stockholding has also risen. Modern information technologies have significantly decreased the cost of market transactions: many discount brokerage houses now offer their services with under \$5 commissions-per-trade or even for free (e.g. Revolut and Robinhood online banks). The practice that was non-existent even fifteen years ago. Because of the larger number of market participants, the implicit cost of transacting (measured by bid-ask spread) has also decreased significantly for some securities. A modern investor has an informational advantage: the availability of inexpensive but high-quality equity research (which was previously available only to the institutional investors), and educational materials (e.g. seminars, periodicals), empower investor to explore, analyse and trade in the stock market.

In the United Kingdom, Italy and France, many successful privatisations of utilities took place in the 1990s. The governments' advertising campaigns were targeted at individual investors as potential participants, which brought people who formerly did not have any knowledge of the stock market into the stockholder base.

As a result, the general consensus is that the increase in the global stockholder base is positive and welcome; nevertheless, there are challenges that need to be addressed. It is obvious that the growing availability of potential investment opportunities brings additional risks to portfolios. Some shareholders are overconfident, do not diversify properly, or trade excessively and as a result decrease the expected return on their portfolios (Barber and Odean, 2001). Such behaviour can create financial distress, and in extreme cases, provoke the abandonment of holding risky assets; for instance, according to the 2001 Survey of Consumer Finances, there was a 3% decrease in stockholding after the dot.com bubble burst (Aizcorbe et al., 2003). It is prudent for government organizations to ensure that newcomers have sufficient knowledge of the risks of stock trading and have access to expert advice regarding stock investment. Under the life-cycle model this is particularly important: optimal portfolio allocation should be

ensured. Low transactions costs have also brought low-wealth households into the financial markets; they might overreact to market movements due to their unpreparedness to face financial distress or correctly interpret market signals (Guiso et al, 2003b). Such overreactions can provoke excessive volatility in asset prices. For example, some analysts speculate that young people drawn to low-cost trading applications such as Robinhood, might have caused excessive price spikes during the COVID-19 lockdown of 2020 (Salzman, 2020).

Although increased stockholding might pose challenges, the benefits to financial markets and society should outweigh the costs. Guiso et al. (2003b) stress the large influence that increased stockholding may have via perceptions: “The new stockholders [...will] acquire new attitudes towards capitalism, private property, and reforms that potentially enhance the value of corporations, liberalise labour markets and improve the functioning of the financial sector.” (p. 15).

2.7.2 Financial Literacy Impact on Portfolio Choice

While the spread of equity culture is a well-documented phenomenon, it is important to investigate the impact of financial literacy on stockholding and examine the characteristics of the stockholder base. Several studies have done so: Almenberg and Dreber (2015); Arts (2018); Guiso and Jappelli (2005); Mbabazi and Daniel (2017); Thomas and Spataro (2018); Utkus and Young (2010) and Van Rooij et al. (2011) among others.

A few studies have focused specifically on the relationship between financial literacy and portfolio diversification; a positive relationship between the two has been found by Abreu and Mendes (2010); Giofré (2017); Guiso and Jappelli (2008); and Mouna and Jarboui (2015). Some studies focus on financial derivative markets (Hsiao and Tsai, 2018); some on pension and retirement planning (Almenberg and Säve-Söderbergh, 2011; Brown and Graf, 2013; Farrar et al., 2018 and Van Rooij et al., 2011); or on general financial planning (Arrondel et al., 2012).

Research into stock market participation has also been driven by policymakers: many believe that low participation in the stock market can cause significant welfare losses in an economy (Cocco et al., 2005). Consequently, the numbers of studies on financial literacy and stock market participation is growing. Using the comprehensive measure of financial knowledge from De Nederlandsche Bank, Van Rooij et al. (2011) found that financial knowledge incentivises individuals to invest in the stock market. Thomas and Spataro (2018) investigate the determinants of stock market participation in nine European countries including Austria, Belgium, Denmark, Germany, Italy, France, Switzerland, and Netherlands; they discovered that financial literacy has a positive and significant effect on stock market participation, together with human capital. This supports the previous findings of Guiso and Jappelli (2005) that the lack of awareness of stocks among Italian households is one of the reasons behind low participation in financial markets.

Yoong (2011) argues that being able to understand how stocks work as a financial instrument is the necessary precondition for investing, and the general lack of that understanding is the primary reason for why households do not invest in stocks. Using a US sample, he suggests that financial illiteracy negatively affects stock market participation, even for people with a high level of income, wealth or education. In Sweden, Almenberg and Dreber (2015) show that when controlling for basic financial literacy, the gender gap between men and women in stock market participation diminishes; this suggests that when facing a decision over whether or not to participate in the stock market, financial literacy is invariant to the gender gap and acts as an important criteria for both men and women to participate.

One of the first studies to distinguish between basic and advanced financial literacies found that financial literacy affects financial decision-making, with those of low literacy much less likely to invest in the stock market (Van Rooij et al., 2011). Although most of the respondents in this study were able to present basic financial knowledge such as inflation and

present/future value of money, many were unable to differentiate between bonds and stocks, the relationship between bond prices and interest rates, and the basics of risk diversification. This indicates that there is a positive relationship between financial literacy and stock market participation occurs, to a certain extent: Yoong (2011) reveals that even highly financially literate people can become classified as illiterate if they have fallen behind on their knowledge of current financial issues and trends, while Guiso and Jappelli (2005) demonstrate that a lack of financial awareness significantly contributes to increased participation costs in the stock market and consequently reduces the participation rate.

Low financial literacy can be mitigated by finance-related education; several studies have found that a higher level of financial education can promote a higher degree of stock market participation. For instance, Dolvin et al. (2008) found that investment analysis courses at three universities positively influenced the willingness of students to take on more significant and efficient stock positions within simulated portfolios; this increased willingness seems to be because students have become more informed and less risk-averse to keep higher stocks with higher expected returns. Smaller in scope, Mbabazi and Daniel (2017) examined a small regional market in Rwanda comprising 98 small and medium-sized enterprises, and found that financial literacy has a significant positive relationship to stock market participation; this implies that the importance of financial literacy not only holds for individuals but also for small corporations such as SMEs.

Country-specific social connectedness also moderates the magnitude of the positive relationship between financial literacy and stock market participation (Arts, 2018). In China, using the Chinese Survey of Consumer Finance, Xia et al. (2014) found that subjective financial literacy overconfidence is positively correlated with stock market participation; overconfidence was defined as being highly optimistic of the prospects for achieving a positive result from a financial action.

The impact of financial literacy on portfolio choice, diversification and management practices has also been studied, although the results are conditional on specific financial products. In general, more knowledge about finance can help individuals avoid large losses from their portfolio choices. Abreu and Mendes (2010), using a survey of individual investors by the Portuguese Securities Commission (CMVM), demonstrate a positive relationship between financial literacy and portfolio diversification. Abreu and Mendes (2010), and using the Unicredit survey for the eurozone, Guiso and Jappelli (2008), found that financial literacy is strongly correlated to portfolio diversification. Similarly, respondents of the Dutch Central Bank Household Survey (DHS) who possessed low numerical financial skills were highly vulnerable to incurring substantial losses from their undiversified portfolios (Von Gaudecker, 2015).

Hsiao and Tsai (2018) found that individuals with higher levels of financial literacy are more likely to actively participate in derivative markets, even after controlling for stock market participation rates. Using samples taken from the Financial Supervisory Commission of Taiwan and using the probit model, they revealed that financial literacy represents a significant benefit to individuals by providing them beneficial information to minimise entry barriers when purchasing complex derivatives products. Giofré (2017) found virtually the same: financial education corresponds to a higher diversified portfolio consisting of international investments. Finally, in Tunisia, investors' experience, age, their use of an availability heuristic, familiarity bias, and portfolio size, all have a significant impact on their portfolio diversification (Mouna and Jarboui, 2015).

Portfolio diversification is also related to financial products chosen in the context of retirement planning and pension preparation. Several studies have revealed that financial literacy can increase an individual's willingness to enrich their retirement planning portfolio. Van Rooij et al. (2011) support this finding; they determine that higher levels of financial

knowledge encourage individuals to more actively participate in retirement planning and wealth accumulation. Similarly, and by defining retirement planning as the possession of a voluntary retirement saving account, Brown and Graf (2013) show that among 1500 households in Switzerland, financial literacy is strongly correlated with voluntary retirement saving and financial market participation. The study also found financial literacy to be lower among persons with less income, less education, those who are immigrants and are non-native speaking. Dolvin and Templeton (2006) determine that financial education can give a better understanding of the retirement planning process, such that individuals are able to create more efficient portfolios and improved risk management. Similar findings were uncovered in Italy by Fornero and Monticone (2011), where there was a positive and significant relationship between financial literacy and pension plan participation. This positive impact of financial literacy towards retirement planning is also found in Lusardi and Mitchell (2014), an OECD study (2005), and others.

In Sweden, using features of the Swedish pension system, Almenberg and Säre-Söderbergh (2011) found that financial literacy is significantly and positively correlated with retirement planning; highly financial literate individuals also had a more diversified portfolio. Abreu and Mendes (2010) found that investors' financial knowledge has a positive impact on investor diversification; in greater detail, the study also revealed that the source of information utilised by retail investors has a significant impact on the number of different assets in the purchased portfolio. Both Arrondel et al. (2015), and Lusardi and Mitchell (2011c), using the *Patrimoines et Préférences face au Temps et au Risque* (PATER) survey in France, found that highly financial literate people are more likely to be engaged in the preparation of detailed financial planning.

To summarise, multiple studies have documented the link between financial literacy and participation in risky markets: more financially literate households are more likely to avoid

investing mistakes such as under-diversification and engage in better risk mismanagement practices.

2.7.3 Other Variables Impacting Portfolio Choice

In order to assess the wide range of theories and economic models developed to explain stock market participation, it is first necessary to make some observations on the total population of stockholders in various countries; this will help detect some common patterns and correlations between stockholding and various economic and socio-demographic variables. A substantial body of information has been collected over the last few decades regarding household wealth and portfolio choices. The three main sources of data used by researchers are macroeconomic aggregates, financial institutions' databases, and survey data. Most of the data presented below is drawn from various surveys; surveys are generally considered to be less biased and more representative of populations. For a thorough discussion on the data available on household portfolios see Guiso et al. (2002). Some well-documented observations on stock market participants are summarised below.

Nearly all studies note a significant effect of *age* on decisions about asset allocation, and the age – participation profile is hump-shaped in all observed countries. The number of participating households steadily increases with age, reaches its peak at 45 to 55, and rapidly declines over 60 (Chambers and Schlagenhauf, 2002; Fagereng et al., 2017; Holden and Vanderhei, 2005; Morin and Suarez, 1983; Poterba and Samwick, 2007; Riley and Chow, 1992; Schurer, 2015; and Sung and Hanna, 1996). Some studies (Banks et al., 2019; Pachur et al., 2017;) document the fact that risk aversion increases as households approach retirement, which explains why people decrease their equity holdings during the later stages of their lives.

Decreasing equity holding with age is logical and consistent with asset allocation recommendations given by financial planners. A fact regarding younger households is surprising, however: Guiso et al. (2003a) note that young households tend to have more

conservative portfolios. Fagereng et al. (2017) believe that this phenomenon is caused by the significant participation costs that the young have to bear in order to enter stock markets. Weagley and Gannon (1991) also stress the high values of savings vehicles owned by younger cohorts; holding a large proportion of assets in safe securities contradicts the advice of financial planners, who recommend having a larger share of wealth invested in risky assets. The rationale for their advice stems from the fact that younger households have a future stream of income that should offset any losses they could conceivably incur from holding risky assets; older generations do not have that option. Ameriks and Zeldes (2004) provide evidence that individuals do not gradually decrease their proportion of equity as they approach retirement, and that approximately half of the individuals in their study made only minor changes in portfolio allocation over a ten year period. This effect could be attributed to investor inertia (Brown et al., 2018; Shin et al., 2019).

Many financial advisers and researchers believe that *gender* is important since women are believed to be more conservative in choosing investment vehicles than men. Studies by Bajetelsmit and VanDerhei (1997), Hinz et al. (1997), Jianakoplos and Bernasek (1998), have each confirmed that women (especially single women) tend to hold much less risky assets, choose conservative pension plans, and allocate more money into government bonds. Women also reported less willingness to take investment risks. According to Thomas and Spataro (2018), being a female decreases the likelihood to participate in the stock market by 3.5%. Bertocchi et al. (2011) note that single women tend to invest in less risky assets in comparison to married females and men; married people may have higher risk tolerance as they consider marriage to be a safe asset.

However, these studies suffer from an inability to determine who actually makes investment decisions. Bernasek and Shwiff (2001) have included questions regarding how investment decisions were made by households; most households arrive at portfolio decisions

jointly, but they found out that women were generally more risk averse, and it was common for men who had risk-averse partners to decrease their allocation of risky assets. Ameriks et al. (2003) also observed that men tend to invest in the stock market more often than women.

The gender characteristic, although very important, should be analysed together with *marital status* since those two are closely related. Xiao (1996) indicates that married couples hold less risky assets in comparison to their single counterparts. However, Gilliam et al. (2011) arrived at the conclusion that portfolio allocation was varied, attributing that to the lack of microdata on how portfolio allocation decisions are made within the marital unit. An inclusion of a marital status variable may cause a multicollinearity problem, since this variable might be positively correlated with wealth and income variables: married couples tend to have a higher asset base and more financial resources to allocate to risky assets.

Another important variable is *education*; households with a higher level of education tend strongly to have a better understanding of various investment vehicles and the risks/returns embedded in them. According to Xiao (1996), households with higher levels of education have more diversified portfolios, while those with postgraduate degree had more sophisticated assets like money market instruments and corporate bonds in their portfolios. According to Guiso et al. (2002), the extent of households' participation more than doubles when level of education changes from high school to college degree. Guiso et al. (2005) observe that the participation rate was higher among those with a university education in all European countries and the U.S; this is especially true in Italy and Netherlands. According to Zhou (2020), less educated households were more likely to drop out of the stock market after the financial crisis. A positive relationship between level of education and likelihood of holding stocks (both directly and indirectly) has been confirmed by Black et al. (2018), Gao et al. (2019), Grable (2000), Hariharan et al. (2000), Kezdi and Willis (2011), Shum and Faig (2006), and Waggle and Englis (2000).

Wealth or net worth (defined as total assets minus total liabilities) is the strongest determinant of whether a household will invest in stocks or not in virtually all studies. The more net worth a household has, the less financial risk is present and the ability to withstand investment risk is magnified. Another, much simpler explanation, is that a wealthy household has much more money to invest so it is more likely that stocks will be chosen as an asset class. In fact, Gomez (2017) reports that while an average household in the U.S. invests 40% of its wealth in equity (both direct and indirect), the wealthiest 0.01% households allocate 75% of their financial portfolios into equities.

Most studies have found a significant positive relationship between net worth and stockholding as documented by: Balloch et al. (2015), Bertaut (1998), Gao et al. (2019) Haliassos and Bertaut (1995), Hariharan et al. (2000), King and Leape (1998), and Weagley and Gannon (1991). It is important to distinguish between financial and nonfinancial net worth: nonfinancial net worth (according to the Survey of Consumer Finances (SCF) definition which is used throughout this thesis) includes assets such as real estate, automobiles, and other durable goods minus any outstanding loans (apart from consumer loans, which are subtracted to determine financial net worth). Shum and Faig (2006) suggest that households with very high net worth will be more risk averse than households that have a smaller percentage of wealth comprised of financial assets, because of a lower correlation with consumption for the latter group.

Another variable, **household income**, is another strong determinant of participation in many studies (Campbell, 2006; Heaton and Lucas, 2000; Lahey et al., 2003; Mankiw and Zeldes, 1991 and Yuan, 2018), however, it is notable that the effect of wealth is much stronger than the effect of income in both the U.S. and the EU (Guiso and Jappelli, 2005). In assessing the influence of income as a determinant of stockholding, it is necessary to make a further

inquiry into the source, variability and background risks that are connected with income, which is the task of the following paragraphs.

Homeownership is an important explanatory variable since real estate represents a very significant non-financial asset. Generally, holding real estate should logically reduce the likelihood of stock market participation since it represents an intensive financial commitment in the form of mortgage payments, property taxes and repairs. According to Cocco et al. (2005), younger and lower income households have fewer financial resources to invest in stocks since a large proportion of their income is consumed by mortgage payments; there is also a crowding-out effect caused by house price risk, which reduces stockholding. This effect is particularly visible for low net worth households. An interesting observation was made by Heaton and Lucas (2000) that higher mortgage values are positively related to stockholding; their explanation suggests that some stocks are indirectly financed by mortgage debt.

Cocco et al. (2005) subsequently attempted to relate housing risks with other risks that households face and found that income shocks and housing shocks are closely related, but uncorrelated, with stock returns. These investors with higher equity stakes and higher mortgages “capitalise” labour income, which becomes a more important component of their wealth, and that in turn leads to an increased proportion of stocks in the portfolio. Yao and Zhang (2005) also observe that when investors own a house versus renting it, they tend to hold more stocks so as to capture the diversification benefit that arises from the low correlation between stock and housing returns. They also argue that owning a house may serve as a protective shield against financial and labour income risks. According to Vestman (2019), the stock market participation rate in the U.S. is almost twice as high among homeowners over renters. On the other hand, however, Arrondel and Savignac (2009) report that an increase in housing to total wealth ratio of French households crowds out stock market participation; they

argue that households may perceive housing as a risky asset and therefore attempt to reduce overall risk by shunning stocks from their portfolios.

Another variable that has received some, although limited, attention, is the presence of *entrepreneurial risk* or business ownership. Heaton and Lucas (2000) used the dichotomous variable of whether a household owns a private business, as a proxy for entrepreneurial risk or the presence of illiquid projects. It is to be expected that households with a stake in a private business, and exposing themselves to such risk, would decrease participation in the stock market; this is consistent with observations from Heaton and Lucas (2000) and Shum and Faig (2006). Vaarmets et al. (2019), on the other hand, report that being self-employed increases one's probability of participating in the stock market in Estonia; they claim that self-employed people are more actively searching for various possibilities to increase their wealth. Spataro and Corsini (2017) also observed higher levels of participation in stock markets among the self-employed and small business owners, noting a higher level of financial literacy within this group most probably because they have to deal with financial planning more often than employees.

Shum and Faig (2006) have also included *professional investment advice* as a variable in their probit analysis, finding that stockholding is positively related to the dummy variable of receiving financial advice. Nevertheless, one should keep in mind possible endogeneity, since a household willing to buy stocks is more likely to seek investment advice.

Calcagno and Monticone (2015) also found that investors with higher level of financial literacy are more likely to consult advisors, while those with a lower level tend to make investment decisions themselves; they also stress the importance of trust in the financial system. Georgarakos and Inderst (2014) also note that the decision on whether or not to follow investment advice, and whether to participate in the stock market, is dependent on the household financial capability and trust.

The section documented the impact of financial literacy on stockholding and provided an overview of other major determinants of stockholding. Those determinants will be used as control variables in the regression analysis to test the hypotheses formulated in the next section.

2.8 Conceptual Framework and Hypotheses

This section aims to synthesise the theories, concepts and ideas presented in the literature review section into a coherent framework. This section overviews the preconditions of financial literacy, the supply and demand sides of financial literacy, its role within household financial outcomes, as well as its long-range impact on financial markets themselves. The determinants of financial literacy are listed, and the hypotheses that are to be tested in subsequent chapters, are formulated.

Consistent with autonomous theory, financial literacy is a form of human capital. One's level of human capital varies during one's lifetime and may begin to decline late in life (e.g. because of a decline in cognitive ability and/or an unwillingness to keep up with or a disinterest in economic current affairs). No one, of course, is born (financially) literate; it is entirely acquired knowledge, and a few key factors dictate whether a household will acquire and/or improve its financial literacy.

The first factor is the provision (or in economic terms, the supply) of channels through which one's level of financial literacy level may be improved. As discussed in section 2.3.4.2, there are various channels through which households can acquire financial literacy. These range from formal education (e.g. university, high school or employer-sponsored course) to very informal channels such as blogs, social media, or interactions with friends and family.

The availability and scope of those channels is largely dependent on the economic development of the society. Developed economies have significantly more resources to devote to educating their citizens. Initiatives such as Financial Council and Education Commission in

the USA, Financial Capability Strategy in the UK or the *Gilla Din Ekonomi* (Love Your Finances) Swedish financial education network are very expensive to design and implement.

It is to be expected that countries with higher levels of economic development will encourage people to improve their financial literacy. Higher disposable incomes create more possibilities to save and invest, and therefore competency in investment becomes more relevant and important. Meanwhile, in lower developed countries one would expect to see more of an emphasis on money management and financial planning than on investment literacy.

Furthermore, one can argue that the presence of advanced financial systems (i.e., those with many different financial instruments and a wide range of financial services) may also lead to higher levels of financial literacy. A household that has to make financial decisions by analysing various alternatives would be forced to learn the underlying building blocks and necessary key concepts. Financial institutions would also have an incentive to provide financial education as it can help attract long-term customers. For instance, more than 70% of Swedish financial institutions provide some sort of financial education (Sveriges Riksbank, 2017). This is frequently done through an institution's "financial education" webpage, blog, or via other social media channels. Furthermore, a developed financial ecosystem also employs more people that can educate and/or provide financial advice, which again adds to the supply side of financial literacy provision.

A country may possess the best educational system in the world and spend countless resources and energy on financial literacy programs, but there are other critical factors besides the provision or the supply side of financial literacy. The second factor is the external environment that surrounds each individual household. Previous research has shown that households are very heterogeneous in nature, yet despite this, section 2.6 identifies some similarities within corresponding levels of financial literacy within various demographic and psychographic groups. As a result of an analysis of those relationships, the following

hypotheses were developed to differentiate among the Swedish population those that are the most and the least financially literate.

Table 2.5
Hypotheses Proposed in Relation to Financial Literacy

Nr.	Variable	Hypothesis	Relevant literature
1	Gender	Men tend to exhibit higher levels of FL than women.	Almenberg and Dreber, 2015; Atkinson and Messy, 2012; Grohmann, 2016; Preston and Wright, 2019.
2	Education	There is a positive relationship between the level of education attained and the level of FL.	Kadoya and Khan, 2019; Lusardi and Mitchell, 2011.
3	Age	There is a positive relationship between age and the level of FL.* * up to a certain age as the level of FL might decline with old age.	Atkinson and Messy, 2012; Finke et al., 2017.
4	Income	There is a positive relationship between household income and the level of FL.	Mouna and Jarboui, 2017.
5	Wealth	There is a positive relationship between wealth and the level of FL.	Monticone, 2010; Van Rooij, Lusardi and Alessie, 2012.
6	Accommodation ownership	People who live in owner-occupied accommodation tend to have higher levels of FL.	Anderloni et al., 2012; Atkinson, 2007; Ramana and Muduli, 2019.
7	Self-employment	There is a positive relationship between being a self-employed/business owner and one's level of FL.	Ćumurović and Hyll, 2019; Fornero and Monticone, 2011.
8	Living with the partner	There is a positive relationship between living with a partner/spouse and one's level of FL.	Hogarth and Hilgert, 2002; Potrich et al., 2018.
9	Children	There is a positive relationship between having a child(ren) and one's level of FL.	Potrich et al., 2015.
10	Risk tolerance	There is a positive relationship between risk tolerance and one's level of FL.	Yu et al., 2015.
11	Retirement planning	There is a positive relationship between thinking about old age and one's level of FL.	Bucher-Koenen and Lusardi, 2011.

Source: Author

Higher levels of financial literacy have significant macroeconomic implications. Most researchers agree that well-developed financial markets are a necessary precondition for economic growth (Gray and Talbot, 2007; Shin, 2013; Wu et al., 2020). Well-developed financial markets are characterised by having a wide choice of financial instruments (depth and breadth) on the supply side and a considerable investor base pursuing various risk-return trade-offs on the demand side. The previous section noted that the presence of developed financial markets may help increase levels of financial literacy by motivating people to learn about financial instruments and the economy. However, it is now apparent that a well-functioning financial market or financial ecosystem is reliant on the presence of financially literate participants. Financial asset prices reflect available information and market participants' actions based on expectations. It is thus important to have a broad base of investors to ensure the continuity of trade flows and liquidity of markets (hence the emphasis of this dissertation on stock market participation). What is more, it is important to ensure that those who transact in financial markets can properly assess the values and risk-return profiles of various financial instruments. Such sound assessment helps to diminish the propensity to speculate and can reduce market volatility. As mentioned in the introductory chapter, the presence of a broader and more knowledgeable shareholder base can decrease the equity premium puzzle and thereby reduce market frictions.

As also noted previously, many countries have prioritised the development of defined contribution pension plans in recent years (Fisch et al., 2019). The success of such a shift is largely dependent on household motivation to save for retirement and trust in the financial system. Both are the by-products of financial literacy (Van Rooij, et al., 2012). More sophisticated pension systems require more independent choices (e.g. how much to contribute, where to invest, level of diversification, and asset allocation). Since household well-being at

retirement is at stake, these choices have to be carefully analysed and the most appropriate course of action must be followed.

Although preparation for retirement is one of the major reasons behind savings and investments, one should not forget that households often save and invest for other needs (e.g. college tuition, down payment on real estate, etc.). Therefore, studying household portfolio choice is paramount; households' rate of participation in the stock market is insufficient. Avoiding stocks in one's portfolio can be costly in the long run as they provide an enhanced rate of return and diversification benefit to one's portfolio.

Attention now turns towards the second main objective of this thesis: an evaluation of how financial literacy impacts portfolio choice, namely stockholding.

As there are two types of stockholding — direct and indirect — two probit models are created with both of the corresponding dependent variables. The main hypotheses are:

H12a. Level of financial literacy has a positive impact on direct stockholding;

H12b. Level of financial literacy has a positive impact on indirect stockholding.

It is expected that the effect of financial literacy will be weaker for indirect stockholding. Multiple other factors may influence the decision of a household to indirectly hold stocks, which could include recommendations by a financial advisor, inertia, among others. The following control variables were added to the regression based on the literature review (refer to Section 2.7.3): age, gender, income, wealth, level of education, living with a partner, having children, owning an accommodation, being an entrepreneur, tracking one's expenditures, thinking of old age, and risk tolerance.

As discussed previously, reverse causality might exist between stockholding and being financially literate. To address the endogeneity problem, an instrumental variable business education was added. The rationale for the addition, as well as for the model specifications, are presented in the third chapter.

Although this thesis focuses on portfolio choice, it is worth mentioning that financial literacy has an impact on other household financial wellbeing outcomes such as money management (Hamid and Loke, 2021; Shockey, 2002), financial planning (Lusardi and Mitchell, 2011; Sekita, 2011), portfolio management (Bianchi, 2018), borrowing (Pak, 2018) and wealth protection (Lin et al, 2018).

It is important to distinguish between financial capability and financial literacy within the research framework. Although these terms are used almost interchangeably by many researchers, they should nevertheless be considered as separate constructs. Throughout this thesis, the knowledge and skills aspects (which forms financial literacy) are separated from the behavioural/action aspects of financial capability. Financial literacy is a precondition for households to be financially capable (that is, to make utility maximising decisions and being able to commit to those decisions over the long term). Financially capable households are able to achieve positive effects such as rational portfolio choice along with the others mentioned in the previous paragraph.

Consistent with discussions by Hastings et al. (2012), Huston (2010), Remund (2010), and Stolper and Walper (2017), the thesis distinguishes between two key dimensions of financial literacy: financial knowledge and skills. Under this two-dimensional paradigm, aptitude can be partially attributed to skills, or in a broader sense, from financial capability. What financial knowledge and skills are necessary for a financially literate person to become financially capable? There are currently countless initiatives set up by regulatory bodies, ministries of education, foundations and research councils around the world to promote and/or teach financial literacy. In order to establish the relevant competencies and domains, an analysis of the following educational frameworks/policies was conducted:

- Financial Literacy Standards & Framework by National Financial Educators Council (NFEC, 2019);

- G20/OECD INFE Core competencies framework on financial literacy for adults (OECD, 2015);
- National Standards in K-12 Personal Finance Education by Jumpstart Coalition (Jumpstart, 2017).

From these frameworks, it is clear that proficiency – successfully navigating through financial decisions – is perceived to follow four domains/competencies, summarised in the table below:

Table 2.6
Major Competency Areas

Competency area	Sub-domains or notes
Money management	Forms of money, transfers, price comparison, sources of income
Financial planning and decision –making	Budgeting, savings and Investments, debt Management
Risk and reward	Being able to identify risk/reward profiles of various instruments. Insurance.
Financial environment	Financial services and products, economic and government influence (e.g. tax/regulatory environment)

Source: Author

To study the determinants of financial literacy and its relationship to stockholding, one must first be able to measure it. As discussed in the literature review, there are two ways to measure financial literacy: administering a financial literacy test (objective financial literacy) or by asking households about their perceptions of their own level of knowledge (subjective). Both have corresponding advantages and drawbacks, but it is also well worth drawing a correlation between the two and determining the impact of each on stockholding.

Objective financial literacy is most commonly operationalised by administering financial literacy tests and questionnaires that range from 3 questions to 15 (with a few going up to 60). Although the “Big 3” questions have become the gold standard, mostly due to their brevity and from a desire to maintain comparability with previous studies, very little information is available on the validity of these measures. Accordingly, a main section of the

third chapter is devoted to fill this gap by constructing a financial literacy test and to assessing its validity. Because this dissertation primarily focuses on one particular application of financial literacy – portfolio construction – most questions in the financial literacy test were drawn from the last three competency areas mentioned above.

Figure 2.2 illustrates the relationship between the various demand and supply factors related to financial literacy discussed in this chapter. It is worth noting that this thesis focuses on the demand side, and those that form the basis of this research methodology are highlighted.

Financial literacy is influenced by many demographic and psychographic variables (Table 2.5), as well as the availability and quality of financial education. It has many macroeconomic implications such as potentially reducing information asymmetry in financial markets, improving their efficiency, and reducing their volatility. Most importantly, it has a demonstrable impact on household financial well-being.

This thesis maintains that the concept of financial literacy is distinct from the broader concept of financial capability. Two dimensions - financial knowledge and financial skills - are defined within financial literacy. When deciding whether to invest in the stock market, specific domains of financial knowledge and skills are required, chief among them financial planning, risk and reward profile, and financial instruments/environment.

First, the level of financial literacy among the Swedish population is established. Second, the relationship between subjective and objective financial literacy is established. Eleven hypotheses, exploring various socio-demographic and personality factors, are proposed in order to identify the determinants of financial literacy. During the third stage, financial literacy is tied to participation in the stock market, which is one of the desirable financial outcomes from the perspective of household well-being.

Figure 2.1
Stockholding within Portfolio Construction Framework

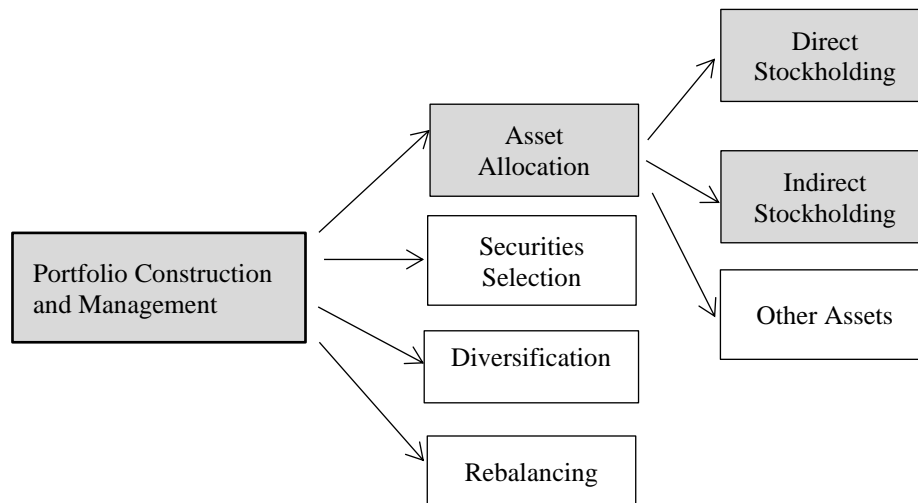
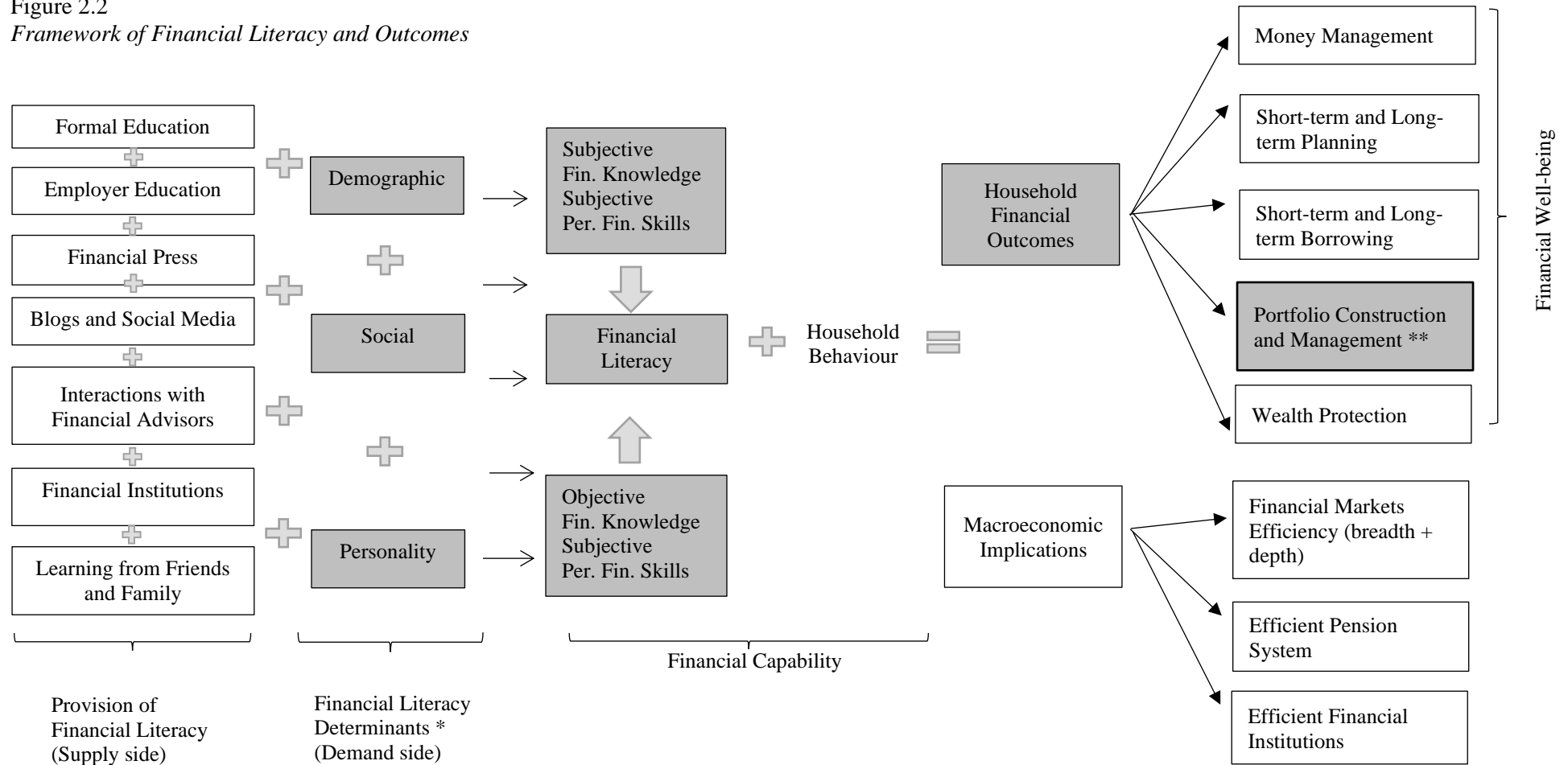


Figure 2.2
Framework of Financial Literacy and Outcomes



* Hypotheses 1-11 in table 2.5

** Hypothesis 12a and 12b, refer to figure 2.1

2.9 Summary

This chapter provided an extensive literature review of financial literacy and its relation to portfolio choice. The term financial literacy has been defined inconsistently across studies, and there are significant gaps in how the concept is operationalised and measured. Most studies rely on short tests that can assess only a basic level of financial literacy, or they rely on subjective financial literacy or other proxies. The literature review identified eleven determinants of financial literacy, and alongside financial literacy, several other variables were identified which may also impact stock market participation. While this chapter provided the research framework, the following chapter presents the research strategy, methodology, and instrumentation of the concept of financial literacy.

Chapter 3. Research Philosophy and Methodology

3.1 Introduction

The literature review section identified significant gaps and inconsistencies within the operationalisation and measurement of the concept of financial literacy. This chapter lays the foundations of the research strategy: it outlines the research design and details the methodology and operationalisation of the concept of objective and subjective financial literacies. It then presents an overview of the data gathering process, questionnaire design, reliability and validity of the instrument, and the procedure of data analysis.

3.2 Aims of the Study

This study explores the determinants of financial literacy and its impact on portfolio choice, and has two central aims: first, to study the determinants of financial literacy, and second, to evaluate the impact of financial knowledge on the decision to hold riskier securities, specifically, stocks within a household's portfolio. These aims are meant to expand the boundaries of knowledge about financial literacy which could assist policymakers, educators and financial practitioners.

3.3 Research Objectives and Questions

To achieve the abovementioned aims, the thesis must: (i) operationalise the concept of financial literacy and propose a valid measurement instrument; (ii) investigate the relationship between subjective (SFL) and objective (OFL) financial literacy; (iii) explore the determinants of financial literacy; (iv) evaluate the impact of objective financial literacy on direct and indirect participation in the stock market; and (v) evaluate the role of a financial adviser in the acquisition of financial knowledge mitigating the effect of low financial literacy. Although this chapter provides a roadmap of how those objectives will be achieved throughout the thesis, it

pays considerable attention to the creation and validation of a measurement instrument – a financial literacy test.

To translate these objectives into useful research questions:

1. What is the level of financial literacy among Sweden's population?

Descriptive statistics of the sample is presented in chapter 4, and chapter 6 follows this up by comparing the results of the current survey to previous research.

2. Does self-reported financial literacy provide an accurate representation of a respondent's level of financial literacy? In other words, can financial advisers or researchers use self-reported financial literacy as a proxy for objective knowledge? chapter 4 aims to quantify this relationship, chapter 5 explores whether financial advisors support this relationship, and chapter 6 discusses the findings within the analysed literature.
3. How do financial literacy determinants (such as age, gender, level of education, wealth, income, being an entrepreneur, and risk aversion) relate to one's level of financial knowledge? Chapter 2, the literature review, identified the main factors that may have an impact (refer to Figure 2.2), Chapter 3 proposes how to measure this relationship quantitatively, and chapter 4 applies it.
4. Do higher levels of financial literacy translate into a decision to include risky assets in one's portfolio? This chapter proposes a model for how to measure this relationship through regression analysis while also ensuring there is no endogeneity. The regression analysis is carried out in chapter 4.
5. How do households – with and according to varying levels of financial literacy – acquire knowledge about finance? This chapter explains how the data was collected (through interviews), with results presented in chapter 5.

3.4 Research Purpose and Approaches

Research purposes are most commonly classified in accordance to these four categories: exploratory, descriptive, explanatory (Saunders et al., 2009) and interpretive (Gray, 2014). Question 1 above is descriptive; 2, 4 and 5 are explanatory; 3 is interpretive; and each type requires its own specific approach.

Exploratory research is usually conducted in settings where little is known about the phenomenon, or more data is required to develop a research framework. During the early stages of research into an area this can be valuable; however, Stebbins (2001) cautions against limiting its employment to only the early stages, since social science research is always to some extent exploratory because no single study can be truly definitive. Much of the literature on financial literacy and its relation to the other variables and determinants of stockholding discussed in the previous chapter can be classified as exploratory.

Descriptive research entails the systematic collection of information about a research problem or issue that requires description or interpretation. It is an antecedent to exploratory research, but also an inextricable part of explanatory research since “all inquiry entails description, and all description entails interpretation” (Sandelowski, 2000, p. 335). In the context of this thesis, it primarily used to evaluate the level of financial literacy among households, and to describe the sample and assess its representativeness, in order to compare the results with other household surveys and identify whether patterns emerging from the data collected are consistent.

Explanatory study is more concerned with asking “why” and “how” types of questions and places its emphasis on determining causality (or lack of it) between variables (Hair et al., 2007). Often it is quantitative in nature, and key variables are usually defined and tested beforehand, creating a higher level of certainty than exploratory research.

Last but not least, interpretive studies try to extract and analyse people's perceptions, experiences, views and perspectives on a particular issue. These are usually associated with a qualitative approach to data analysis and are very useful when trying to discover the meaning of a particular phenomenon. Generally, it avoids absolutes and is helpful when a researcher is faced with unanticipated data or outcome (Wu and Chen, 2005).

Social science research follows either an inductive or deductive approach, depending on a subject matter's relationship with theory. The deductive method begins with a review of the relevant theoretical knowledge in a particular domain that later translates into a formulation of testable hypotheses. The researcher's role is to confirm or repudiate the theory, and therefore, the formulation of hypotheses is a crucial step that will dictate how and what data will be collected according to the research design. Bryman (2016) and Saunders et al. (2009) both highlight the fact that the deductive approach is most commonly associated with quantitative research and is highly structured.

The inductive approach is more explorative in nature, starting with observations of the data and drawing generalizations and shaping theories from an analysis of it. The approach is more flexible as it can make adjustments to a research design as the research progresses, and is more common among studies relying on qualitative methods.

The methodology employed in this research primarily employs a deductive approach, and the theoretical propositions regarding financial literacy's impact on portfolio choice are tested with quantitative data collected specifically for this purpose.

3.5 Research Philosophies

The term research paradigm was first coined by Kuhn (1970) as "the practices that define a scientific discipline at certain point in time" (p.10). Gliner et al. (2009) defines it as "the beliefs members of a scientific community share" (p27). Research philosophy is a term that relates to the development, as well as the nature, of knowledge. Crotty (1998) stresses that

a coherent conceptual framework is needed to tie a research philosophy to the design of any study because those paradigms have an impact on the design and conclusions of any study. Research paradigms are commonly explored through ontology (understanding of reality), epistemology (theory of knowledge), and axiology (value). There are three key research paradigms that are reflected in most research works in social science: positivism, post-positivism and interpretivism.

Positivism is an epistemological perspective that emphasises the scientific method to promote theory and observation. According to it, social reality is independent of a researcher's interventions or experiences; knowledge is derived from "positive" or verifiable empirical information that can be observed. Importantly, under this paradigm, knowledge is value-free and remains uninfluenced by cultural or social context (Hayes, 2000). The positivistic paradigm is frequently associated with both a deductive approach and quantitative methods.

Positivism originated as a framework within the natural sciences (Naturwissenschaften), focusing on the precise relationships between atoms, molecules or other particles. However, social sciences recognised that human beings have thoughts, emotions, cultural backgrounds, and various expectations, and as a result, interpretivism or anti-positivism gained popularity in the nineteenth century among philosophers and researchers who acknowledged the role of humans as social actors. Researchers who adopt the interpretivist approach view social reality as a constructed one, modified by individuals who are active participants. Naturally, advance formulations of hypotheses are generally not encouraged by this paradigm and it tends to gravitate towards qualitative research with an inductive approach.

According to positivism, reality can be ascertained, carefully measured through deductive cause and effect reasoning and even controlled. Post-positivism, which gained traction in the mid-20th century, grew from an acceptance of the imperfections in measuring reality that arise from humans' perceptions and biases that may distort it (Alvesson and

Sköldberg, 2009). As a result, scientists adopting a post-positivistic perspective explicitly acknowledge that their research will inevitably be influenced by their backgrounds and perceptions of reality. One of the post-positivism social science approaches – constructivism – even presumes that social reality is “emergent from individual or collaborative construction of concepts, values, beliefs, ethics and norms of actors within a social field (Fox, 2008, p. 3)”. The role of scientist, accordingly, is shifted from that of a passive observer to a contributor to the construction of social reality (i.e. a “double hermeneutic” outcome of social science as described by Giddens, 2016). Epistemologically, that means that knowledge is context dependent (as neutral knowledge does not exist) and reflexivity by researchers is encouraged (Ryan, 2006). Under this paradigm, research is inevitably broad, theory and practice are commonly intertwined, and the ethical aspects of research are emphasised.

Modern research has become increasingly interdisciplinary and complex, therefore a “new” pragmatic approach is increasingly being adopted in the social sciences. It does not commit to any particular method or strategy, but rather supports both singular and multiple ontological realities from which multiple perspectives can arise; pragmatic approaches tend to favour a mixture of various methods and paradigms because a weakness in one paradigm maybe compensated by strengths in another (Collis and Hussey, 2013).

These paradigm debates have of course affected economics and business studies (for an excellent review see Denzin and Lincoln, 2008; Guba, 1990; Hassard and Kelemen, 2002). Nevertheless, it is indisputable that most research in business and economic studies has gradually and increasingly become conducted mainly within a positivist framework.

While some researchers – namely Pfeffer (1993) and Silverman (1971) – have strongly objected to combinations of research paradigms due to a fear of blurring or incomplete conclusions, most modern researchers do not object and even encourage the use of multiple paradigms and mixed methods. For example, Berg et al. (2004) insist that mixing methods

allows researchers to “obtain a better, more substantive picture of reality”. This view is also supported by Borman et al. (1985), Denzin (1978), and LeCompte and Goetz (1982).

The approach of this thesis employs both pragmatism and post-positivism frameworks, while most of the research objectives are formulated within a positivism paradigm. While pragmatism is extremely useful in achieving most of the research objectives since it can accommodate different assumptions and views to gain a broader picture on financial literacy, a positivism paradigm also offers several advantages. First, it is consistent with much of the previous research conducted in the field, and second, a larger body of evidence may be collected in shorter periods of time through the use of quantitative methods.

3.6 Research Strategy

As noted above, a researcher’s paradigm has a significant impact on which methodology is chosen. The two most commonly referenced approaches are quantitative and qualitative, and a significant amount has been written about the advantages and limitations of both (see Blaikie, 2007 or Guba, 1990 for extensive reviews). However, it is hard not to notice that almost all of the traditional research methods textbooks tend to portray the two approaches as almost antagonistic to one another (for a debate on this, see Brannen, 2017; Bryman, 1984; Onwuegbuzie and Leech, 2005; Sale et al., 2002).

This quantitative v. qualitative argument is largely unproductive for the purposes here. One of the key problems associated with quantitative research is the lack of contextual data on heterogeneous households, making conclusions derived from such studies limited. Some human characteristics such as emotions and motivations are very hard to capture with standardised measurement mechanisms. On the other hand, qualitative methods also have their own inherent limitations: personal interpretations stemming from the possible researcher bias;

an inability to process vast amount of information, which in turn limits the scope of research; and an often low ability to generalise findings.

One possible solution to overcome the disadvantages of both methods is to triangulate methods (or mixed methods methodology, as it is commonly referred). Triangulation is a nautical term to describe a strategy that utilises several data points in order to arrive at a precise estimate of an object's position. Similarly, in a research context, triangulation allows for a particular conclusion or result to be validated by more than one research method.

The subject of this thesis is ideally suited for a mixed methods research design approach. Typically, these designs include at least one quantitative method and one qualitative, where neither type of method is inherently linked to any particular research paradigm (Greene et al., 1989). There are several reasons and motivation behind linking qualitative and quantitative data; Rossman and Wilson (1994) have identified three: a) corroboration of each method through triangulation; b) richness of detail; and c) fresh insights acquired through new lines of thinking. Firestone (1993) suggests that the key advantage of triangulation is its ability to achieve more precise and generalizable results, and Gray (2014) notes that some of the foremost advantages of the approach are: complementarity of assessing different aspects of the same concept; generation of new insights; the ability of one method to help to develop another method; and a wider range of studies in general.

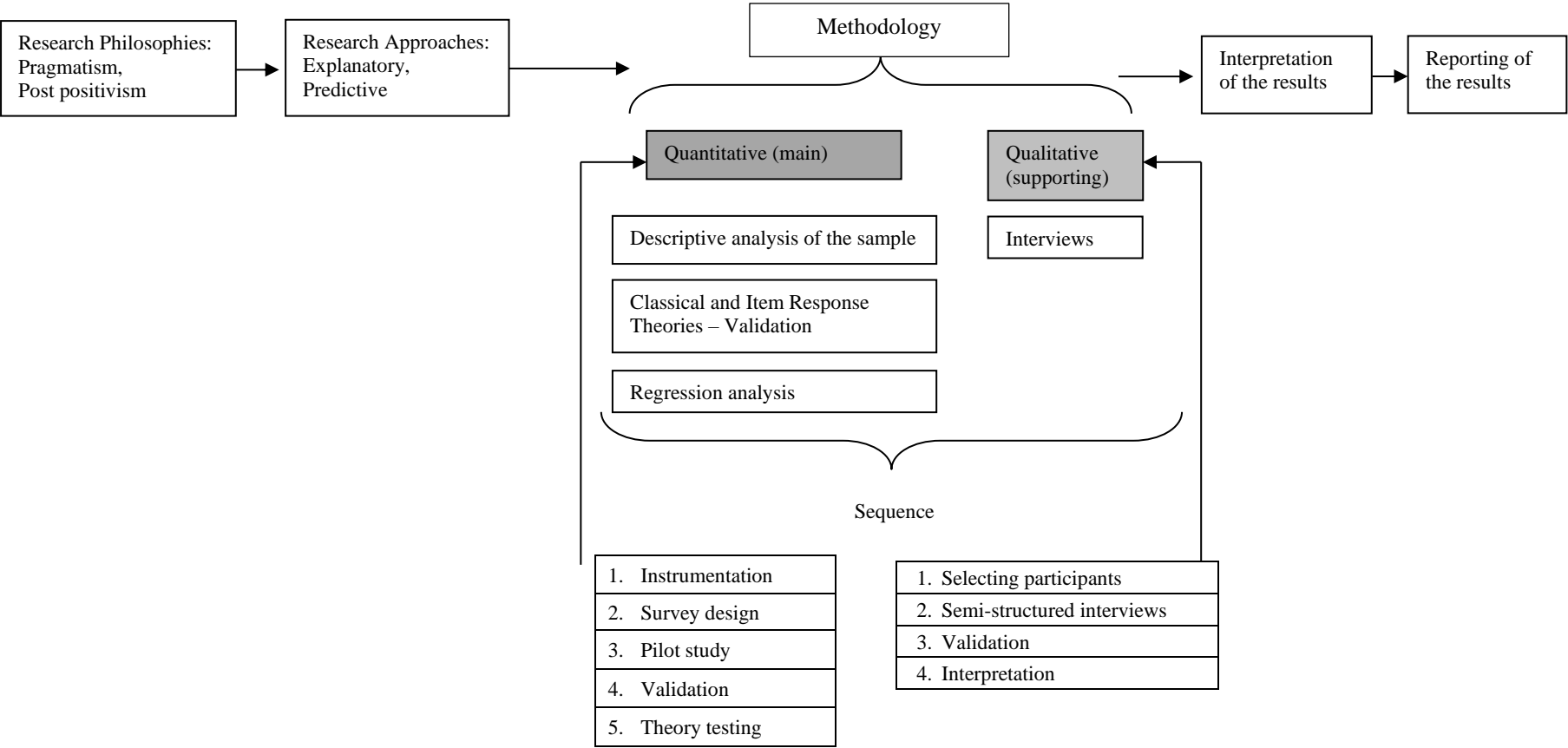
This thesis primarily relies on a survey (quantitative method) to determine levels of financial literacy and to correlate financial literacy and portfolio choice. By this means alone, however, it is not possible to determine the motivations of households to increase their stock of financial literacy, nor how that knowledge is acquired, nor its relation to financial mistakes. To fill this gap, interviews (qualitative method) are undertaken with financial professionals who work with households on a daily basis, which are also used to validate the quantitative results.

3.7 Research Methodology and Design

This thesis adopts a sequential explanatory design (Ivankova et al., 2006; Subedi, 2016), which is depicted in Figure 3.1. The primary method is a quantitative analysis, based on survey data that is used to evaluate objective and subjective financial literacy levels. The survey also collects socio-demographic data, and indicates whether households in the sample participate in the stock market. It also helps to identify the link between subjective and objective financial literacies.

By this means alone, it is not possible to capture the motivations of households to increase their stock of financial literacy, nor does it identify the mechanics and attitudes that contribute to this learning process. To fill this gap, the survey was supplemented by qualitative research, namely, through interviews with financial advisors, who are professionals that work with households on a daily basis. Those interviews had a three-fold purpose. First, to supplement and enhance the quantitative data analysis results. The emphasis was to aid in interpretation of the results obtained from the survey. All of the hypotheses presented in the conceptual framework section were discussed with the interviewees. Then, the results of the survey were presented to them. This procedure helped to corroborate the outcomes indicated by the quantitative research. The second purpose was to explore the causal links between some psychographic variables that could not be tested directly (e.g. motivation, relationship with advisors, risk tolerance). Third, as discussed within the literature review, previous studies involving households tend to suffer from endogeneity bias. The interviews with financial advisors helped to confirm the nexus of causality of the relationships identified within the conceptual framework.

Figure 3.1
Research Process



3.7.1 Quantitative Method

The quantitative data is comprised of two parts: client demographic data records that were provided by an anonymous bank in Sweden, and data obtained from administering a questionnaire to the same clients of this bank. This section will provide an overview of the availability of data on households and its attributes, followed by how the questionnaire was developed, tested, and validated. The last section describes the data analysis procedures.

3.7.1.1 Availability of Data on Households

Before proceeding with a description of the dataset employed here, it is necessary to take a small detour and examine the data which has been used by other researchers for similar purposes (portfolio choice and/or financial literacy), as well as to explore the advantages and disadvantages of such datasets.

Traditionally, most studies on household portfolio allocation have relied on three types of cross-sectional secondary data: household surveys, brokerage company accounts, and tax records.

1. **Household surveys.** In the U.S., the most prominent is the Survey of Consumer Finances administered by the Federal Reserve (used by Bergstresser and Poterba, 2004; Bertaut and Starr-McCluer, 2000; Bricker et al., 2019; Carroll, 2002; Gans et al., 2019; Greenberg and Mogilner, 2020; Heaton and Lucas, 2000; Poterba and Samwick, 2007; Tracy and Schneider, 2001; and Tracy et al., 1999). The SCF has the largest sample, however, has a problem of oversampling richer households and relies on self-reported household data. A similar survey was conducted by several central banks in Europe under the Household Finance and Consumption Network (HFCN) in 2010/2011(1st wave), 2013-2015(2nd wave) and 2017 (3rd wave), however the microdata is still not available for all the countries as of this moment. Regrettably, Sweden did not participate in this survey. Similarly to the SCF, HFCN surveys suffer from oversampling wealthy households, and sample sizes vary from

1,004 to 13,685 households, which do not necessarily coincide with the size of the respective populations of EU countries (ECB, 2020). Similar well-known surveys are: the Wharton Survey conducted in the 1970s and the UBS/Gallup survey, both of which rely on telephone interviews; and the Health and Retirement Survey (US) and The Survey of Health, Ageing and Retirement in Europe, both of which have high quality data but only on older households.

2. **Brokerage or pension management company accounts** (used by Bellofatto et al., 2018; Barber and Odean, 2001; Goetzmann and Kumar, 2004; Ivkovic et al., 2008; Ivkovic and Kramer, 2016; Stolper, 2018; Weisbenner, 2005; and Zhu, 2002). This data is generally very detailed and has a per security allocation; however, it is not particularly useful for understanding the broader population (since most active investors who actually hold risky assets would usually be included in the sample), nor does not take into account relationships with more than one financial institution.
3. **Tax records** (used by Blume and Friend, 1975; Calvet et al., 2007; Fagereng et al., 2017; Kopczuk and Saez, 2004; von Fintel and Orthofer, 2020) are another way to extract data on portfolio allocation. Unfortunately, this method has several limitations. First, countries that do not have wealth tax do not hold such records, only *post factum* realised gains and losses, nor does this data have any additional background information (especially psychographic).

Notably, very few longitudinal studies/datasets are available for similar research purposes. Their key limitation is that they are focused on a particular demographic group and entail a significant level of attrition. Examples include the National Longitudinal Survey of Youth (Scheresberg, 2013), and the English Longitudinal study on Ageing (Banks and Oldfield, 2007).

The data used in this research blends a household survey and a financial institution's records. The key advantage of such data lies in its greater accuracy, coming from financial institution records and the flexibility which comes from designing a unique and tailored questionnaire.

3.7.1.2 The Questionnaire

A questionnaire is a research tool comprised of several questions or question sets that is administered to collect information from respondents. They can be conducted in person, by telephone, via the internet, or by post. This technique is among the most popular methods in social research because of its ability to reach a large sample of people quickly and at a relatively low cost. Some other advantages include the ability to allow respondents to stay anonymous, nor is there necessarily any need for the researcher to be physically present during the data collection process.

Two types of questions are frequently used in questionnaire design: close-ended and open-ended. In a close-ended questionnaire, sometime referred to as a forced-choice questionnaire, the respondent selects an answer out of predefined answers. This particular type is well suited for quantitative data analysis (Hague, 2002; Oppenheim, 2000). Open-ended questionnaires, on the other hand, allow respondents to include their own answers and can be quite useful for qualitative analysis, since it allows a researcher to gain greater insights that tend to be more profound and personal. However, the time it takes to collect and process this information can be prohibitively time consuming. (Dillman, 2011; Hague, 2002; Krosnick, 2018).

3.7.1.3 Questionnaire Administration

A considerable amount of data on the demographic characteristics of households was already available from the bank; therefore, the questionnaire had two purposes to augment it: to evaluate the level of financial literacy of each participant, and to gather additional information regarding investment knowledge acquisition. Pinsonneault and Kraemer (1993) and Sivo et al. (2006) both stress the need to account for the nonresponse error when designing and administering a survey. Linderman (2019) collected information on the response rates of various methods of conducting surveys, and found in-app, telephone and online surveys to be among the least effective. Both Babbie (2015) and Linderman (2019) recommend using in-person surveys in order to improve the response rate, which was undertaken partially for this thesis.

The questionnaire was administered by the same bank that provided the client data, during the months of July to September 2018. In all, 1554 usable questionnaires were obtained, and 42% of the questionnaires were collected via online survey: customers of the bank received a notification to update their financial data (as required by the Markets in Financial Instruments Directive provisions) and were then prompted to complete the financial literacy survey during the log-in process, which was optional. Regrettably, 69% of those who received the notification decided not to participate in the financial literacy survey. The other 58% were collected by personal financial advisors who met with clients, and were instructed to update their information (a majority of the bank's clients are assigned to a personal financial advisor, who is the first point of contact for the household with the financial institution). While financial advisers disclosed that the financial literacy segment was optional, the participation rate was significantly higher: 73% of questionnaires were filled in. Overall, the response rate was 46.11%.

3.7.1.4 The Questionnaire Layout and Instrumentation

There is no universal rule or recommendation regarding the length of the questionnaire, but there is a documented negative relationship between the length of a questionnaire and the response rate, and a tendency of respondents to repeat the same answer, referred to as fatigue (Bansak et al., 2018; Choi and Pak, 2005; Herzog and Bachman, 1981; Jepson et al., 2005; Peytchev and Peytcheva, 2017). Here, the aim was to create a questionnaire that could be completed within 12 to 15 minutes by the respondents. This was meant to offset fatigue: the questions required not just a recollection of easily recallable facts (as a majority of questionnaires do), but were also intended to test the knowledge of financial concepts and the application of such knowledge, a process requiring more intensive mental work. Another reason to limit the response time was to ease the time burden for the financial advisors who administered the questionnaire. A majority of the meetings with clients run for approximately 38 minutes, and the completion of the questionnaire was not a main agenda item for those meetings.

The questionnaire consisted of 16 closed-ended questions and is reproduced below, together with a brief explanation of the rationale for inclusion, the knowledge domain tested, and source of the question.

Table 3.1
Questionnaire

Questions	What financial literacy dimension is measured?	Source and rationale for inclusion
1. Suppose you have 1000 kronor in a savings account and the interest rate is 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? a) More than 1020 kr b) Exactly 1020 kr c) Less than 1020 kr d) Do not know	Numeracy and an understanding of interest rates	One of the “Big 3” questions prepared by Lusardi and Mitchell (2011a) in the original form but modified for Swedish krona.

<p>2. Imagine that the interest rate on your savings account is 1% per year and inflation is 2% per year. After 1 year, how much would you be able to buy with the money in this account?</p> <p>a) More than today b) Exactly the same c) Less than today d) Do not know</p>	Understanding of inflation and interest rates	One of the “Big 3” questions prepared by Lusardi and Mitchell (2011a) in the original form.
<p>3. Which of the following categories of people are most likely to be helped by inflation?</p> <p>a) People living on a fixed income (e.g. pension, dividends) b) People lending money at fixed interest c) People borrowing money at a fixed rate of interest d) Do not know</p>	Understanding of inflation and inflation effect on savings & borrowing	Modified Council for Economic Education question (2018). Serves as an addition to the previous question. More applicable to real life situation.
<p>4. If interest rates rise, what will happen to the bond prices?</p> <p>a) Rise b) Fall c) Stay the same d) There is no relationship e) Do not know</p>	Understanding of bond v. interest rate relationship	FINRA (2011) question.
<p>5. Under which of the following is your investment amount up to 950,000 kronor guaranteed by the government?</p> <p>a) Stock b) Bond issued by the company c) Deposit at the bank d) Do not know</p>	Understanding of risk-return profile of various investments.	Author’s question. Addresses risk and reward as well as financial environment competency areas.
<p>6. Sara and Nils have just had a baby. They received money as baby gifts and want to save for the baby’s education. Which of the following would yield the highest growth over the period of 18 years?</p> <p>a) A current account b) Stocks c) Bonds d) Savings account e) Do not know</p>	Understanding of risk –return profile for various investments	Question from Jumpstart (2004) questionnaire. This question tests whether respondent understands whether stocks provide the highest rates of return over the long-run.
<p>7. Please tell me whether this statement is true or false. —Buying a single company’s stock usually provides a safer return than a stock mutual fund.</p> <p>a) True b) False c) Do not know</p>	Diversification benefits	One of the “Big 3” questions prepared by Lusardi and Mitchell (2011a) in the original form.

<p>8. Which type of asset displays the highest fluctuations in value over time given normal market conditions?</p> <p>a) Stocks b) Bonds c) Savings account d) Do not know</p>	<p>Understanding of volatility of various asset classes</p>	<p>Van Rooij et al., 2011 Question focuses on risk and volatility.</p>
<p>9. In the case of company bankruptcy, what kind of financial instrument holders have priority in receiving the invested money?</p> <p>a) Common shareholders b) Preferred shareholders c) Bondholders d) Do not know</p>	<p>Understanding risk-reward profiles of various financial asset classes</p>	<p>Author's question. Question distinguishes between common and preferred shareholders as well as embedded risks.</p>
<p>10. Which one of the following is true?</p> <p>a) Common dividends are paid before preferred dividends b) Preferred stockholders have voting rights c) Preferred dividends are usually cumulative d) Common dividends usually can be paid if preferred dividends have been skipped e) Do not know</p>	<p>Understanding of preferred and common stock differences</p>	<p>Author's question. A more sophisticated question designed to assess investment literacy and quality of various financial instruments.</p>
<p>11. Do you think that the following statement is true or false? A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest over the life of the loan will be less?</p> <p>a) True b) False c) Do not know</p>	<p>Effect of compound interest, mortgage terminology</p>	<p>One of the "big 5" questions. Tests the understanding of the effect of interest as well as numeracy conceptualisation.</p>
<p>12. Which of the investments below is most likely to lose purchasing power quicker than others?</p> <p>a) Stock market b) Real estate c) Savings account d) Bonds e) Do not know</p>	<p>Inflation. Reward profile of various assets.</p>	<p>Author's question. Focuses on long-term horizon.</p>
<p>13. How do you rate your knowledge of investments/financial instruments? (Scale of 1 to 7) lowest = I am not knowledgeable in this area at all middle = I am somewhat knowledgeable in this area highest = I consider myself an expert in this area.</p>	<p>Self-assessed financial literacy</p>	<p>Included to determine if self-reported financial literacy is the same as the literacy score obtained by questionnaire (Babiarz and Robb, 2014; de Bassa Scheresberg, 2013; Henager and Cude, 2016; Porto and Xiao, 2016).</p>

<p>14. How do you most often acquire knowledge or information when you choose investment products? Choose up to three answers.</p> <ul style="list-style-type: none"> a) From pamphlets/brochures provided at financial institutions b) At a lecture meeting or a seminar c) Consultation with financial professionals/financial advisors d) Through media reports (TV and radio programmes, newspapers, magazines, etc.) e) From websites (Indicate the one you use most often) f) Conversations with family members/friends g) Other information sources (provide an example) h) I do not invest 	<p>Knowledge acquisition</p>	<p>Author's question</p> <p>The task of the question is to determine how the investment knowledge is acquired.</p>
<p>15. How often do you acquire financial and economic information from sources such as newspapers, magazines, television, and the Internet? Choose only one answer.</p> <ul style="list-style-type: none"> a) Every day b) Once a week c) Twice/three times a week d) Once a month e) Twice/three times a month f) Less often than the above g) Never h) Other 	<p>Frequency of financial information acquisition</p>	<p>Author's question</p> <p>Serves as a measure of how actively is the investor seeking financial information.</p>
<p>16. Have you been exposed to financial/business education (offered by a school or college you attended, or a workplace where you were employed)? Select all that applies to you.</p> <ul style="list-style-type: none"> a) Yes, I have studied finance, accounting, business at university/vocational college b) Yes, I have taken a class sponsored/ offered by my employer c) Yes, I have done that independently (took a live /online class) Please state which and where d) I have not been exposed to financial/business education e) I am not sure 	<p>Exposure to formal or informal financial education</p>	<p>The question will help to identify how the exposure to financial/business education would impact investment literacy.</p>

Source: Author

The questionnaire was developed in accordance with the construct method (also known as the substantive method) which was systematised by Jackson (1971) and is a deductive method. According to this method, the construction of the questionnaire starts at the theoretical level, where a theory is laid out as a nomological network (Oosterveld, 1996) which includes constructs to be operationalised along with various variable specifications. Here, related variables (e.g. financial information acquisition in the questionnaire) were kept distinct from the researched variables (e.g. financial literacy). Careful consideration was devoted to mapping the confounding variables, and convergent and discriminant validity were addressed at a very early stage. Meel and Cronbach (1955) stress the importance of semantics, as items might be overlapping and/or interrelated; their recommendation is to use a panel of experts or/and potential respondents to ensure non-ambiguous wording and to also conduct a pilot study. As discussed in the literature review, the wording of questions does have a significant impact on the analyses. Here, then, both of these suggested measures were implemented and are described in more detail in the following section.

Care was also exercised to make a questionnaire that adhered to the “BRUSO” questionnaire framework as outlined in Peterson (2000). Questions were made brief (not more than two average computer screen lines of text), relevant (five questions were excluded from the final version that tested the same concept), unambiguous (an extensive pilot study was undertaken, discussed later), specific (to assess various domains of knowledge) and objective. Predominantly, closed-ended questions were used.

3.7.1.5 Financial Literacy Test Scoring Method

When choosing how best to determine the objective financial literacy score, three methods were considered: Equal Weighting (correct answer count), Principal Component Analysis of Ridit Scores (PRIDIT), and Item Response Theory (IRT) scores. Correct answer count is the most simplistic model where a correct answer is given a certain percentage or a 1,

and the questions are equally weighted. This approach is used in 93% of the research articles mentioned in the literature review section. The second method is called PRIDIT, a weighting scheme which was first applied by Brockett et al. (2002) to identify insurance fraud. The assignment of weights is conducted in two steps. First, a ratio of correct and incorrect answers is calculated for each question and a negative penalty is applied for incorrect answers. The penalty is dependent on and is positively related to the percentage of the sample that answered a question correctly. Second, correlations between the answers are established by means of a principal component analysis. More informative (less correlated) questions are assigned larger weights as a result. This method was first applied by Behrman et al. (2010) to create a financial literacy index and was later used by Lusardi, Mitchell and Curto (2014), Sekita (2013), Letkiewicz and Fox (2014), and others. Lusardi, Mitchell and Curto (2014) also noted a correlation of 0.977 between a PRIDIT and equal weighting score within their research.

The third method is to use the scores generated from a 2SLS regression (which is described in Section 4.2 on the application of the item response theory). It is worthwhile noting that IRT regression scores are predicted values but not the actual test scores with an applied weighting scheme as in the case of PRIDIT. Kim and Nicewander (1993) conducted a very thorough Monte Carlo analysis of the scores embedded into various econometrics models and observed a resulting bias in parameter and standard error estimates. Since then, some techniques have been proposed to correct biases resulting from direct usage of IRT scores (see Lu et al., 2005 for a detailed discussion); however, research on their effectiveness is still quite scarce.

An equal weighting (correct answer count) method was used for the determination of the financial literacy score due to its simplicity and a virtually perfect positive correlation with PRIDIT (0.977 as tested by Lusardi, Mitchell and Curto, 2014). IRT regression scores were not utilised in the end due to a desire to avoid the finite item bias in parameter estimation.

Furthermore, IRT modelling was used primarily to confirm validity as well as to analyse the difficulty of the questions, although not to predict the levels of financial literacy.

3.7.1.6 Pilot Study Administration

Pilot studies are an important element of a coherent research methodology because they aim to test the instruments, identify flaws in the research protocol, and evaluate the effectiveness of the sampling frame and techniques (De Vaus, 1993; Peat et al., 2002).

As the main purpose of the questionnaire was to determine the level of financial literacy (as opposed to the collection of demographic or economic household data), as well as to gather some psychographic data, careful pretesting of the questionnaire was a necessary step to ensure the validity of the proposed instruments. Twenty professionals (12 PhD students, two business owners, five university instructors, and one financial advisor) along with a subsample of 50 bank customers participated in the pre-testing of the questionnaire. In the first step, each person was given the questionnaire in order to confirm the content validity; they were asked to comment on their understanding of the questionnaire, the difficulty of the questions, and were invited to express their opinions as to whether the questions were representative of the body of knowledge required to navigate the complex world of investments, and whether they considered the questions to be a good means of measuring financial literacy. A few minor corrections and suggestions were incorporated that related to the order of the questions, the order of answers within the questions, the questionnaire layout, and the font size.

The next step involved translating the questionnaire into the Swedish language. Care was taken to preserve the semantic, conceptual and normative equivalence of the survey instruments. A back translation method was chosen as it is considered to be a reliable and cost-efficient method (Brislin and Freimanis, 2001). Under this method, the translated questionnaire is translated back into the original language (English) by another translator. Four people who

have an MA or PhD degree in Linguistics participated in the translations, comparing the sourced versions of the original survey as well as proofreading.

The translated questionnaires were then distributed to the sample of the 50 bank clients and were administered by financial advisors. The average completion time for a questionnaire was 14.57 minutes. Clients were asked if they understood all the questions and terms used in the questionnaire. Four clients stated that they had trouble with the question five regarding government protection of deposits. After an investigation, a transposition error was found in the number and it was corrected before the final version was released.

3.7.1.7 Questionnaire Reliability and Validity

Questionnaires must be both reliable and valid. According to Joppe (2000), “The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability” (p. 1). It is common to distinguish between two types of reliability: test-retest reliability (consistency of performance/scores over time) and internal consistency (how reliably survey items measure what was intended to measure). The test-retest method is largely acknowledged to be infeasible, due to possible biases, extraneous influences, and small sample sizes (Golafshani, 2003).

As for internal consistency, two methods or procedures are commonly employed: split-half reliability (also known as Spearman Brown prediction), and Cronbach’s alpha. The design of the financial literacy test (e.g. different difficulty levels of questions, different content of the body of knowledge tested) was not suitable for the first method. The second method, Cronbach’s alpha, was developed by Lee Cronbach (1951) in order to measure the internal consistency of a test or a scale, an extent to “which all the items in a test measure the same concept or construct and hence it is connected to the inter-relatedness of the items within the test” (Tavakol and Dennick, 2011, p. 1). Cronbach’s alpha is expressed as a number ranging from 0 (inconsistency) to 1 (perfect correlation). Values of 0.5 are commonly determined to be

unacceptable, 0.5 to 0.7 somewhat acceptable, 0.7 to 0.9 to be acceptable. (Bland and Altman, 1997; DeVillis, 2016). A low alpha can be caused by a small number of questions, no interrelation between items, or heterogeneous constructs. A common practice is to calculate the correlation of each test item with the total score test. Pearson product moment correlation of an individual item with the total scale is used for that purpose. If the correlation is too low (as a rule of thumb 0 to 0.3), an item is deleted. Notably, if the Cronbach's alpha is too high, it may also suggest that items are redundant as they serve the very same purpose. Streiner (2003) recommends a maximum value of 0.9. The resulting Cronbach's alpha calculated from the sample of 70 people involved in pilot testing was 0.75, meaning it is sufficiently consistent. The correlated item-total correlations ranged from 0.4 to 0.952. One question had a 0.21 correlation and was subsequently removed from the final version of the test.

3.7.1.8 Data Collection and Sampling

It has been nicely suggested that “in research, sampling is destiny (Tashakkori and Teddlie, 2010, p. 275)”. When a sample is not representative it prohibits generalisations, which threatens the external validity of any research project.

Statisticians typically distinguish between two types of sampling techniques: probability sampling (some random selection method is adopted) and nonprobability sampling (does not involve random selection of participants). While the first method is commonly believed to yield more superior results as it is more representative and reduces bias in the selection process, nonprobability sampling might be more feasible in some situations (e.g. case study or phenomenological types of research).

This study utilised a dataset that was provided by the commercial bank that is headquartered in Stockholm as a starting point of the data collection procedure. The dataset covers financial records on bank's clients that live in Sweden. Since the aim of the thesis is to evaluate household's portfolio choice decisions, the target population, as defined in this study,

is the population of Sweden. It must be noted that this country has some of the highest levels of current account holding among global households: 100% of Swedish households have a current account (Hodgson, 2017). The sample used here, then, resembles the population as a whole in this important respect.

The sample size must also sufficiently and accurately represent the population. There is a trade-off between the accuracy of the results and the sample size. The following formula was used to calculate the sample size:

$$\frac{Nx}{(N-1)E^2 + x}$$

Where

$$Z\left(\frac{c}{100}\right)^2 r(100-r)$$

And

$$Sqrt\left[\frac{(N-n)x}{n(N-1)}\right]$$

n – sample size; E – margin of error; N is the population size, r is the fraction of responses that researcher is interested in, and $Z\left(\frac{c}{100}\right)$ is the critical value for the confidence level c .

The sample size was calculated in accordance with the above formula by utilising the calculator developed by Raosoft Inc.

Table 3.2 below presents the recommended sample sizes for various margins of error and various confidence intervals. The population of Sweden is around 10 million people, rounded to the nearest million respectively (Statistics Sweden, 2018) and the response distribution was modelled at 50%. The 5% margin of error and 95% confidence interval, which

are the most common choices among researchers, are in bold font. As one can infer from the table that the sample employed in the research is more than sufficient to be considered representative.

Table 3.2
Required Sample Sizes under Different Confidence Intervals

Margin of error	5%	5%	5%	1%	1%	1%
Confidence interval	90%	95%	99%	90%	95%	99%
Required sample size	271	385	664	6761	9598	16569

Source: Author

3.7.1.9 Data Analysis Procedures

A variety of approaches exist to conduct multivariate data analysis (i.e. capturing a relationship between two or more variables). They include, but are not limited to: canonical correlation, multivariate analysis of variance, multiple discriminant analysis, multiple regression analysis, conjoint analysis, cluster analysis, multidimensional scaling, factor analysis, structural equation modelling, and others. There are two primary research objectives here that need to be achieved with quantitative analysis: to provide an overview of factors/determinants that influence or are correlated with higher level of financial literacy and to determine how financial literacy influences the stockholding decision. Both of these aims were achieved by employing multiple regression analysis.

The quantitative part of the dissertation includes univariate, bivariate and multivariate analyses. Univariate analysis was used primarily to provide descriptive statistics of the data sample. Variables were analysed by the means of central tendency and dispersion. Frequency distribution charts were presented where necessary. Bivariate analysis was used primarily to identify if there are any particular groups within the sample that had a significantly higher or lower level of financial literacy. It was also used to determine if there is an association between the OFL and SFL. The methods employed were t-tests, analysis of variance, and correlational analysis.

Multivariate analysis was used to define the determinants of financial literacy as well as the impact of financial literacy on the decision to participate in the stock market. The determinants of financial literacy were analysed by means of ordinary least squares regression. Multiple ordinary least squares regression is a generalised linear modelling technique which is used to estimate the relationship between several independent variables and a dependant variable. It is achieved by minimising the sum of the squared differences between the observed and predicted values of a dependent variable. This particular technique has been extensively used in the social sciences and economics research for the analysis of cross-sectional data. It reveals significant relationships between a dependent variable and independent variables and the strength of its impact. A forced entry method for the variables in the regression was chosen to ensure comparability and replicability of the results. Studenmund and Cassidy (1987) consider this to be a superior method over the stepwise techniques, as the results become less influenced by the variation in the data and it also diminishes the overfitting (too many variables in the data) or underfitting (too few, as key ones got left out) of the model. A successful implementation of multiple ordinary least squares regression is dependent on several assumptions:

1. The regression model is linear in parameters.
2. There is no or very little multicollinearity between independent variables. This refers to a strong correlation between two or more independent variables. Such an undesirable property results in unreliable standard errors that limits a researcher's ability to assess the importance of individual predictors. It is usually corrected by removing one or several variables.
3. Homoskedasticity assumption. This refers to the assumption that the variance of the residual terms is constant. Data is considered to be heteroskedastic if there is a

specific pattern in the distribution of residual values. This leads to biased standard errors and affects the inferences about the significance level of the coefficients.

4. Independence of errors. Residual terms for any two observations should be uncorrelated, otherwise it will result in biased estimators. Autocorrelation is a particularly large problem for time series or longitudinal data.
5. Errors are normally distributed.

These assumptions were tested after the implementation of the regression model and are fully described in the fourth chapter.

Since participation in the stock market is a dichotomous variable, the use of a probit regression was necessary to calculate the predicted probability of investing in the stock market. It is a special type of generalised linear model where the outcome follows the Bernoulli distribution. The model specification is based on the inverse Cumulative Normal Distribution.

In the probit model, participation in the stock market (Y) is given a value of 1, while non-participation is recorded as 0. The probability p_i of investing in the stock market can be modelled as:

$$p_i = \text{Prob}(Y_i = 1|X) = \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt = \Phi(x_i'\beta)$$

In which Φ is the cumulative distribution function of a standard normal variable and $0 \leq p_i \leq 1$,

\mathbf{x} is a vector of factors that determine the variation in stockholding,

β is a vector of parameters or coefficients that reflects the effect of changes in \mathbf{x} on the probability of being a stockholder.

Unfortunately, the output coefficients of the probit regressions are not very intuitive for interpretation purposes as they demonstrate the change in the z-score or probit index for a one-unit change in the predictor. Therefore, it is more common to measure the relationship between

a variable and the probability of the outcome by calculating the marginal effect. The marginal effects reflect the change in the probability of the dependent variable to be equal to 1, given a one-unit change in an independent variable x . It is calculated in a different way depending on whether an explanatory variable is dichotomous or continuous.

Holding other variables constant, the marginal effect of a certain continuous variable on $P(Y = 1|X)$ can be derived in the following way:

$$\frac{\partial p_i}{\partial x_{ik}} = \varphi(x_i' \beta) \beta_k$$

Where φ is the probability density function of a standard normal variable.

The marginal effect on a dichotomous variable is calculated as the difference (Δ) between value of $\Phi(x_i^T \beta)$ when $x_i = 1$ given the other regressors equal fixed values and value of $\Phi(x_i^T \beta)$ when $x_i = 0$ and the other regressors equal the same fixed values. Therefore:

$$\Delta = \Phi(x_i^T \beta, x_i = 1) - \Phi(x_i^T \beta, x_i = 0)$$

In this analysis, the average marginal effect (AME) was calculated for each regressor. To obtain the AME, the marginal effect of a change in variable x_k was calculated for the first observation in the data, leaving all other independent variables' values as they are. This was subsequently performed for all observations. Finally, the average of all marginal effects to find the AME for the variable x_k was taken. These steps were repeated for each relevant regressor in the model.

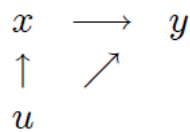
In Section 2.6.2 of the literature review, it was mentioned that the possibility of endogeneity between financial literacy and being a stockholder, could be a potential threat to internal validity. Unfortunately, it is impossible to confidently eliminate endogeneity unless a controlled experiment is performed. The only way to evaluate and partially remedy the endogeneity problem is by using an instrumental variable regression. The presence of endogenous regressors caused the models to estimate the magnitude of the association, but not the magnitude and direction of causation which is needed for the purposes here because the

coefficients are biased and inconsistent. Instrumental variable regression is conducted by introducing a special type of variable named an instrumental variable or instrument. According to Maddala (1994) such a variable should be “correlated with the endogenous regressor for reasons the researcher can verify and explain, but uncorrelated with the outcome variable for reasons beyond its effect on the endogenous regressor” (p. 154).

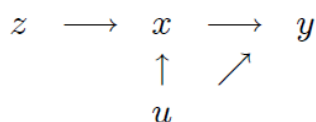
To illustrate the rationale and structure of the instrumental variable approach taken here, it is helpful to first introduce a simple econometric regression, where the dependent variable Y is stockholding and the independent variable X is financial literacy level.

$$Y = a + x\beta + e, \text{ graphically expressed as } x \longrightarrow y$$

There could be multiple different omitted variables u that are correlated with both X and Y that determine stockholding, expressed graphically as:



The instrumental variable approach is a method that generates only exogenous variation in x (i.e. the u is held constant). That is achieved by introducing a new variable z - an instrumental variable. This variable z has a causal effect on x ; it affects the outcome variable y only through x (exclusion restriction) and there is no confounding effect for z on y .



Business education was selected as an instrument variable following an intuition that a person who is exposed to business education is more likely to be financially literate. A typical business education curriculum at both university and professional level would include such basics as compounding, inflation, and stock risk reward profiles. All of these are included in the objective financial literacy tests. As a robustness check, the second higher education

instrumental variable was introduced in one of the regressions in order to perform an overidentification test. See Chapter 4 for more details.

The instrumental variables regression was conducted through the two-stage least squares approach (2SLS). In 2 SLS, two equations are estimated. In the first stage, the explanatory variable x (financial literacy) is regressed on the instrument z (exposure to business education):

$$X = a_1 + Z k + e_1$$

The estimated coefficient k did capture the effect of the instrumental variable on financial literacy, whether all the unexplained variation is captured by the residuals e_1 . The predicted variables of \hat{X} are obtained only by using the information from the variation in the Z variable. The effect of the u variable is eliminated. \hat{X} becomes an exogenous, unbiased version of X .

The second stage regression has the form of:

$$Y = a_2 + \hat{X} b + e_2$$

In this equation the coefficient b does reflect the causal effect of \hat{X} on Y without any disturbance caused by other variables.

3.7.1.10 Variable Description

Both the ordinary least squares regression, aimed at explaining the determinants of financial literacy, and the probit model, aimed at predicting the probability of stockholding, utilise a similar set of predictor variables. Those variables are summarised in Table 3.3.

Table 3.3
List of Variables Used in Regressions

Variable	Type	Used in Bivariate	Used in OLS	Used in IV probit	Used in probit
AGE and AGE2	Continuous		✓	✓	✓
AGE CAT	Categorical	✓			
PARTNER	Binary		✓	✓	✓
GENDER	Binary		✓	✓	✓
SELFEMPLOYED	Binary		✓	✓	✓
HOUSEOWNER	Binary		✓	✓	✓
CHILD	Binary		✓	✓	✓
EDULEVEL	Categorical		✓		✓
INCOME CAT	Categorical		✓	✓	✓
WEALTH CAT	Categorical		✓	✓	✓
RISK TOLERANCE	Categorical		✓	✓	✓
TRACKING	Categorical		✓	✓	✓
THOUGHTOLDAGE	Categorical		✓	✓	✓
BUSEDU	Categorical			✓	
MET_ADVISOR	Binary	✓			

Source: Author

The first explanatory variable is the age of the respondent. A transformed variable AGE² was introduced in order to model the effect of age more accurately, as it tends to have a non-linear monotonic relationship with the independent variable. Combining a positive effect of age and a negative effect of age squared signifies that as people get older the effect of age is lessened. AGE CAT was another transformed variable that was used primarily in ANOVA and chi-square analysis of financial literacy. Six categories of age with a ten-year interval were created (18 to 24, ..., 65 and higher).

For this analysis it was decided to go beyond the traditional married/non-married status variable and replace it with a binary variable for living together with a partner (both married or unmarried). A couple living together must make very similar household finance decisions as a married family. It is estimated that 13% of people in Sweden are cohabitating without registering a civil partnership or marriage (Eurofound, 2020), which is the highest coefficient in the EU. What is more, asking whether someone lives with a partner is more inclusive of the LGBT+ community.

In the preliminary regression analysis, it turned out that having children at all has more explanatory power on household financial decisions, as well as financial literacy, than the number of children, which turned out to be insignificant. As a result, a dichotomous variable on whether a household has any children (CHILD) was created.

The self-employed variable combines several types of professional activity. A person who owns a small business (sole proprietorship), works or cooperates in a family business, or works on a freelance basis, are all included in this category. The task of this variable is to identify and proxy the idiosyncratic background risks that entrepreneurs face.

People who own their primary residence (whether outright or by holding a mortgage) were included in the HOUSEOWNER category.

As the system of education is rather complex in Sweden due to its emphasis on professional and vocational training, six categories were added that aimed to distinguish between various stages: primary, secondary (up to 16), secondary (up to 18 years), vocational, higher professional, and university. Most prior research did not distinguish between university levels (undergraduate v. graduate v. doctoral), or if it did it found insignificant effects, and so was decided not to include these. As the exposure to a business education was chosen as an instrument variable, respondents were asked how much they were exposed to economics/business within their education and the answers were reflected in the BUSEDU variable.

Income and wealth were aggregated into 4 and 9 subsequent categories and expressed in euros. An average daily Swedish krona v. euro exchange rate for the calendar 2018 year was used for the conversion. Income is self-reported, net of taxes, and is per entire household. Wealth is also self-reported; however, it is calculated from a formula (reported assets – reported liabilities), and is also determined for the whole household. The highest wealth category was capped at 200,000 EUR and above in order to insure the anonymity of high net-worth clients.

Respondents were asked about their attitudes to risk (RISK TOLERANCE) by selecting/indicating the level of agreement with the following statement: “I think it is more important to have safe investments and guaranteed returns than to take a risk to have a chance to get the highest possible returns”. This precise wording was previously used in studies of household preferences and financial decisions by Donkers and Van Soest (1999), Borghans and Golsteyn (2006), Lee et al, (2015), and others. Kapteyn and Teppa (2011) examined the relationship between self-reported risk aversion by utilising the very same question and the results derived by psychometric testing (questions regarding various risky outcomes of possible choices) and found them to be correlated.

Two more variables were introduced in the questionnaire. TRACKING which asked how often the household members keep track of their spending, and THOUGHTOLDAGE which tries to determine how often households consider their retirement plans. As the behavioural aspect of household financial decision-making is still relatively under researched, and very few validation studies have been performed, these variables aim to help evaluate household self-control and how forward looking they are.

The questionnaire also asked respondents how often they acquire financial knowledge, and in what form, so as to learn more about the financial literacy acquisition process. Another variable which was analysed separately was whether a household met with a financial advisor at least once in past three years. Unfortunately, it was not possible to track the motivations of engaging with a financial advisor through the survey, due to space limitations and this theme being a secondary research question. Because it could not reliably be controlled for reverse causality, nor was it possible to introduce more instrumental variables that would risk the regression’s predictive power, this variable was not included in the underlying regressions. The key motivations of engaging with financial advisors and their impact on portfolio choice are discussed in the interviews in Chapter 5.

3.7.1.11 Missing Values and Outliers

The dataset has 1554 datapoints; however, some variables have missing values. Of the thirteen variables used in the regression model, five have at least one missing observation, as reported in Table 3.4.

Table 3.4
Missing Values

Variable	Observations
TEST_SCORE	1554
NCOME_CAT	1553
WEALTH_CAT	1554
EDULEVEL	1553
AGE	1554
PARTNER	1554
GENDER	1554
CHILD	1554
RISK_TOLERANCE	1550
TRACKING	1541
THOUGHTOLDAGE	1540
SELFEMPLOYED	1554
HOUSEOWNER	1554

As the regression estimator cannot deal with missing points, it only considers datapoints in which all regressors have valid values. Thus, the complete model uses 1532 observations to compute the estimates. The 22 observations comprise 1.4% of the dataset which is a small percentage. It is safe to assume that the unavailability of these data will not affect our estimates meaningfully.

To evaluate if the dataset holds outliers, the diagnostic tool DFFITS (Belsley et al., 2005) was used. Put simply, the weight of each observation in the sample is calculated and it is subsequently evaluated whether any datapoint has a weight above a certain threshold. If an observation has a high DFFITS, it means that that point has a major influence in the estimation results – it is an outlier. Here, the usual threshold was used: $|DFFITS_t| > 2\sqrt{\frac{K}{T}}$ in which K is the number of regressors and T is the sample size.

Of the 1532 observations used in the regression estimation, 39 were outliers (2.5% of the sample). To examine how these datapoints influence the estimations, three regressions are used: standard results, regression estimation discarding outliers, and the estimation with the median of TEST_SCORE (the score 8) imputed in the place of outliers in Appendix A.

The results show that the point estimates do not change much between columns, but treating outliers had an impact on significance levels. As the TEST_SCORE variable has a slightly skewed distribution, imputing the median value was a reasonable approach to deal with these influential observations.

3.7.2 Qualitative Method

This thesis relies primarily on the quantitative analysis of household data, which allows for measuring the stock of financial literacy and for connecting it to common demographic variables such as age, nature of employment, income, wealth, etc. It also allows a peek into some psychological variables such as risk aversion and the sources of information acquisition. Unfortunately, due to the inherent limitations of the quantitative data and other constraints, it is impossible to inquire into the motivation of the households to increase the stock of financial literacy, to evaluate the process of financial literacy acquisition, or to see the challenges that households face while doing so. This is the reason why a triangulation of quantitative and qualitative methodology was used. This allowed for “refining, broadening and strengthening conceptual linkages” (Goetz and LeCompte, 1984, p3).

A majority of households in the Nordic countries do not have multiple relationships with financial institutions and are traditionally assigned to an in-house personal financial advisor/banker. That personal advisor is the main point of contact between the household and the various departments at the financial institution. That advisor will also serve as an investment specialist who recommends investments that are suitable for a particular risk tolerance level and personal circumstances. Since advisors work with clients on a daily basis

and can observe their decision-making process, they are uniquely able to provide additional insights that would not be apparent from an analysis of the quantitative data alone, and as a result were chosen as the subjects for interviews.

3.7.2.1 Structuring the Interviews

Interviewing is a qualitative analysis technique that is essentially a conversation with the purpose of collecting information (Leedy and Ormrod, 2014). A semi standardised interviewing structure was selected to gather information on household investment portfolio choice and financial literacy acquisition. The key advantage of such a structure lies in the fact that the interviewer may reorder questions as well as introduce his or her own during the interview. The interviewer can then also probe the given answers to the pre-assigned questions (Lune and Berg, 2016). One of the purposes of the interviews here is to verify the accuracy (or corroborate the data) of the quantitative analysis. Participants were also presented with the findings of the quantitative analysis and were asked to comment on them. As a result, some of the interviews have deviated from the pre-assigned questions as discussions emerged over new themes or very specific issues and relationships. Such deviations from the protocol are recommended and justified by Castillo-Montoya (2016). According to her: “in qualitative research, the most useful instrument is the researcher. He/she/ze can listen carefully and adjust, change paths, and otherwise follow intuition in a way that his/her/zer protocol will never be able to do. Yet, by following the IRP [Interview Research Protocol] framework, even if some departure occurs in the field, the researcher will be more prepared (cognitively) to follow intuition and yet, still have a map in their minds of the sorts of questions they hope to ask” (p. 20).

According to Wengraf (2001), no unifying theory of instrumentation exists but only “a constant reflection upon successes and failures, strengths and weaknesses of particular instrumentation practices” (p. 62). As a result, his suggestion is to examine the content of

previous interviews to help direct future ones. This suggestion is coherent with Schon's reflective practitioner theory and was employed in this research.

The final survey instrument consisted of 15 essential questions, with a few additional questions used as required. Careful attention was given to the wording of the questions: affective words were reduced to a minimum, and double-barrelled questions were eliminated as per Denzin's (1970) recommendation. The instrument/research protocol was pretested by conducting a mock interview with one PhD student, who also happened to work as a financial advisor in the United Arab Emirates, although that interview was excluded from the results section later. As interviews are a time-consuming technique and the interviewees were busy professionals, a time constraint of 40 minutes per interview was imposed. Six interviews were face-to-face while two were conducted over Skype.

3.8 Ethical Considerations and Procedures

The term ethics is derived from the ancient Greek language word *ethos* that means character, disposition, or custom. Ethics is a branch of philosophy that deals with moral principles, and it evaluates human decisions and actions based on what is good or bad from the individual as well as societal point of view.

Ethics as applied to research primarily relates to dealing with the ethical dilemmas that researchers face in their research design, review and evaluation of research, and the enforcement of ethically sound principles (Teti, 2005). Guillemin et al. (2012) distinguish between procedural ethics in research and "ethics in practice" or "microethics" (as it was referred to by Komesaroff (1995) in biomedicine).

Rosenthal (1994) stresses not only the importance of adherence to ethical principles because of the moral obligations of researchers, but also because there is a close relationship between the quality of research and ethics. Research designs that which are not well thought-through tend to lack substance and are more likely to harm participants in the long run or be

less ethically sound. As far as procedural ethics is concerned, it is recommended to establish a blueprint for research that is adhered to at all stages.

Two procedural ethics documents were followed throughout the enquiry: The American Psychological Association Ethical Principles of Psychologists and the Code of Conduct, and the University of Plymouth Ethical Protocol. This project received the approval of the Faculty of Research Ethical Approval Committee prior to commencing the data collection. More information is presented in Appendix B.

Because both quantitative and qualitative methods were used here, different ethical implications arose for each. First, the data provided by the bank contained the detailed financial information about households. To preserve the anonymity of the sample participants, the data was coded in such a way as to eliminate any information that could lead to the identification of a person or a family. For example, each participant was allocated a randomly assigned number and the name, middle initials, and surname were withheld. As it was mutually agreed to with the bank, 12 observations from the sample were removed that represented ultra-high net worth individuals, as the composition of their asset portfolio could have revealed their identities. Much care was taken to protect the data from unauthorised access. 128-bit cipher Advanced Encryption Standard was used throughout all the sessions that required data transmission, coding or analysis. Most of the analysis was performed on the bank's premises to avoid any information loss.

The qualitative interviews involved physical interactions with human subjects; therefore, these required more preparation. All the interviewees were contacted by telephone approximately a month before the start of the interviews. The reasons for the interview were carefully explained, as was the research topic and the expected time commitment. During that preliminary stage, participants were able to ask any questions that were related to the future interviews. Interviewees were able to select the places which were the most comfortable for

them. A majority selected their workplace to minimise disruption. At the beginning of each interview, each person was given a consent form (Appendix C) and it was explained to them how their information and data would be recorded, stored, analysed and discarded upon the project's conclusion. All of the research data was handled in accordance with the provisions of the General Data Protection Regulation (GDPR) of 2016, which describes how any kind of personal data should be handled within the European Union. The participants were informed that they could stop the interview at any time or leave a question unanswered if they felt uncomfortable for any reason.

All of the interviews proceeded very smoothly without any interruptions. Since five of the interviewed advisors also helped to collect the quantitative data for the analysis, the bank requested that their identities be anonymised to comply with GDPR as those advisors have access to clients' "identifiable personal information" (as defined in Article 4 of GDPR). Having analysed the interviews, which included descriptions of some of the clients' portfolios and investment styles, it became apparent that some clients could be able to identify themselves based on such descriptions; therefore, it was decided to anonymise all the interviewees identities in the published manuscript. Background demographic information about the advisors is nevertheless provided where necessary (also in Appendix D). Three people requested to be updated on the research findings after the conclusion of the project.

Chapter 4 Quantitative Analysis

4.1 Introduction

The literature review section has identified significant gaps in the financial literacy scale construction and measurement, as well as conflicting results obtained by studies that have investigated the determinants of financial literacy. What is more, while the majority of researchers agree on the positive relationship between levels of financial literacy and stockholding, different studies have determined various degrees of such association. This thesis aims to expand the body of knowledge by revisiting those gaps.

This chapter addresses the first four research objectives through quantitative analysis. The chapter opens with an assessment of the discriminant validity, consistency and reliability of the proposed financial literacy instrument. Those are then tested from the perspective of Classical Test Theory and Item Response Theory. The second section provides a descriptive statistical analysis of the sample in order to evaluate both the objective and subjective financial literacy levels among Swedish households. The third section presents the determinants of financial literacy. The final section presents the results of the probit regression created to evaluate the likelihood of investing into the stock market both directly and indirectly.

4.2 Assessment of the Financial Knowledge Instrument

As demonstrated in Section 3.7.1, most of the questions in the questionnaire, which was designed to measure the stock of financial knowledge, were drawn from multiple well-respected publications in the field, along with a few added by the author. As discussed in the literature review, very little work has been undertaken to assess the reliability and validity of those questions by the corresponding authors. A natural query emerges – even though a particular item set/question was used multiple times in different datasets, does that question reliably measure what it is supposed to measure? Furthermore, does the instrument (i.e. financial literacy test as a whole) measure what it is supposed to measure?

4.2.1 Assessment of the Financial Knowledge Scale from the Classical Test Theory Perspective

4.2.1.1 Classical Test Theory Overview

In order to answer these questions, it is necessary to explore the various approaches behind the measurement theory. The most widely used approach to date is the Classical Test Theory (CTT) which is also sometimes referred to as the ‘Classical True Score Theory’. The underlying concept of the CTT is the test’s reliability and consistency. Ideally, perfectly constructed (i.e. error-free) identical knowledge tests taken by the same pool of test takers over separate sessions should produce the identical results. That is, a test taker’s observed score on a particular test is a true score. However, as such tests would be administered multiple times; it is inevitable that some variability in those scores would occur. Such variability is referred to as observed score variance which is the result of multiple interferences such as examination administration conditions (e.g. noise), scoring, examinee-attributable factors (e.g. mood swings), poorly worded test items, etc. (Brown, 2013).

The relationship could be described in the following formula, which forms the underlying premise of the CTT:

$$\text{Observed Score (X) Variance} = \text{True Score (T) Variance} + \text{Error (E) Variance}$$

Obviously, the true score is unobservable in practice; therefore, researchers have to rely on various techniques such as parallel tests, split-half-reliability tests, Cronbach alpha and others (cf. Bachman, 2004 and Brown, 2013). The CTT may aid researchers in analysing distinct test items through the following measures: item facility (or item difficulty, IF) and item discrimination (ID). The IF is calculated as a percentage of correct answers to a distinct test question. For example, a value of 20% would indicate that the test item is difficult as only 20% of respondents were able to answer it correctly.

The ID provides a guideline whether an item helps to differentiate between high-performer and a low performer. It is calculated as a differential between the IF values of the certain percentage of lowest score candidates and the certain percentage of the highest score candidates. That ‘certain percentage’ is predetermined by a researcher and typically ranges from 25% to 35%, depending on the assessment. The ID values range from -1 to +1, where -1 would mean that the lowest percentage of candidates always provide a correct answer to this particular item while the highest percentage is always incorrect – a rather strange and undesirable scenario, however. According to Ebel (1979), an item with an ID of 0.3 or above is considered to be reasonably good, and otherwise, items require a revision.

4.2.1.2 Analysis of the Results

Both the IF and ID were calculated with a 27% threshold and presented in Table 4.1 below.

Table 4.1
Item Facility and Item Discrimination Parameters

Question	Theme	Item Facility	Item Discrimination
Q1	Numeracy	0.9247	0.2333
Q2	Inflation	0.8514	0.4143
Q3	Inflation effect	0.4402	0.6881
Q4	Bond/Interest	0.2445	0.4571
Q5	Risk	0.6918	0.6762
Q6	Risk-return trade-off	0.6905	0.6500
Q7	Diversification benefits	0.6737	0.6929
Q8	Volatility	0.6030	0.5571
Q9	Risk-reward profile	0.6474	0.5643
Q10	Types of stocks	0.4614	0.6571
Q11	Mortgage	0.4646	0.4595
Q12	Inflation effect	0.6017	0.7286

(rounded to 4 decimal places)

According to this table, the most difficult question was question 4 which tests understanding of the inverse relationship between the bond prices and interest rates as only 24% of the respondents were able to answer it correctly. The next most difficult question was

question 3 that tests the understanding of inflation's impact on various categories of the economic participants. Questions 10 (financial instruments) and 11 (numeracy) have a slightly higher item facility score; however also turned out to be quite difficult.

Somewhat surprisingly, the very first question on numeracy and understanding of the interest rates, which is one of the "Big 3" questions, had the lowest item discrimination out of all the questions within the financial literacy test. Apparently, this question was the easiest out of the whole index. Many people were able to gauge the effect of compound interest applied for longer than one period on their savings. Interestingly, the study by Almenberg and Säv-Söderbergh (2011), which was also conducted in Sweden, asked participants to calculate the accumulated amount after two years. Only 35.2% of the sample were able to answer that more difficult question correctly.

To explore the internal consistency reliability of the 12 assessment items, multiple classical item analyses are conducted. These include: item-test correlations for each item, Cronbach's Alpha for the combined score of all 12 items and omitted-item Cronbach's Alpha for each item.

The item-test correlations illustrate the extent to which each item is measuring the similar set of knowledge to the test as a whole. These correlations range from 0.3913 to 0.6108. Since they are all substantially above zero, each item is measuring the same set of knowledge which is measured by the test as a whole. Since they are all substantially less than one, each item contributes to some unique information about financial literacy.

The Cronbach's Alpha provides an estimate for the internal consistency reliability of the assessment. Cronbach's Alpha for the combined test score is 0.7406, suggesting that the assessment has a decent level of internal consistency. This value is acceptable given that the assessment is relatively short, containing only twelve items.

The omitted-item Cronbach's Alphas provide estimates for what the internal consistency reliability of the assessment would be when each item is removed. These are useful for identifying items that are not consistent with the other items. Only one item had a high omitted-item Cronbach's Alpha, Item 11, with a value of 0.7437. This is not much higher than the 0.7406 value for the whole test, so this item is retained. Appendix E provides the details on Cronbach alpha estimations.

4.2.2 Assessment of the Financial Knowledge Scale from the Item Response Theory Perspective

4.2.2.1 Item Response Theory Overview

The Item Response Theory (IRT) was developed in the late 1950s with an intention to expand the measurement capabilities of researchers that were constrained by the CTT. It is commonly referred to as the 'latent trait theory' because statistical models that form the core of the IRT aim to measure an underlying trait (or ability) that results in a particular test performance score rather than the performance itself. Such models try to gauge an association between abilities (or levels on a latent variable) and probabilities of particular item responses.

There are a few CTT shortcomings that the IRT models attempt to overcome. First, item facility and item discrimination parameters are dependent on the sample of test takers which hinder any attempts of generalisation. As financial literacy needs to be measured across the globe and within different socioeconomic strata, utilising the tools of CTT alone will hinder the test comparability. Second, the primary unit of analysis under the CTT is the overall test score as opposed to the test item score. This makes it harder for a researcher to eliminate redundant and inefficient items. Third, the CTT tools generally favour a test with a larger number of items as it represents the researched domain more accurately and it is more likely that the test will represent true characteristics. As operational constraints usually limit the

number of items to 30-50, every question has to be carefully analysed and should be informative of the test taker's ability. Stage (2003) also points out that the ability estimates would be less precise for the low and high ability members of the sample as opposed to those with an average ability.

The IRT can overcome some of the shortcomings of the CTT. First of all, the item statistics are not dependant on the sample of test takers. Second, the IRT does not assume that all of the test items are equally difficult. Furthermore, it considers the abilities of the examinees as independent of the choice of test items. Each item difficulty is modelled in conjunction with the test taker's ability. Logistic models of the IRT strive to fit the data as closely as possible; therefore, more flexibility in terms of model specification is permitted.

Item response theory purports to overcome the shortcomings of classical test theory by providing an ability scale on which examinee abilities are independent of the particular choice of test items from the pool of test items over which the ability scale is defined.

Interest in item response theory stems from two desirable features which are obtained when an item response model fits a test dataset: Descriptors of test items (the item statistics) are not dependent upon the particular sample of examinees chosen from the population of examinees for whom the test items are intended, and the expected examinee ability scores do not depend upon the particular choice of items from the total pool of test items to which the item response model has been applied. Invariant item and examinee ability parameters, as they are called, are of immense value to measurement specialists. Neither desirable feature is obtained when the well-known and popular classical test models are used.

4.2.2.2 Assumptions

The IRT models rely on two primary assumptions: unidimensionality and item local independence. According to Han (2007) unidimensionality presumes that the corresponding test measures one particular trait. In other words, the test taker's performance is driven by one

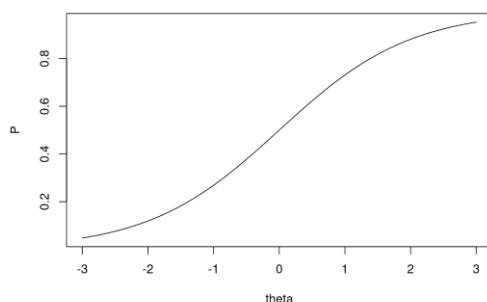
factor – his or her ability. Unidimensionality can be violated by either personal characteristics (e.g. cognitive biases) that cannot be controlled by the researcher or by the flaws in the test design. There are tests designed to test for unidimensionality assumption which include, but are not limited to, Cronbach test, Factor analysis, and Eigenvalue test.

The second assumption is the local item independence that a response to any given item on the test is not related to any other test item; i.e. the probability of answering an item correctly is not dependent on an answer to a previous item. Though, it does not imply that test items must be uncorrelated (Embretson and Reise, 2000).

4.2.2.3 Models

According to Hambleton and Swaminathan (1985) the IRT models assume that the performance of a test taker can be fully explained by a latent or unobservable trait, which is also commonly referred to as ‘ability’. The models are created and calibrated in such a way so as to conjugate this ability to an observed score on a corresponding test. The probability of a particular item response is estimated by employing a logistic model given an examinee ability and item characteristics (Ani, 2014). Such a mathematical function is frequently presented in a graphic form and is named an item characteristic curve (ICC). An example of an ICC is presented below in Figure 4.1.

Figure 4.1
Sample Item Characteristic Curve



Source: Baker and Kim (2017)

Examinee's ability is denoted as Theta (θ) on the horizontal axis and the probability of an examinee answering the question correctly is denoted by P (θ) on the vertical axis. The probability is a monotonically increasing function of Theta. In other words, as examinee's theta increases, the probability of giving a correct answer increases as well (An and Yung, 2014). Thetas are assumed to have normal distributions with a mean of zero and variance of one.

The location of an ICC is determined by the difficulty parameter (denoted as b) that represents a particular test item difficulty. Change in difficulty will shift the ICC along the ability scale. Easier items will cause a shift to the left side while more difficult items will cause a shift to the right. It is advisable to include test questions of various difficulty so as to capture various levels of the latent trait.

The slope of the ICC function (denoted as a) is the discrimination parameter. It measures the association between the latent trait and the item. A test item possessing higher discrimination value will result in a higher probability of the correct response given an increase in the latent trait. Such a property helps to understand whether a test item can effectively discriminate between highly and less proficient examinees. It is advisable to include test questions that have positive discrimination parameters. The negative a would indicate that more proficient examinees will have lower probability of answering an item correctly. A caution should also be exercised with questions that have discrimination parameters closer to the extreme value of zero and 2 as those questions might relate to other constructs in the case of zero, or might rely purely on memorisation of a fact as in the case of 2 (Sudol and Studer, 2010).

A generic functional form of an ICC can be presented as:

$$\Pr(\text{success}|a,b, \theta) = F \{a(\theta - b)\},$$

where probability of success is a function of the distance between the item location and an examinee location on the ICC, and F is a variation of a cumulative logistic distribution.

Having specified desired constraints on the estimated parameters, we can fit an assortment of the IRT models. The most common ones are 1 parameter (1PL), 2 parameter (2PL), and 3 parameter (3PL) models.

The most simplistic is the 1PL model (frequently referred to as Rasch model – even though modelling process is the same to 1PL, they have slight conceptual differences).

$$P_{ij}(\theta_j, b_i) = \frac{\exp(\theta_j - b_i)}{1 + \exp(\theta_j - b_j)}$$

Within this model, the item description parameter is set to any constant (typically 1) as this model assumes that all the test scale items relate to the ability in an equal way. Therefore, items vary only within one parameter, which is difficulty.

Adding the discrimination parameter a to the previous model, the 2 PL model is formed as:

$$P_{ij}(\theta_j, b_i, a_i) = \frac{\exp[a_i(\theta_j - b_i)]}{1 + \exp[a_i(\theta_j - b_j)]}$$

It is possible to add the third lower asymptote ICC parameter to create a 3PL model. The fourth upper asymptote ICC parameter can be added as well (when examinees with a highest level of latent trait might not have high probability of success). This is very rarely done in knowledge testing/examination settings but might be used in psychology and biostatistics (Cheng and Liu, 2015).

The 3PL (and above) models might not be very reliable and practical to estimate. The guessing parameter is dependent on the test conditions and is also person-specific. For example, a person sitting for a university admissions examination where wrong answers are not penalised will have a much higher incentive to guess in comparison to someone who is taking a diagnostic knowledge test in order to enrol in a paid online course. What is more, there is little research conducted on the estimation of the propensity to guess (Sideridis et al., 2016). According to

Thissen and Wainer (1982) 3PL models might result in imprecise parameter estimates especially within smaller samples (De Ayala, 2013). Wright (2013, p. 1) refers to 3PL model as “mathematically non-converging, inestimable elaboration of the Rasch model”.

The IRT was used to validate the proposed FL test because of its key advantages over the CTT. First, difficulty and item discrimination parameters allow the researcher to extract valuable test item characteristics on the item level. Second, tests administered under the IRT have more comparability even if various researchers use a smaller or bigger version of the test provided. A researcher might include only specific questions that are of interest to him or her, or are a better fit for a particular demographic group. For example, a researcher who is working with college students might deliberately omit some pension planning questions out of a larger financial literacy question bank. Third, the ICC is a powerful visual tool compared to the traditional CTT coefficients such as Cronbach Alpha or item-total correlations.

While the IRT is a very robust method for the analysis of validity and reliability of knowledge testing, caution should be exercised when small samples are used. Sudol and Studer (2010) also warn against using the theta scores as a substitute for test scores in order to assess the students because the resulting ability scores are only estimates.

4.2.2.4 Analysis of the Results

Both the 1PL and 2PL models were fitted to the data that contained responses to the financial literacy knowledge test. The comparison between the models revealed that the 2PL model has significantly better fit to the data. Using a likelihood-ratio test, there was a substantial improvement in model fit moving from the 1PL model to the 2PL model ($\chi^2_{11} = 240.78, p < 0.001$).

Table 4.2 below depicts the output of the 2PL IRT model for the 12 FL knowledge test.

Table 4.2

2 PL IRT Model Results

Question	Topic/ Coefficient	Question/ Std. error	z	P> z	[95% Conf.	Interval]
LQ1	Numeracy + Interest rates ("Big 3")	Suppose you have \$100 in a savings account and the interest rate is 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?				
Discrim.	1.597964	.1612165	9.91	0.000	1.281986	1.913943
Diff.	-2.163309	.1420683	-15.23	0.000	-2.441757	-1.88486
LQ2	Inflation ("Big 3")	Imagine that the interest rate on your savings account is 1% per year and inflation is 2% per year. After 1 year, how much would you be able to buy with the money in this account?				
Discrim.	1.919984	.1623769	11.82	0.000	1.601731	2.238237
Diff.	-1.405796	.0779999	-18.02	0.000	-1.558673	-1.252919
LQ3	Inflation effect on borrowing and savings	Which of the following categories of people are most likely to be helped by inflation?				
Discrim.	.8446934	.0912361	9.26	0.000	.6658739	1.023513
Diff.	.329265	.074592	4.41	0.000	.1830674	.4754625
LQ4	Investing (Big 5)	If interest rates rise, what will happen to the bond prices?				
Discrim.	.8986357	.094761	9.48	0.000	.7129076	1.084364
Diff.	1.453403	.1380597	10.53	0.000	1.182811	1.723995
LQ5	Risk – Investing	Under which of the following your investment amount up to 950,000 kronor is guaranteed by the government?				
Discrim.	2.045862	.1619773	12.63	0.000	1.728393	2.363332
Diff.	-.6391124	.0493607	-12.95	0.000	-.7358577	-.5423672
LQ6	Investing	Sara and Nils have just had a baby. They received money as baby gifts and want to save for the baby's education. Which of the following would yield the highest growth over the period of 18 years?				
Discrim.	1.879304	.1460238	12.87	0.000	1.593103	2.165505
Diff.	-.6591347	.0518262	-12.72	0.000	-.7607123	-.5575572
LQ7	Risk – Investing ("Big 3")	Please tell me whether this statement is true or false: "Buying a single company's stock usually provides a safer return than a stock mutual fund".				
Discrim.	1.882855	.1454775	12.94	0.000	1.597724	2.167986
Diff.	-.5947341	.0501749	-11.85	0.000	-.6930752	-.496393
LQ8	Risk – Investing	Which type of asset displays the highest fluctuations in value over time given normal market conditions?				
Discrim.	.8402279	.0792321	10.60	0.000	.6849359	.99552
Diff.	-.5714809	.0828556	-6.90	0.000	-.7338749	-.409087
LQ9	Risk – investing	In the case of company bankruptcy, what kind of financial instrument holders have priority in receiving the invested money?				
Discrim.	1.025931	.0874671	11.73	0.000	.8544988	1.197364
Diff.	-.7153346	.0765713	-9.34	0.000	-.8654117	-.5652576

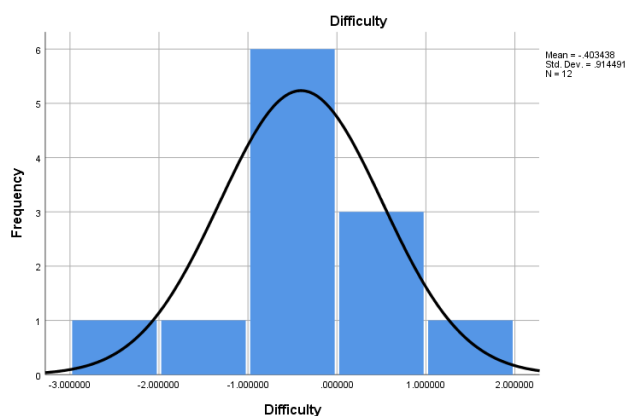
LQ10	Investing	Which one of the following is true [regarding various types of dividends]?				
Discrim.	.7963373	.0884394	9.00	0.000	.6229992	.9696754
Diff.	.2216817	.0750401	2.95	0.003	.0746058	.3687576
LQ11	Interest – Debt management (Big 5)	Do you think the following statement is true or false? A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest over the life of the loan will be less.				
Discrim.	.5907873	.0698117	8.46	0.000	.4539588	.7276158
Diff.	.2571486	.096401	2.67	0.008	.0682062	.446091
LQ12	Investing	Which of the investments below is most likely to lose purchasing power quicker than others?				
Discrim.	1.689922	.1307086	12.93	0.000	1.433738	1.946106
Diff.	-.3538528	.0480241	-7.37	0.000	-.4479784	-.2597272

Consistent with the CTT analysis presented earlier, the first “Big 3” numeracy question turned out to be the easiest of all the twelve questions. However, unlike the CTT results, it has a very good discrimination parameter. It is notable that the sample was drawn from a developed country where majority of the households possess basic numeracy skills and have a universal access to such basic financial service as a savings account. It is possible that item characteristics might change if the question was presented in the emerging markets. The second “Big 3” question also turned out to be the second easiest. Nevertheless, this question also possesses excellent discrimination ability. The third “Big 3” question on the benefits of diversification also possesses good discrimination ability.

While all “Big 3” questions possess very good discrimination ability, the two extended questions (Q4 and Q11) that form the “Big 5” do not exhibit such properties. In fact, Q11, regarding debt management, has the lowest alpha among all the questions in the questionnaire. Q5, unique to this survey, also proved not to be a very difficult question to answer as its beta coefficient is -0.6391. This could imply that the question tests factual knowledge (in this case, the level of government protection provided for a particular asset class). On the other hand, it has very high discrimination ability (slightly above 2). Even though the question is easy to answer, it is still useful in differentiating participants according to their financial knowledge. Appendix F provides the ICCs for all 12 questions that formed the FL test.

By employing the IRT, this allows for verification that the developed FL test is psychometrically coherent. First, it demonstrated that the most commonly used questions developed by Lusardi and her colleagues are suitable to measure financial literacy. Second, the developed instrument is robust. The majority of the questions possess high discrimination parameters and the test consists of items of various difficulties, which is a desirable characteristic. Figure 4.2 presents the distribution of difficulty parameters of the questions included.

Figure 4.2
Distribution of Difficulty Parameters



Third, an item-by-item analysis of the questions provides information about the effectiveness of each question in measuring FL. As one of the key advantages of the IRT is the portability of questions from one instrument to another, other researchers will be able to ‘pick’ the necessary questions for their own instruments.

4.3 Descriptive Analysis of the Data and Key Variables

4.3.1 Respondents’ Sample Demographic Characteristics

This subsection presents descriptive statistics for the main variables of the analysis. The sample is composed of 1,554 survey respondents. Figure 4.3 shows the distribution of ages by categories. The 18-24 age group is the smallest one, with only 17 people. All groups above 24 years old have between 260 and 361 people. The largest group, with 361 observations, is

composed of people between 45 and 54 years old. The average age of the respondents is around 49 with a standard deviation of 15 (Table 4.3). Although the distribution curve indicates a slight tendency towards younger ages (Figure 4.4), a comparison of the mean against the median (the 50% centile) shows that the distribution is still very centred.

Table 4.4 presents statistics for the categorical variables used in the analysis. Regarding gender, the sample is almost equally distributed: 55.15% of men against 44.85% of women. Most participants of the survey were still active in the labour market (79.21%), and a substantial proportion of the sample had met with a financial advisor at least once in the past three years (79.67%). The education level distribution is bimodal: instead of leaning toward one category, almost 50% of the sample had either Secondary (up to 16) level (23.12%) or Higher professional level (25.95%). Only 12.75% of the sample have a university degree. When asked about business education, 81.52% of the respondents had had at least some exposure related to economics or business in their education (the sum of the categories ‘much’, ‘somewhat’, and ‘little’), while 18.48% said they had had virtually no contact with these themes. Regarding income, the sample leans towards higher salary levels with nearly 63% earns 1,801 EUR or more. A considerable share of the sample has up to 60,000 EUR of wealth (56.55%), while only 4.5% has 140,000 EUR or more. Considering the nature of the occupation, a large proportion of the sample is composed of people employed on a contractual basis: nearly 53%. Only 1.03% of the sample is formed by students, and very few people work on their own business (0.64%). The sample has comparably equal proportions of people living alone (27.86%), living with a partner without children (35.01%), and living with a partner and children (32.63%).

Table 4.3
Descriptive Statistics for Age Variable

Variable	N	Mean	SD	min	25%	50%	75%	max
Age	1554	49.41	15.00	22	37	49	60	90

Figure 4.3
Age of Participants

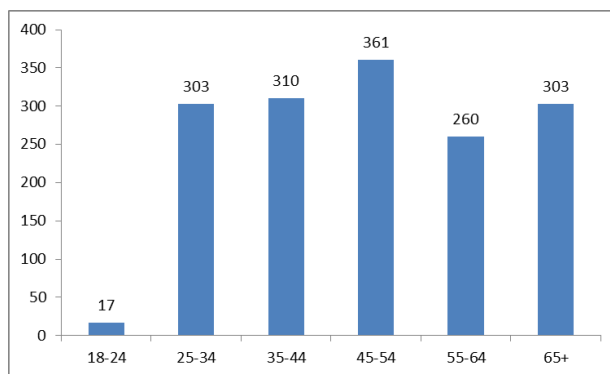


Figure 4.4
Distribution of the Age Variable

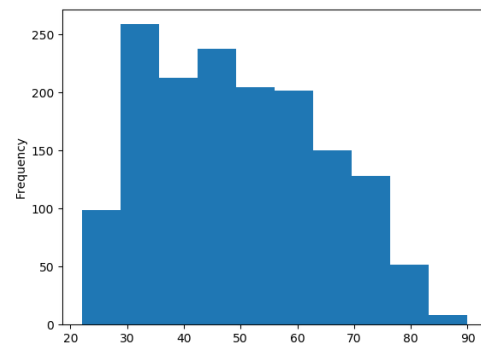


Table 4.4
Descriptive Statistics of other Categorical Variables

Variable	Category	N	%
Gender	Male	857	55.15
	Female	697	44.85
Retired	No	1162	79.21
	Yes	305	20.79
Met with financial advisor	No	1238	79.67
	Yes	316	20.33
Education level	Primary	70	4.51
	Secondary (up to 16)	359	23.12
	Secondary (up to 18)	209	13.46
	Vocational	314	20.22
	Higher professional	403	25.95
	University	198	12.75
Learned about business or economics in his/her education	Much	246	16.07
	Somewhat	580	37.88
	Little	422	27.56
	Virtually no	283	18.48
Income	Up to 1,150 EUR	162	10.43
	1,151 EUR-1,800 EUR	415	26.72
	1,801 EUR-2,600 EUR	449	28.91
	2,600 EUR and above	527	33.93
Wealth	Up to 20,000 EUR	162	10.42
	20,000 EUR-40,000 EUR	339	21.81
	40,000 EUR-60,000 EUR	378	24.32
	60,000 EUR-80,000 EUR	185	11.90
	80,000 EUR-100,000 EUR	257	16.54
	100,000 EUR-120,000 EUR	110	7.08
	120,000 EUR-140,000 EUR	53	3.41
	140,000 EUR-200,000 EUR	44	2.83
Nature of occupation	200,000 EUR and above	26	1.67
	Employed on a contractual basis	823	52.96
	Works in own business	10	0.64
	Free profession, freelance, self-employed	60	3.86
	Looking for work after having lost job	34	2.19
	Looking for first time work	4	0.26
	Student	16	1.03
	Works in own household	194	12.48
	Retired (including pre-retirement)	305	19.63
	(partly) disabled	71	4.57
	Unpaid work; benefit payments	1	0.06
	Works as volunteer	26	1.67
	Other occupation	10	0.64
Household composition	Too young, no occupation	0	0
	Is living by her/himself	433	27.86
	Is living together with a partner; no children living at home	544	35.01
	Is living together with a partner; children also live at home	507	32.63
	Living without a partner but with children	52	3.35
	Other	18	1.16

4.3.2 Descriptive Analysis of the Objective Financial Literacy Test

This subsection describes the results of the objective financial literacy test and shows how the test scores varied by social and economic characteristics.

4.3.2.1 Objective Financial Literacy Test Results

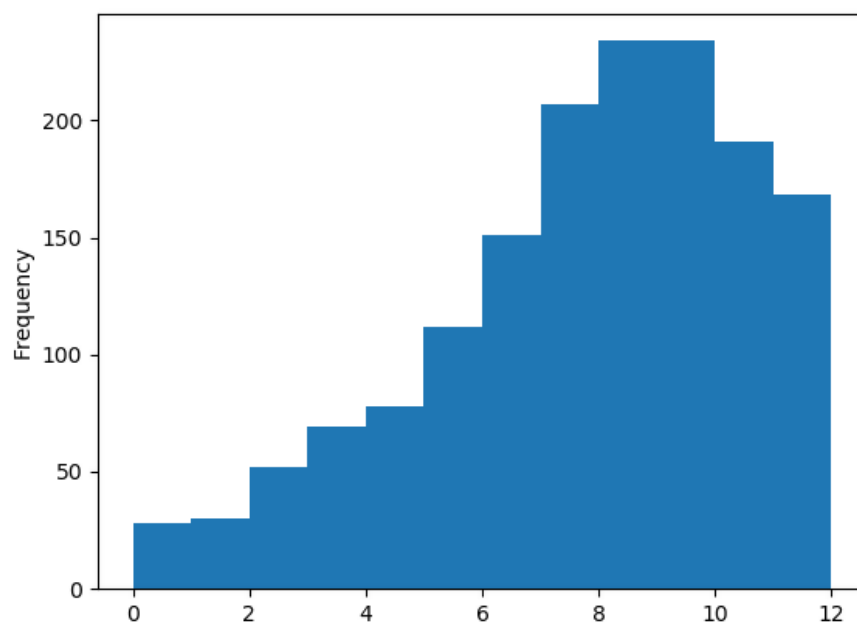
On average, the participants answered 7.3 out of 12 questions correctly (on a scale from 0 to 10, this is equivalent to an average score of 6.08) (Table 4.5). The distribution is negatively skewed (Figure 4.5) as the mean is below the median (8). Most participants showed reasonable knowledge about finance: around 75% of the sample scored 6 (out of 12) or higher.

Table 4.5
Descriptive Statistics of the TEST_SCORE Variable

Variable	N	mean	SD	min	25%	50%	75%	max
TEST_SCORE	1554	7.302	2.778	0	6	8	9	12

Source: Author

Figure 4.5
Distribution of the Test Scores



4.3.2.2 Analysis by the Question

Table 4.6 presents the results of a series of Chi-square tests that evaluate if answering the questions correctly have any statistical relationship with age categories, gender, and a dummy indicating if the person received financial advice or not. The column variables are all binary: they take the value 1 when the person answered correctly and 0 when the participant answered incorrectly.

Almost a half of the correct answers to the questions have a connection with the age of the participant. However, receiving financial advice seems to have no effect on the score, except for one question of the test.

The data also shows that gender is very important for TEST_SCORE as every question shows a significant relationship between these variables.

Table 4.7 explores this connection in detail by estimating the correlation between Gender and TEST_SCORE variables for each question. The results show that all correlations are positive and significant. Moreover, men got a higher percentage of right answers than women in all the questions on the objective financial literacy test. The seventh question of the test was where the difference between genders was the largest. Participants were asked to evaluate if the following sentence is true or false: ‘Buying a single company’s stock usually provides a safer return than a stock mutual fund.’ While 75.85% of male participants chose the right answer (‘false’), only 57.1% of women answered correctly. In summary, the data clearly show that men outperformed women in the objective financial literacy test.

Table 4.6
Chi-square Tests

Variable	AGECAT	GENDER	MET_ADVISOR
LQ1	11.7790**	7.3522***	0.1450
LQ2	22.1269***	28.0009***	0.1567
LQ3	4.4561	26.6356***	0.0470
LQ4	8.9921	13.4104***	6.5924**
LQ5	14.3174**	46.3624***	0.7168
LQ6	6.1868	59.2229***	0.0480
LQ7	2.8032	61.5010***	0.2742
LQ8	22.5999***	4.6643**	1.4240
LQ9	3.4031	21.7411***	0.6760
LQ10	4.9675	25.1688***	0.1436
LQ11	12.1028**	7.7819***	1.9252
LQ12	5.1548	48.4863***	0.0461

Notes: *** p<0.01; ** p<0.05; * p<0.1. The values of the table are the chi-square statistics with the significance level. The AGECAT variable has six categories, while both Sex and MET_ADVISOR are dummy variables.

Table 4.7
Correlation of Test Questions by Gender

Variable	Corr with gender	Right answers by men	Right answers by women	Difference
LQ1	-0.069***	94.17%	90.53%	03.63
LQ2	-0.134***	89.50%	79.91%	09.58
LQ3	-0.131***	49.94%	36.87%	13.06
LQ4	-0.093***	28.12%	20.09%	08.03
LQ5	-0.173***	76.43%	60.40%	16.03
LQ6	-0.195***	77.25%	59.11%	18.14
LQ7	-0.199***	75.85%	57.10%	18.75
LQ8	-0.055**	62.78%	57.39%	05.39
LQ9	-0.118***	69.89%	58.54%	11.34
LQ10	-0.127***	51.93%	39.17%	12.76
LQ11	-0.071***	49.71%	42.61%	07.10
LQ12	-0.177***	68.03%	50.65%	17.38

Notes: *** p<0.01; ** p<0.05; * p<0.1

4.3.2.3. Analysis of Financial Literacy Test Score in Relation to Key Variables

Table 4.8 presents the result of mean t-tests for test score on financial literacy test (TEST_SCORE) with respect to receiving financial advice and gender. The group that received financial advice scored 7.5 on average, while the group that did not meet an advisor scored 7.25. Although those who met an advisor seem to have scored higher, the test showed that the difference is not statistically significant. On the other hand, gender is a major factor: men averaged a score of 7.94, while women averaged 6.52. This difference is statistically significant at the 1% level.

Table 4.8
Mean t-tests for the Scores on Financial Literacy Test

Variable	MET_ADVISOR = no		MET_ADVISOR = yes		Mean t-test
	N	Mean	N	Mean	
TEST_SCORE	1238	7.25	316	7.5	-1.39

Variable	GENDER = Male		GENDER = Female		Mean t-test
	N	Mean	N	Mean	
TEST_SCORE	857	7.94	697	6.52	10.3***

A one-way ANOVA is conducted to evaluate whether the average TEST_SCORE varied for different age groups (Table 4.9). There were 6 age groups. The size of the groups varied from 17 observations ('18 to 24 years old' group) to 361 observations ('45 to 54 years old' group). The variances of the groups are approximately equal, according to the reported Bartlett's test for equal variances. I found statistically significant difference between age groups for TEST_SCORE at the 5% level ($F = 2.73$; $p\text{-value} = 0.0183$). Although ANOVA does not specify which means departed from the means of the other categories, it is noticeable how the group of people from '18 to 24 years old' (group 2 in Table 4.9) had a financial literacy test score mean of 5.88 while all the other groups' means varied around 7.

To verify whether this value is significantly lower than the others, a mean t-test was conducted. The test confirmed that the average score of Group 1 is indeed significantly lower than the mean of the rest of the sample at the 1% level of significance ($t = -2.5083$; $p\text{-value} =$

0.0061). Thus, the data suggest that the youngest group did worse on the test than older respondents. Furthermore, the group of adults between 45 and 54 years old (Group 4) noticeably had the highest average score among all groups (7.62). A t-test also showed that the mean score of Group 4 is higher than the mean of the rest of the sample, significant at the 5% level ($t = 2.1215$; $p\text{-value} = 0.0170$). To sum up, the data shows that the youngest group had the worst performance in the objective test, while the group of 45-54 years old had the best performance.

Table 4.9
ANOVA for *TEST_SCORE* Variable

Summary of TEST_SCORE					
AGECAT	Mean	Std.Dev.	Freq.		
1 - 18-24	5.8823529	2.997548	17		
2 - 25-34	7.1122112	2.8657516	303		
3 - 35-44	7.2387097	2.9209297	310		
4 - 45-54	7.6232687	2.6701875	361		
5 - 55-64	7.4846154	2.7655761	260		
6 - 65 or more	7.0990099	2.6212515	303		
Total	7.3024453	2.7783371	1554		

Analysis of Variance					
Source	SS	df	MS	F	Prob>F
Between groups	104.832992	5	20.9665984	2.73	0.0183
Within groups	11883.0177	1548	7.67636803		
Total	11987.8507	1553	7.71915693		

Bartlett's test for equal variances: $\chi^2(5) = 5.4202$ Prob> $\chi^2 = 0.367$

4.3.3 Descriptive Analysis of Subjective Financial Literacy

This subsection is devoted to the data analysis from the subjective financial literacy self-evaluation.

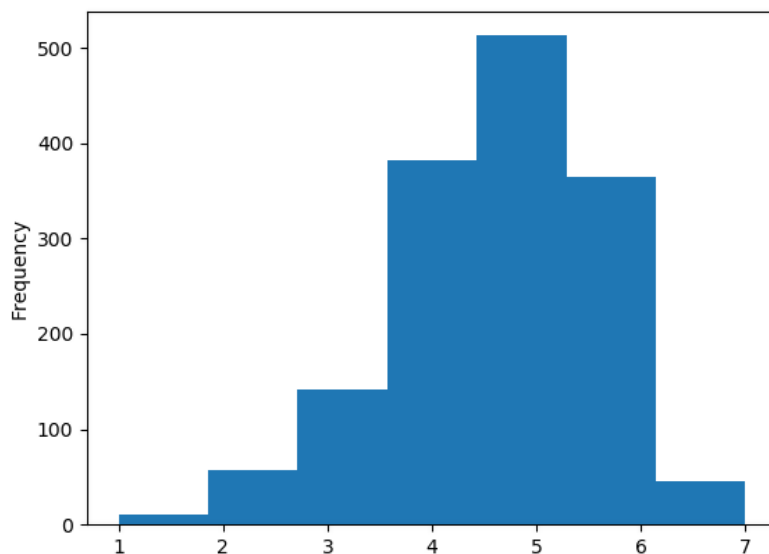
4.3.3.1 Subjective Financial Literacy Results

Besides applying an objective assessment of financial knowledge, the questionnaire also asked respondents to self-evaluate their financial literacy. The participant could choose a number between 1 and 7, in which 1 meant “I am not knowledgeable in this area at all” and 7 meant “I consider myself an expert in this area”. Participants gave themselves an average score of 4.72 (which is equivalent to an average score of 7.86 on a 0 to 10 scale). The mean value is below the median (5), denoting a negatively skewed distribution, which is depicted in Figure 4.6.

Table 4.10
Descriptive Statistics of the Subjective Financial Literacy Variable

Variable	N	Mean	SD	min	25%	50%	75%	max
SELFKNOW	1513	4.720423	1.164039	1	4	5	6	7

Figure 4.6
Subjective Financial Literacy Distribution



4.3.3.2 Correlation of Objective and Subjective Financial Literacies for Various Groups

This section estimates the correlation level of objective test scores (TEST_SCORE) with subjective financial literacy scores (SELFKNOW). The general level of correlation between these variables is 0.3301, significant at the 1% level. Below, this correlation for several groups is estimated. Based on this information, it is possible to assess the ability of distinct groups to self-evaluate their financial knowledge.

Table 4.11 presents the correlation of TEST_SCORE with SELFKNOW for those who met and did not meet a financial advisor. The correlations are statistically significant for both groups, and the values are similar. The results show that people who met a financial advisor are slightly more capable to estimate how much they know about financial assets.

Table 4.11
Correlations of OFL and SFL with those who Met Financial Advisor

Group	N	Correlation
no	1238	0.328***
yes	316	0.379***

*** p<0.01; ** p<0.05; * p<0.1.

Table 4.12 shows that, for both men and women, self-evaluation is positively and significantly correlated with objective measures. Yet, men were better at assessing their own level of financial knowledge than women.

Table 4.12
Correlations of OFL and SFL with Gender

Group	N	Correlation
female	697	0.258***
male	857	0.346***

*** p<0.01; ** p<0.05; * p<0.1.

Table 4.13 depicts the correlation of SELFKNOW and TEST_SCORE for various age groups. All age categories show positive and significant correlation. The youngest group stands out with a correlation level much higher than the others (0.716). However, this statistic should be interpreted with caution, as this group has only 17 observations.

Table 4.13
Correlations of OFL and SFL with Various Age Groups

Group	N	Correlation
1 - 18-24	17	0.716***
2 - 25-34	303	0.253***
3 - 35-44	310	0.324***
4 - 45-54	361	0.351***
5 - 55-64	260	0.425***
6 - 65 or more	303	0.312***

*** p<0.01; ** p<0.05; * p<0.1.

The reader can observe how Objective Financial Literacy (OFL) (represented by “TEST_SCORE” is correlated to Subjective Financial Literacy (SFL) (represented by “SELFKNOW”) for various levels of business education by analysing Table 4.14. Surprisingly, the group that claimed that much attention was paid to business in their education was the one which had the lowest correlation. This indicates a poor ability of this group to assess their own knowledge about financial instruments and financial environment. Indeed, while their average score on the objective test was more than 2 points above the whole sample (9.5 against 7.3), their self-evaluation was less than 1 point above the whole sample (5.4 against 4.7). Put differently, people who received most business education tend to underestimate their own knowledge.

Table 4.14
Correlations of OFL and SFL with Various Level of Business Education

Group	N	Correlation
1 - much	246	0.131**
2 - somewhat	580	0.234***
3 - little	422	0.246***
4 - virtually no	283	0.27***

*** p<0.01; ** p<0.05; * p<0.1.

The Table 4.15 depicts the same correlation between the OFL and SFL but segmented by wealth levels. The values are all significant and the correlations range from 0.22 to 0.562.

Table 4.15
Correlations of OFL and SFL with Various Wealth Levels

Group	N	Correlation
1 - 1 EUR-20,000 EUR	162	0.22***
2 - 20,000 EUR-40,000 EUR	339	0.312***
3 - 40,000 EUR-60,000 EUR	378	0.304***
4 - 60,000 EUR-80,000 EUR	185	0.239***
5 - 80,000 EUR-10,0000 EUR	257	0.295***
6 - 100,000 EUR-120,000 EUR	110	0.341***
7 - 120,000 EUR-140,000 EUR	53	0.562***
8 - 140,000 EUR-200,000 EUR	44	0.3**
9 - 20,0000 EUR and above	26	0.448**

*** p<0.01; ** p<0.05; * p<0.1.

Table 4.16 repeats the exercise for occupations. The categories ‘works in own business’, ‘self-employed’, ‘looking for work after having lost job’, ‘looking for first time work’, ‘student’, and ‘other occupation’ showed no significant correlation between the OFL and SFL. For the remaining categories, the significant correlations are all positive and close to 0.3 – except for ‘volunteer’, which showed ability for self-evaluation much higher than other categories (0.624). The category 10 was ‘unpaid work’ and had no observations.

Table 4.16
Correlations of OFL and SFL with Various Types of Occupation

Group	N	Correlation
1 - employed on a contractual basis	823	0.312***
2 - works in own business	10	0.53
3 - free profession. freelance. self-employed	60	0.101
4 - looking for work after having lost job	34	0.284
5 - looking for first time work	4	0.899
6 - student	16	0.204
7 - works in own household	194	0.356***
8 - retired (including pre-retirement)	305	0.328***
9 - (partly) disabled	71	0.369***
11 - works as volunteer	26	0.624***
12 - other occupation	10	0.309

*** p<0.01; ** p<0.05; * p<0.1.

Table 4.17 depicts how different education levels affect the correlation between OFL and SFL. All values are positive and significant. While people with primary level education showed a correlation of 0.26, all other categories averaged 0.3.

Table 4.17
Correlations of OFL and SFL with Various Types of Education

Group	N	Correlation
1 - primary	70	0.26**
2 - secondary (up to 16)	359	0.339***
3 - secondary (up to 18)	209	0.313***
4 - vocational	314	0.331***
5 - higher professional	403	0.34***
6 - university	198	0.336***

*** p<0.01; ** p<0.05; * p<0.1.

4.3.3.3 Analysis of Subjective Financial Literacy Related to Key Variables

Table 4.18 shows mean-tests of SFL for two variables: whether a member of household met with an advisor (MET_ADVISOR) and gender (GENDER). The test produced a significant statistic for both variables, meaning that the mean of financial literacy self-assessment score is different depending on respondents' gender and whether he or she received financial advice. People who met an advisor evaluated themselves as possessing lower financial knowledge score than those who did not. Men evaluated themselves with higher scores than women did in their self-evaluation. The differences were statistically significant at the 1% level.

Table 4.18
Mean t-test for Subjective Financial Literacy

Variable	MET_ADVISOR = no		MET_ADVISOR = yes		Mean t-test
	N	Mean	N	Mean	
SELFKNOW	1202	4.8	311	4.4	5.58***

Variable	SEX = male		SEX = female		Mean t-test
	N	Mean	N	Mean	
SELFKNOW	838	4.87	675	4.53	5.81***

*** p<0.01; ** p<0.05; * p<0.1.

In order to evaluate the differences within the age groups, a one-way ANOVA was performed and the results are depicted in Table 4.19. The sample included 6 age groups, with

frequencies ranging from 17 to 356. The analysis showed that there are significant differences in the subjective financial literacy mean for these categories at the 1 % level ($F = 3.21$; $p\text{-value} = 0.0068$). According to the Bartlett's test, the variances of the groups are approximately equal as the null hypothesis was not rejected. It is interesting to observe how the average self-evaluated scores are comparable to the objective assessments. While the youngest group had the lowest scores in the objective test, the same group gave themselves the highest scores on average. A mean t-test did not find that Group 1 (18-24 years old) self-assessment score was different from the rest of the sample with any statistical significance. However, when Groups 1 and 2 were combined (from 18 to 34 years old) into a single group, and then compared to the rest of the respondents, the test showed that this new group average was significantly higher than the rest of the sample ($t = -3.1766$; $p\text{-value} = 0.0008$). This indicates that the people of younger ages tend to assess their own financial knowledge higher than other groups, while at the same time they perform worse in objective tests than the average. The group that evaluated their own knowledge with the lowest scores was Group 6, composed of people with 65 years old or more. The average score was 4.56, which is significantly lower than the average at the 1% level ($t = 2.5996$; $p\text{-value} = 0.0047$). This same group also had the second worst performance in the test. When we compare these estimates to how the younger groups evaluated themselves and how they scored in the test, the data imply that older respondents are more capable of evaluating their own level of knowledge regarding financial instruments than younger participants.

Table 4.19
One-way ANOVA for Subjective Financial Literacy

Summary of SELFKNOW			
AGECAT	Mean	Std.Dev.	Freq.
1 - 18-24	4.9411765	.89934617	17
2 - 25-34	4.9047619	1.1196863	294
3 - 35-44	4.6366667	1.2259685	300
4 - 45-54	4.7078652	1.1910677	356
5 - 55-64	4.7913386	1.0996603	254
6 - 65 or more	4.5616438	1.1545375	292
Total	4.720423	1.1640387	1513

Analysis of Variance					
Source	SS	df	MS	F	Prob>F
Between groups	21.6184194	5	4.32368389	3.21	0.0068
Within groups	2027.12051	1507	1.34513637		
Total	2048.73893	1512	1.35498606		
Bartlett's test for equal variances: chi2(5) = 6.2553 Prob>chi2 = 0.282					

4.3.4 Descriptive Analysis of Meeting with Financial Advisor Variable

This subsection evaluates how receiving financial advice (MET_ADVISOR) variable is related to other variables within the study. This variable is binary, and it divides the sample into two subgroups: those who met a financial advisor in the last three years (or someone in their household did), and those who did not.

Out of 1,554 people who completed the questionnaire, 316 participants confirmed that they met a financial advisor of a bank or an independent financial advisor in the previous three years, or someone in their household did. This group corresponds to 20.3% of the sample.

Figure 4.7
Percentage of the Households who Met Financial Advisor

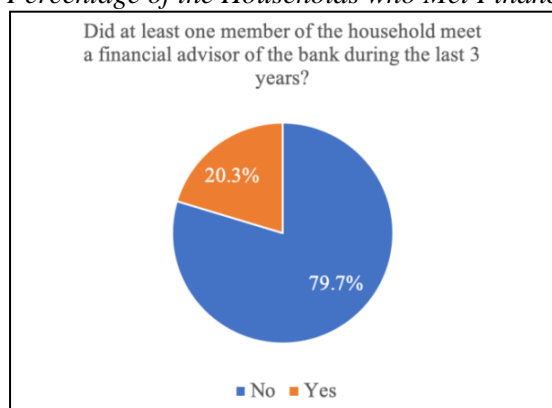


Table 4.20 depicts the mean t-test results of OFL, SFL and risk tolerance (RISK TOLERANCE) variables related to whether the household representative met a financial advisor or not. The test results for SELFKNOW and TEST_SCORE were already presented in Subsections 4.3.2 and 4.3.3, and the summary is provided here for convenience. Those who did meet an advisor (or live with someone who did) evaluated themselves as possessing less financial knowledge than their counterparts. The difference in the 1-to-7 scale is 0.4 points, and it is statistically significant at the 1% level. For the objective test score, however, the analysis showed no significant difference between those who met an advisor and those who did not. This suggests that meeting a financial advisor had no real impact on participants' knowledge about financial instruments; but they perceived themselves less knowledgeable than those who did not meet with an advisor. It is possible that the test results imply that meeting a financial advisor had a psychological effect on respondents about how they perceive their level of financial literacy; but it did not necessarily bring real improvements on their objective knowledge level of finance.

Table 4.20
Mean t-test for MET_ADVISOR

Variable	MET_ADVISOR == no		MET_ADVISOR == yes		Mean t-test
	N	Mean	N	Mean	
SELFKNOW	1202	4.8	311	4.4	5.58***
TEST_SCORE	1238	7.25	316	7.5	-1.39
RISK_TOLERANCE	1235	4.12	315	4.23	-1.25

*** p<0.01; ** p<0.05; * p<0.1.

Table 4.21 shows how a set of key variables relates to meeting an advisor. These relationships are tested via Pearson's Chi-squared test. In this test, the null hypothesis states that two variables have independent distributions. Rejecting this hypothesis implies that these variables have some significant (but not specified) relationship. The results show that meeting an advisor has a significant relationship with both direct and indirect stock investing. However,

there was no significant relationship between MET_ADVISOR and whether households plan for old age (THOUGHTOLDAGE), keep track of their spending (TRACKING), nor whether they were exposed to business education (BUSEDU).

Table 4.21
Pearson's Chi-square Test

Variable	MET_ADVISOR
STOCKS_DIRECT	2.7334*
STOCKS_INDIRECT	182.9462***
THOUGHTOLDAGE	5.3673
TRACKING	1.6897
BUSEDU	3.6749

*** p<0.01; ** p<0.05; * p<0.1.

Both Table 4.20 and Table 4.21 support the notion that meeting with an advisor seems to not affect financial literacy; but it changes how one perceives his or her level of financial knowledge.

4.4 Univariate Analysis – Determinants of Objective Financial Literacy

This subsection proposes an empirical model to explore how social, educational, and demographic aspects determine the objective financial literacy score.

4.4.1 Model Specification

Let i be the index of people in the sample. The model is:

$$\begin{aligned}
 Test\ Score_i = & \beta_0 + B_1 INCOME_{CAT_i} + B_2 WEALTH_{CAT_i} + B_3 EDULEVEL_i + \beta_4 AGE_i \\
 & + \beta_5 AGE_i^2 + \beta_6 PARTNER_i + \beta_7 Gender_i + \beta_8 CHILD_i \\
 & + \beta_9 RISK\ TOLERANCE_i + \beta_{10} TRACKING_i + \beta_{11} THOUGHTOLDAGE_i \\
 & + \beta_{12} SELFEMPLOYED_i + \beta_{13} OWNHOUSE_i + \varepsilon_i
 \end{aligned}$$

In which $INCOME_{CAT_i}$ is a vector of 3 binary variables standing for net income categories; $WEALTH_{CAT_i}$ is a vector of 8 binary variables being wealth categories; and $EDULEVEL_i$ is a vector of 5 binary variables that identifies education categories.

AGE_i and AGE_i^2 model the quadratic relationship of age and TEST_SCORE.

$PARTNER_i$ is a dummy variable which takes the value 1 if the person lives with her partner and 0 otherwise; $GENDER_i$ is a binary variable that assumes the value 1 if the person is female and 0 if the participant is male; $child\ dummy_i$ is a dummy variable which identifies if the respondent lives with children in the same house.

$RISK\ TOLERANCE_i$ measures, on a scale from 1 to 7, how much risk the person is willing to take; $TRACKING_i$ measures how often the person or his partner keep track of spending, in which 1 is ‘never’ and 4 is ‘always’; $THOUGHTOLDAGE_i$ indicates how often the participant thinks about old age, in which 1 is ‘virtually not’ and 4 is ‘always’.

$SELFEMPLOYED_i$ is a dummy variable which shows whether the participant is self-employed or an entrepreneur; and $OWNHOUSE_i$ indicates whether the person owns the accommodation in which he or she lives.

Our dependent variable is $TEST_SCORE$, which is the score each participant obtained in the objective literacy test. The grade is in the range of 0-12 (see Section 3.7.1.9 for a detailed overview of the variables mentioned). An OLS regression was employed in order to explore the determinants of $TEST_SCORE$.

4.4.2 Assessment of the Model Fit

Coefficient of determination

The dataset has 1,554 observations. The estimation of the standard model obtained a fit of 23% ($R^2 = 0.233$), showing that our model explains about one quarter of the variation of the $TEST_SCORE$ variable.

Multicollinearity

To assess the presence of multicollinearity, two analyses are performed: correlations between regressors and estimation of variance inflation factors (VIF) (Kuh et al., 1980).

By checking pairwise correlations between regressors, no pair of variables with a prominent level of correlation was found. The higher absolute correlation value was 0.4. From this test, we conclude that there is no multicollinearity.

The second method, VIF, also showed that multicollinearity is not a problem in this model. If we adopt a criterion value of 10, no variable shows a sign of multicollinearity. Apart from AGE and AGE² – which score high VIF levels because one variable is a direct transformation of the other – all VIF are far below 10. The highest VIF value is 5.6 (again, disregarding AGE and AGE²).

Table 4.22
Variance Inflation Factors

Variable	VIF	1/VIF
INCOMECAT		
2	2.83	0.353519
3	3.41	0.293521
4	4.39	0.227796
WEALTHCAT		
2	2.46	0.406231
3	2.66	0.375350
4	2.00	0.499145
5	2.43	0.410964
6	1.79	0.559493
7	1.45	0.690044
8	1.46	0.683950
9	1.31	0.765494
EDULEVEL		
2	4.96	0.201611
3	3.65	0.274195
4	4.74	0.210779
5	5.60	0.178632
6	3.72	0.268573
AGE	49.58	0.020169
AGE ²	49.57	0.020175
PARTNER	1.65	0.606508
GENDER (female)	1.24	0.804260
CHILD	1.46	0.684696
RISK_TOLERANCE	1.16	0.861164
TRACKING	1.07	0.933702
THOUGHTOLDAGE	1.17	0.853322
SELFEMPLOYED	1.04	0.957977
OWNHOUSE	1.35	0.742835

Heteroscedasticity

In order to obtain precise confidence intervals and reliable significance tests for the estimated coefficients, the variance of the error terms must remain constant and must not depend on the values of the regressors, property known as homoscedasticity. If the regressors affect the dispersion of the errors, heteroscedasticity is present and an alternative estimator will be needed.

According to the Breusch-Pagan / Cook-Weisberg test (Breusch et al., 1979), the null hypothesis of constant variance can be rejected ($\text{Chi}^2(1) = 30.56$; $p\text{-value} = 0.0000$). Thus, there is heteroscedasticity within the model and the heteroskedasticity-robust White estimator can be used (White, 1980).

Below, Table 4.23 presents the estimation results with the standard estimator (column 1) and with the White estimator robust to heteroscedasticity (column 2). There were only minor changes in the standard errors, but none of them changed the levels of significance that had been obtained with the standard estimator.

Table 4.23
Regressions Results with Standard and Robust Estimator

	(1) TEST_SCORE (standard estimator)	(2) TEST_SCORE (White estimator)
NETTOHHINCOMEcats		
from EUR 1151 to EUR 1800	0.4270* (0.23)	0.4270* (0.25)
from EUR 1801 to EUR 2600	0.6135** (0.25)	0.6135** (0.27)
more than EUR 2600	0.8677*** (0.27)	0.8677*** (0.30)
WEALTH_CAT		
20000-40000	-0.5048** (0.23)	-0.5048** (0.23)
40000-60000	-0.1612 (0.23)	-0.1612 (0.23)
60000-80000	-0.2078 (0.27)	-0.2078 (0.27)
80000-100000	-0.2716 (0.26)	-0.2716 (0.25)
100000-120000	0.1935 (0.32)	0.1935 (0.29)
120000-140000	0.4694 (0.40)	0.4694 (0.34)

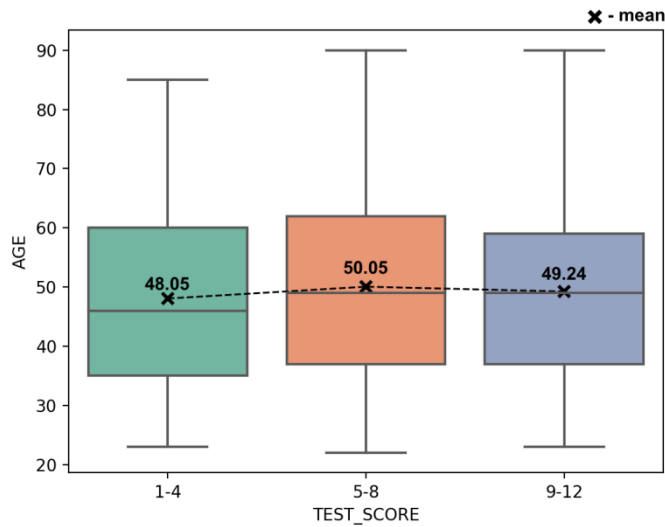
140000-200000	0.1317 (0.44)	0.1317 (0.37)
200000 and above	0.2503 (0.54)	0.2503 (0.51)
EDULEVEL		
secondary (up to 16)	0.2998 (0.32)	0.2998 (0.34)
secondary (up to 18)	1.4605*** (0.34)	1.4605*** (0.35)
vocational	0.6516* (0.33)	0.6516* (0.35)
professional bachelor	1.3253*** (0.33)	1.3253*** (0.34)
university	1.8170*** (0.35)	1.8170*** (0.35)
AGE	0.0627** (0.03)	0.0627** (0.03)
AGE ²	-0.0007*** (0.00)	-0.0007*** (0.00)
PARTNER	-0.0478 (0.17)	-0.0478 (0.18)
GENDER	-0.9371*** (0.14)	-0.9371*** (0.14)
CHILD	-0.4522*** (0.15)	-0.4522*** (0.16)
RISK_TOLERANCE	0.3012*** (0.04)	0.3012*** (0.04)
TRACKING	0.1808** (0.07)	0.1808** (0.07)
THOUGHTOLDAGE	0.2477*** (0.09)	0.2477*** (0.09)
SELFEMPLOYED	0.3578 (0.30)	0.3578 (0.29)
OWNHOUSE	0.3380** (0.15)	0.3380** (0.15)
Constant	2.756** (3.26)	2.756*** (3.36)
Observations	1532	1532

* p<0.10, ** p<0.05, *** p<0.01; standard errors in parenthesis.

Transformations

In the model, a new variable was generated which is the square of the participant's age: age². The square of age was included as a regressor because age often presents a non-linear relationship with the dependent variable. To verify if this is the case in our dataset, TEST_SCORE was divided into three bands: scores 1-4, scores 5-8, and scores 9-12. Then, the average age of each group was taken. The analysis confirmed that AGE indeed shows a non-linear behaviour for different score categories. The mean age is 48.05 for the first group, then it increases to 50.05 for those who scored between 5 and 8 points, then it drops to 49.24 for the group with the highest scores (Figure 4.8).

Figure 4.8
Boxplot of AGE by TEST_SCORE Bands



As expected, the estimations showed that age had a significant and positive coefficient and age^2 had a significant but negative coefficient (Table 4.23). Thus, the regression curve of TEST_SCORE and age forms a parabola: the middle-aged people scored higher points on average; but younger and older people scored lower points on the objective test. By including both age and age^2 , this variable can be modelled more accurately.

4.4.3 Model Results

The treatment of outliers and missing values were discussed in Section 3.7.1.11. The final regression estimation is presented as Table 4.24. These results make use of a heteroskedasticity-robust White estimator and use the median of TEST_SCORE imputed in place of outliers.

Table 4.24
Financial Literacy Determinants Regression Estimation

	TEST_SCORE
INCOMECAT	
from EUR 1151 to EUR 1800	0.5290** (0.24)
from EUR 1801 to EUR 2600	0.6709** (0.26)
more than EUR 2600	0.9408*** (0.28)
WEALTHCAT	
20000-40000	-0.5070** (0.23)
40000-60000	-0.1744 (0.22)
60000-80000	-0.2150 (0.26)
80000-100000	-0.3094 (0.25)
100000-120000	0.1374 (0.28)
120000-140000	0.3676 (0.33)
140000-200000	0.0629 (0.36)
200000 and above	-0.0088 (0.46)
EDULEVEL	
secondary (up to 16)	0.3823 (0.32)
secondary (up to 18)	1.5522*** (0.33)
vocational	0.6806** (0.33)
professional bachelor	1.4255*** (0.33)
university	1.9312***
AGE	0.0650** (0.03)
AGE ²	-0.0008*** (0.00)
PARTNER	-0.0366 (0.17)
GENDER (female)	-0.9700*** (0.14)
CHILD	-0.4703*** (0.16)
RISK_TOLERANCE	0.3011*** (0.04)
TRACKING	0.2015*** (0.07)
THOUGHTOLDAGE	0.2694*** (0.09)
SELFEMPLOYED	0.2672 (0.28)
OWNHOUSE	0.3348** (0.15)
Constant	2.4588*** (0.80)
Observations	1532
R ²	0.2432

* p<0.10, ** p<0.05, *** p<0.01; Robust standard errors in parentheses.

The results show that the level of net income is a strong predictor of financial literacy score. The relationship is positive and is more significant at the highest income level. Wealth, however, is generally insignificant except for the lowest wealth category. Having accumulated wealth between 20,000 and 40,000 EUR decreases the financial literacy score by 0.5 holding other variables constant. The relationship between education and financial literacy is positive and significant for all but the first category, which was expected. The coefficients of age and age² variables are also providing the expected signals, attesting that the relationship between age and TEST_SCORE is non-linear. The PARTNER variable is not significant in this model. The results also show that men are more financially literate than women on average. The child dummy variable is negative and significant, which is different from what we expected. The natural supposition is that parents are more concerned about the future than single people, so they should be more knowledgeable about financial instruments than the average. However, the negative signal can be explained. Parents usually have more monthly expenses than single people, which can lead to having less money left to invest in assets, all other things equal.

The variables related to risk tolerance, tracking spending, and thinking about old age are all positive and significant, showing that personality aspects and behaviours related to organising one's finances are directly connected to financial literacy. The dummy variable which informs whether the person is self-employed or an entrepreneur is not significant. On the other hand, owning a house instead of renting seems to be a strong predictor of higher financial knowledge.

The observed relationships resulting from the determinants of the financial literacy model are discussed within the context of related academic literature in Chapter 6.

4.5 Univariate Analysis – Objective Financial Literacy and Stockholding

This subsection explores how financial literacy affects stockholding. Probit regression technique is used to estimate the proposed linear model.

4.5.1 Model Development Process

Let i be the index of household representative in the sample. The base model is:

Stockholding_i

$$\begin{aligned} &= \beta_0 + \beta_1 TEST_SCORE_i + \beta_2 INCOMECAT_i + \beta_3 WEALTHCAT_i \\ &+ \beta_4 EDULEVEL_i + \beta_5 AGE_i + \beta_6 AGE_i^2 + \beta_7 PARTNER_i \\ &+ \beta_8 GENDER_i + \beta_9 CHILD_i + \beta_{10} RISK_TOLERANCE_i \\ &+ \beta_{11} TRACKING_i + \beta_{12} THOUGHTOLDAGE_i + \beta_{13} SELFEMPLOYED_i \\ &+ \beta_{14} OWNHOUSE_i + \varepsilon_i \end{aligned}$$

To understand how financial literacy impacts stockholding, an objective financial literacy test score is used as the main explanatory variable. The test score variable measures how many questions the participants answered correctly. As the test had 12 questions, this variable ranges from 0 to 12. Two regressions with two dependent binary variables: direct stockholding (STOCK_DIRECT) and indirect stockholding (STOCK_INDIRECT) were performed. These are variables valued with 0 or 1, in which 1 indicates ownership of stocks. The models for each dependent variable were estimated separately.

To isolate the effect of TEST_SCORE on stockholding, there are several control variables in the model. These are the same regressors used in the determinants of financial literacy model in the previous sections (see Sections 3.7.1.10 and 4.4.1).

4.5.2 Endogeneity and Instrumental Variables Regressions

Even when controlling for several confounding variables, OLS estimations can still suffer from endogeneity problems. For instance, one could argue that our model suffers from reverse causality. It is clear that financial literacy can affect stockholding; but the opposite may also be true: for example, someone with no financial literacy, who suddenly receives stocks by heritage, can be encouraged to study and learn about financial instruments. Moreover, it is possible that we have not considered influential factors as control variables. By omitting them, these variables produce bias in the estimations.

To explore endogeneity problems, a stockholding model is estimated with instrumental variables via maximum likelihood. Two instruments were used.

The first one is a categorical variable that measures how much of the person's education was focused on business. This is the main instrument. The survey question is 'How much attention was paid to business/economics in your education?' to which participants answered 1 for 'much', 2 for 'somewhat', 3 for 'little', and 4 for 'virtually no'. As argued in the methodology section, the variable must satisfy both the relevance and the exclusion restriction to be a valid instrument. The fulfilment of the first criterion is direct: business education leads to better financial literacy, which is captured by the objective test. Both the correlation test and the F-test of the first stage of the IV estimation confirm this. The instrument also satisfies the second criterion as, conditional on our set of control variables, business education can only affect stockholding through its influence on financial literacy.

The second instrument is high school level of education. We built a dummy variable which is coded as 1 if the person has completed high school level, and 0 otherwise. This variable is a relevant instrument because people with high school education are prone to have better education overall than their counterparts, which include business and financial knowledge. Additionally, correlation analysis of the first stage variables show that the

instrumental variable is significantly correlated with the test score variable. The first stage F-test is approximately 129 (Table 4.25), which is well above the standard threshold of 10. It also confirms that the instrument is pertinent to our explanatory variable. The high school education dummy also satisfies the exclusion restriction because, conditioning on our control variables, there is no direct link between education level and stockholding – except for its influence on financial literacy. There is one warning for using this variable as an instrument. As the high school dummy is very correlated with the EDULEVEL variable, the EDULEVEL regressors were excluded when this instrument (i.e. the dummy) was included.

Next, the results of two regressions are presented: the first one only with business education as an instrument, and the second one with both business education and higher education as instruments.

With more instruments than endogenous regressors, it is possible to run an over-identification test to evaluate the joint exogeneity criterion of the instruments. In other words, this test verifies if the instruments are effectively uncorrelated with the error term, a fundamental requirement for an IV to be valid (the so-called ‘exclusion restriction’).

If the null hypothesis is rejected, it means that at least one of the instruments is correlated with the structural error, thus, it is invalid. The unreliable IV must be identified and discarded as an instrument. The variable should also be included in the second stage equation: as it is correlated with the error term, it has valuable information for the model.

On the contrary, if the null hypothesis is not rejected, there is evidence that the model is correctly specified, and the instruments are acceptable. As there are two instruments for one explanatory variable, the model is overidentified and the overidentification test can be run. The Amemiya-Lee-Newey minimum chi² statistic can be specifically used, an overidentification test compatible with the probit framework.

Table 4.25

Instrumental Variable Regression with One Instrument

	(1) STOCKS DIRECT	(2) STOCKS INDIRECT
TEST_SCORE	0.3736269*** (0.05)	0.1886710*** (0.05)
INCOMECAT		
from 1151 to 1800	-0.2929680* (0.17)	-0.1006737 (0.13)
from 1801 to 2600	-0.4255409** (0.19)	-0.2446583* (0.14)
more than 2600	-0.3592030* (0.20)	-0.1336930 (0.16)
WEALTHCAT		
20000-40000	-0.0304905 (0.16)	-0.0581313 (0.13)
40000-60000	0.2501344* (0.15)	0.2104885 (0.13)
60000-80000	0.2475818 (0.17)	0.0795194 (0.15)
80000-100000	0.3603220** (0.17)	0.3319999** (0.14)
100000-120000	0.7379649*** (0.20)	0.5422310*** (0.18)
120000-140000	0.9428485*** (0.33)	0.8829497*** (0.28)
140000-200000	0.8451386** (0.35)	0.5438775** (0.27)
200000 and above	1.0057941*** (0.39)	1.0028035*** (0.38)
EDULEVEL		
secondary (up to 16)	0.5899253 (0.37)	0.5233099** (0.21)
secondary (up to 18)	0.6197102 (0.40)	0.4821266** (0.23)
vocational	0.5319691 (0.38)	0.6550594*** (0.21)
professional bachelor	0.5379235 (0.39)	0.4960042** (0.22)
university	0.4279634 (0.41)	0.3605006 (0.24)
AGE	0.0273598 (0.02)	0.0000392 (0.02)
AGE ²	-0.0001547 (0.00)	0.0001506 (0.00)
PARTNER	0.0838621 (0.12)	-0.0441600 (0.09)
GENDER (female)	0.0653681 (0.11)	-0.0341750 (0.09)
CHILD	0.0064765 (0.11)	0.0991036 (0.09)
RISK_TOLERANCE	0.4753803*** (0.05)	0.1317417*** (0.03)
TRACKING	-0.0207646 (0.05)	-0.0154193 (0.04)
THOUGHTOLDAGE	-0.0061269 (0.07)	-0.0998573* (0.05)
SELFEMPLOYED	-0.0463074 (0.20)	-0.0297368 (0.16)
OWNHOUSE	0.0654545	0.0541163

	(0.11)	(0.09)
Constant	-6.8529299***	-2.4182373***
	(0.69)	(0.50)
Observations	1518	1518
First stage F	129.16479	129.16479

Robust standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table 4.25 presents the results for the stockholding model estimation using business education as the instrumental variable. The relationship of TEST_SCORE with both STOCK_DIRECT and STOCK_INDIRECT is positive and significant. The coefficient for STOCK_DIRECT is approximately twice as large as the one for STOCK_INDIRECT, indicating that the effect of financial literacy is stronger on direct ownership of stocks. Income, wealth, and risk tolerance are significant control variables overall, while education levels and thinking about old age are only significant when the dependent variable is STOCK_INDIRECT. The first stage F statistic is 129.16, which confirm the relevance of business education data to predict objective financial literacy.

Table 4.26
Instrumental Variable Regression with Two Instruments

	(1) STOCKS DIRECT	(2) STOCKS INDIRECT
TEST_SCORE	0.3650311*** (0.05)	0.1710145*** (0.04)
INCOMECAT		
from 1151 to 1800	-0.2630802 (0.17)	-0.0518881 (0.13)
from 1801 to 2600	-0.3901251** (0.19)	-0.1864842 (0.14)
more than 2600	-0.3329785* (0.20)	-0.0985885 (0.16)
WEALTHCAT		
20000-40000	-0.0236078 (0.16)	-0.0654424 (0.13)
40000-60000	0.2748348* (0.15)	0.2235707* (0.13)
60000-80000	0.2781624 (0.17)	0.0954590 (0.14)
80000-100000	0.3671753** (0.17)	0.3365915** (0.14)
100000-120000	0.7699601*** (0.20)	0.5508064*** (0.18)
120000-140000	0.9846694*** (0.34)	0.8875598*** (0.28)
140000-200000	0.8303855** (0.34)	0.5055500* (0.27)
200000 and above	0.9457959** (0.38)	0.8959853** (0.38)

AGE	0.0288932 (0.02)	0.0020365 (0.02)
AGE ²	-0.0001727 (0.00)	0.0001135 (0.00)
PARTNER	0.0918662 (0.12)	-0.0383482 (0.09)
GENDER (female)	0.0654493 (0.11)	-0.0579969 (0.09)
CHILD	0.0067187 (0.11)	0.1008377 (0.09)
RISK_TOLERANCE	0.4806234*** (0.05)	0.1382963*** (0.03)
TRACKING	-0.0141898 (0.05)	-0.0116299 (0.04)
THOUGHTOLDAGE	0.0046247 (0.07)	-0.0854990 (0.05)
SELFEMPLOYED	-0.0538896 (0.20)	-0.0333694 (0.17)
OWNHOUSE	0.0720668 (0.11)	0.0791602 (0.09)
Constant	-6.4131237*** (0.63)	-1.9282802*** (0.49)
Observations	1519	1519
Over-id test p-value	0.5399	0.3201
First stage F	82.536482	82.536482

Robust standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table 4.26 presents the results for the IV regressions with two instruments. The result is remarkably similar to the one-instrument case for both dependent variables, which shows the robustness of these results.

When there is more than one IV for a single regressor, it is possible to perform an over-identification test. This test assesses whether at least one of the instruments does not meet the exclusion constraint. Rejection of the null means that at least one of the IVs is invalid; therefore, non-rejection of the null hypothesis indicates that researcher can interpret the estimated significant coefficients as causal relationships. The p-values of the over-identification tests are well above the significance range (p-value > 0.1), showing that the null hypothesis is not rejected either for STOCK_DIRECT nor STOCK_INDIRECT. As the test did not invalidate the instruments, there is robust evidence that TEST_SCORE has a causal effect on stockholding.

Endogeneity Test

The probit regression with instrumental variables method allows us to run the Wald test of exogeneity. In this test, the null hypothesis states that there is no endogeneity. Not rejecting the null hypothesis means that there is not enough evidence to use an instrumental variables approach; thus, an ordinary probit regression is more appropriated.

We ran the test for both dependent variables and using one and two instruments. The results are summarised in Table 4.27. The null hypothesis was not rejected in any regression. A conclusion is that instrumental variables are not necessary in this case; a probit regression is sufficient.

Table 4.27
Results of the Wald test of Exogeneity

Dependent variable/Instruments	One		Two	
	One		Two	
STOCKS_DIRECT	chi2(1) = 2.08; Prob > chi2 = 0.1493		chi2(1) = 2.12; Prob > chi2 = 0.1454	
STOCKS_INDIRECT	chi2(1) = 0.98; Prob > chi2 = 0.3221		chi2(1) = 0.57; Prob > chi2 = 0.4508	

4.5.3 Probit Regression

As the Wald test did not confirm the presence of endogeneity, it allows us to proceed with conducting ordinary probit regressions. As IV methods are not needed, the ordinary method should produce smaller standard errors; thus more precise estimations.

4.5.3.1 Assessment of the model fit

Before discussing the estimation results, the fit of the final model is evaluated. First, the pseudo-R squared is discussed. Second, the presence of heteroskedasticity is verified. Regarding other assessment tools – multicollinearity evaluation, data transformations, outlier's verification, and missing data – the results from the previous section are borrowed and incorporated into this model. As the right-hand sides of the model's equations are the same, these results are equivalent.

Pseudo-R squared

The dataset for the stockholding model has 1,532 observations. As probit estimations are calculated via maximum likelihood, and not by minimising variance, as in the OLS case, we cannot use standard R^2 to assess the model fit. Therefore, an alternative metric which behaves similarly to the R^2 is needed: the pseudo- R^2 measure. This section follows the approach of McFadden (1974). The maximised likelihood function of the model with only the intercept is compared with the maximised likelihood function of the whole model. The resulting value will be between 0 and 1, and it will reflect how well does the data explain the variation of the dependent variable.

Our model can explain 43.8% of the variation of the STOCK_DIRECT variable (Pseudo- $R^2 = 0.483$), capturing a lot of the variation of direct stockholding information. For indirect stockholding, the regressors explain 16.5% (Pseudo- $R^2 = 0.165$) of the variation of the dependent variable. Although this value is smaller than what we have obtained for direct stockholding, it is expected that indirect stockholders are harder to determine from

sociodemographic variables than direct stockholders. Direct stockholders form a much narrower group of people with specific traits and financial literacy background, as the results will show in the following sections.

4.5.3.2 Heteroskedasticity

This subsection evaluates if the models are heteroskedastic and obtains solutions to the problem.

As discussed in an earlier section, heteroscedasticity is when the covariates influence the dispersion of the errors. In OLS models, non-constant variance will distort the estimated variances; but will not change the estimated coefficients. In binary-response models, however; heteroscedasticity also affects the coefficients, aggravating the problem. In order to correct for heteroskedasticity in a probit model, a heteroskedasticity-robust estimator, like the White estimator, cannot be used. Instead, a model describing how the regressors affect the variance of the observations must be proposed.

To test for heteroskedasticity in a probit model, a variance model including all regressors is proposed. Then, a Likelihood-ratio test is run. Rejection of the null indicates that the variance is non-constant and a proper model for the variance needs to be searched for.

Appendix G shows the results of the first estimation, in which heteroskedasticity is tested. The table is divided into two sections: ‘Main model’ shows estimations for the primary model, while ‘Variance model’ presents the estimations in which the variance is the dependent variable. The bottom of the table shows the likelihood-ratio test. The null for both models are rejected with a high level of significance (significant at 1%), indicating the presence of heteroskedasticity.

To model the heteroskedasticity, it is possible to use one regressor, all regressors, or any numbers in between. To avoid any arbitrariness, the models using an objective method are chosen: a stepwise algorithm, following Williams (2010). The algorithm started with an empty

model for the variance and progressively added variables if they showed a significance of at least 0.05. Distinct variance models for the models related to the two dependent variables were obtained. The results are presented in Table 4.28. For STOCK_DIRECT, the variance is modelled by the wealth categories ‘€120,000-140,000’ and ‘€200,000 and above’, by the education category ‘university’, and by the variable RISK_TOLERANCE. For the STOCK_INDIRECT variable, we model the variances with a simpler model: TEST_SCORE, RISK_TOLERANCE and the income category ‘more than €2,600’ are its regressors.

Table 4.28
Probit Model Results

	(1) STOCKS_DIRECT	(2) STOCKS_INDIRECT
	Main model	
TEST_SCORE	0.1690739*** (0.03)	0.0554534*** (0.01)
INCOMECAT		
from 1151 to 1800	-0.1378901 (0.10)	-0.0232423 (0.04)
from 1801 to 2600	-0.2219834** (0.11)	-0.0969345* (0.05)
more than 2600	-0.1526588 (0.11)	-0.0000963 (0.06)
WEALTHCAT		
20000-40000	-0.0518448 (0.10)	-0.0301693 (0.05)
40000-60000	0.1296332 (0.10)	0.0569958 (0.05)
60000-80000	0.0987475 (0.12)	0.0095690 (0.05)
80000-100000	0.1586747 (0.11)	0.1083220* (0.06)
100000-120000	0.3776797** (0.15)	0.1849453** (0.08)
120000-140000	1.0458268* (0.61)	0.2622685** (0.13)
140000-200000	0.3148952 (0.22)	0.2240605 (0.14)
200000 and above	0.3443859 (0.31)	0.4453183* (0.24)
EDULEVEL		
secondary (up to 16)	0.4389055** (0.19)	0.2579626*** (0.09)
secondary (up to 18)	0.4973604** (0.20)	0.2540589*** (0.09)
vocational	0.4230229** (0.20)	0.3167698*** (0.10)
professional bachelor	0.4406325** (0.19)	0.2616620*** (0.09)
university	0.3904869* (0.20)	0.2047369** (0.09)

AGE	0.0239119*	-0.0023007
	(0.01)	(0.01)
AGE2	-0.0001723	0.0000776
	(0.00)	(0.00)
PARTNER	0.0561546	-0.0242237
	(0.07)	(0.03)
GENDER	-0.0197327	-0.0363229
	(0.06)	(0.03)
CHILD	-0.0079534	0.0406210
	(0.06)	(0.03)
RISK_TOLERANCE	0.3485745***	0.0541911***
	(0.05)	(0.02)
TRACKING	0.0111116	0.0045382
	(0.03)	(0.01)
THOUGHTOLDAGE	0.0224454	-0.0287521
	(0.04)	(0.02)
SELFEMPLOYED	0.0153966	0.0315353
	(0.12)	(0.07)
OWNHOUSE	0.0380164	0.0345512
	(0.06)	(0.03)
Constant	-4.413878***	-0.910713***
	(0.73)	(0.27)
<hr/>		
Variance model		
TEST_SCORE		-0.0661453**
		(0.03)
WEALTHCAT		
120000-140000	0.9342185**	
	(0.46)	
200000 and above	-0.6650996	
	(0.78)	
RISK_TOLERANCE	-0.1339418***	-0.1593469***
	(0.04)	(0.05)
INCOMECAT		
more than 2600		0.5707585***
		(0.19)
EDULEVEL		
university	0.3467815**	
	(0.16)	
<hr/>		
N	1532	1532
Likelihood-ratio test	0.449	0.181
<hr/>		

Robust standard errors in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

4.5.3.3 Discussion

As Table 4.28 presents the coefficients from the probit models corrected for heteroskedasticity, these are the models to be analysed. The TEST_SCORE variable has a significant and positive effect on both direct and indirect stockholding, and the impact on direct ownership is much larger than on indirect stockholding – 0.17 for STOCKS_DIRECT while 0.05 for STOCKS_INDIRECT.

The ‘EUR 1,801 to EUR 2,600’ was the only significant income category. Its sign showed a negative impact of this specific income interval on both dependent variables. The other income levels do not seem to have an impact on stockholding.

Among the wealth categories, we obtained significant results for the categories ‘80,000-100,000’ (for STOCKS_DIRECT only), ‘100,000-120,000’, ‘120,000-140,000’, and for ‘200,000 and above’ (for STOCKS_INDIRECT only). The significant coefficients are all positive, which means that there is a positive and robust relationship between income and stockholding. The point estimates are also higher for higher levels of wealth, showing that wealthier people are more inclined to invest in stocks.

Regarding education, all categories were positive and significant. The ‘secondary (up to 18)’ level had the largest coefficient for direct stockholding, while ‘vocational’ was the education level with most impact on indirect stockholding. These results show how education level is relevant to investments.

Age showed a positive and significant coefficient, but only for STOCKS_DIRECT. Neither PARTNER, CHILD nor GENDER got significant estimations. Risk tolerance was positive and significant for both dependent variables, showing a direct correlation between investing and being willing to take risks. THOUGHTOLDAGE and TRACKING were also insignificant, as well as being an employer or an entrepreneur (SELFEMPLOYED) and owning a house (OWNHOUSE).

Probit coefficients are not straightforward to interpret. For this reason, Table 4.29 presents the average marginal effects (AME) of TEST_SCORE for both models. For STOCK_DIRECT, an increase of one point on the financial test score improves the probability of one owning direct stocks by 6.2 percentage points. Higher test scores also have a positive impact on the likelihood of owning indirect stocks, albeit lower: around 4.2 percentage points.

Table 4.29
Average Marginal Effects of TEST_SCORE

Dependent variable	dy/dx	Std. Err.	z	P> z	[95% Conf. Interval]
STOCK_DIRECT	0.0622315	0.004574	13.61	0.000	[0.0532666, 0.0711964]
STOCK_INDIRECT	0.0423999	0.0042309	10.02	0.000	[0.0341075, 0.0506922]

Figure 4.9 and Figure 4.10 show how the marginal effects vary with TEST_SCORE. It is interesting to notice how sensitive the odds of STOCKS_DIRECT are to test scores. For scores close to zero, the probability of direct stock ownership is also very close to zero. However, as TEST_SCORE gets higher, the odds increase at an exponential rate. STOCK_INDIRECT, on the contrary, shows different behaviour. Even though it also has a positive relationship with TEST_SCORE, its curve starts at a much higher level of probability: even at the lowest scores, a one-point increase in the test score raises the likelihood of indirect stock ownership in at least 0.2 percentage points. From there, the curve increases at an almost linear pace, which explains why the average marginal effect is close to the TEST_SCORE probit coefficient (Table 4.28).

The results show that financial literacy – as measured by the financial test – has a significant impact on stock holding. This hypothesis was evaluated through several models and estimation techniques. The results remained positive and significant when using causality identification methods and even after including many control variables.

Figure 4.9
Marginal Effects of STOCK_DIRECT for each TEST_SCORE Value

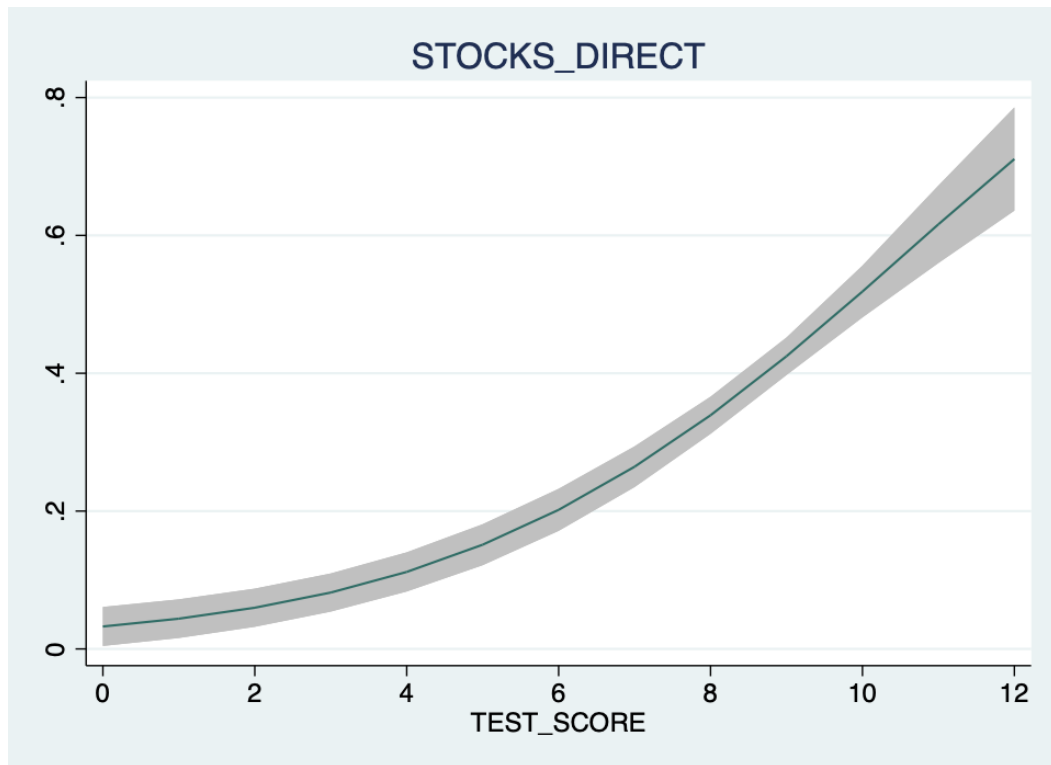


Figure 4.10
Marginal Effects of STOCK_INDIRECT for each TEST_SCORE Value

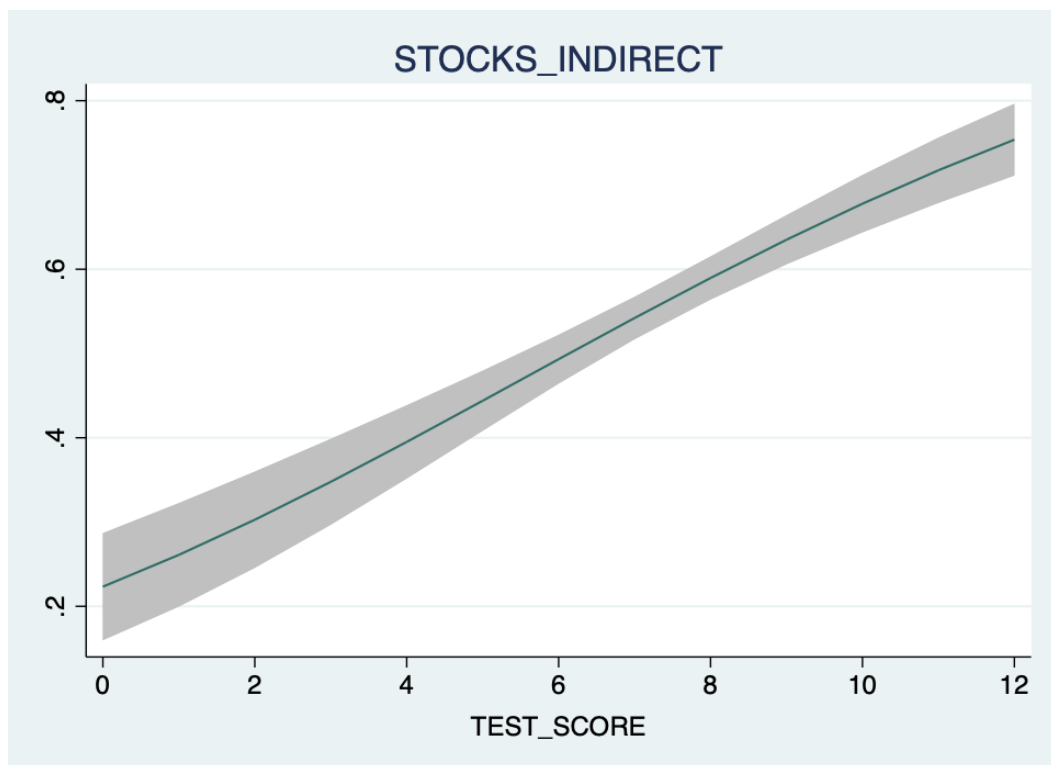


Table 4.30 presents the AME for the remaining significant regressors. According to Greene (2009), ‘an empirical conundrum can arise when doing inference about partial effects rather than coefficients.’ He argues that one should give preference to the hypothesis test of the coefficients rather than of the marginal effects. That is why, in Table 4.30, the stars next to the marginal values stand for the significance of their respective coefficients. The statistical significance of the marginal effects was omitted.

Among the income categories, only the ‘EUR 1,801 to EUR 2,600’ range was significant, for both models. The estimated values indicate that, when compared to the lowest income category, earning an income in the ‘EUR 1,801 to EUR 2,600’ range diminishes the odds of one acquiring stock by 7 and 6 percentage points for direct and indirect stocks, respectively.

Regarding wealth, a wealth of at least EUR 80,000 already causes an impact on the indirect stock ownership, increasing its ownership probability by 11.3 percentage points. But the largest effect was for the ‘120,000-140,000’ wealth range: when compared to the lowest wealth category, the probability of owning an indirect stock is 50 percentage points higher for them.

Regarding education level, all levels show a positive marginal effect, for both dependent variables. The relationship is also non-linear. For direct stockholding, it increases with the education level, peaks at ‘professional bachelor’, and then reduces. For indirect stockholding, it peaks at ‘vocational’, reduces at ‘professional bachelor’, and then rises again at the ‘prouniversity’ level.

The only other variables that presented significant effects were AGE and RISK_TOLERANCE. AGE is only significant for STOCKS_DIRECT. Although RISK_TOLERANCE is significant for both variables, this trait is much more important for STOCKS_DIRECT than for STOCKS_INDIRECT ownership probability.

Table 4.30
Average Marginal Effects

	(1)	(2)
	<u>STOCKS_DIRECT</u>	<u>STOCKS_INDIRECT</u>
NETTOHHINCOME		
from 1801 to 2600	-0.0750269**	-0.0654208*
WEALTH_CAT		
80000-100000		0.113344*
100000-120000	0.1450313**	0.1475027**
120000-140000	0.1827402*	0.5084133**
200000 and above		0.1502329*
EDULEVEL		
secondary (up to 16)	0.1401743**	0.1882346***
secondary (up to 18)	0.164641**	0.1900824***
vocational	0.1374989**	0.2345446***
professional bachelor	0.1415922**	0.192493***
university	0.1279519*	0.2465081**
AGE	0.0061157*	
RISK_TOLERANCE	0.103443***	0.0529622***

* p<0.10, ** p<0.05, *** p<0.01. Variables that were insignificant were omitted from the table.

4.6 Additional Research Findings

4.6.1 Information Acquisition

This section explores two specific questions of the survey ‘How do you most often acquire knowledge or information when you choose investment products?’ and ‘How often do you acquire financial and economic information from sources such as newspapers, magazines, television, and the Internet?’ and their relationship. Figure 4.11 presents the frequency of media consumption by source of information.

For those who seek economic content every day, the internet is clearly the main source of information acquisition. TV/radio, newspapers, and magazines come in second; but the distance between first and second places is remarkable. After another gap, family

members/friends and financial advisor come in third and fourth places, with only a small difference between the two. Lectures/seminars, and pamphlets/brochures come in last place.

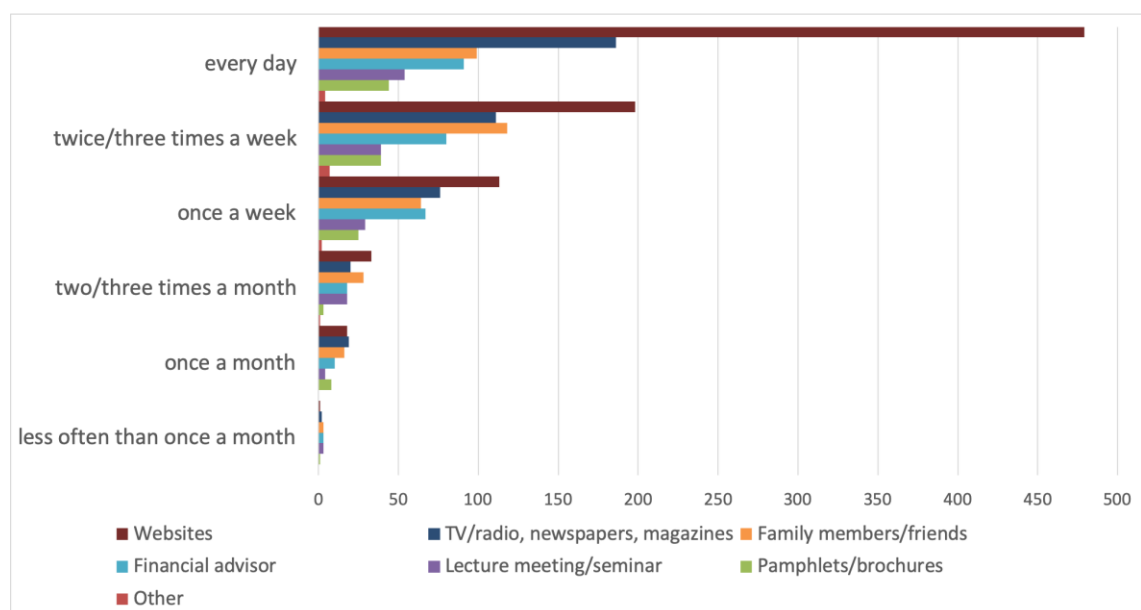
For those who consume financial content twice/three times a week, the main source of information access still is the internet. However, fewer people gave this answer compared to those who access information every day. For this group, family members/friends are more important information sources than TV/radio, newspapers, and magazines, and more relevant than financial advisors.

For those who look for economic content only once a week, the internet and traditional media still play a key role. Yet, different from those who consume information more often, here financial advisors have more relevancy than family members/friends.

For people who obtain financial information with less frequency than once a week, the figure shows that the disparities between medias tend to shrink. For those who answered ‘once a month’, the values for websites, TV/radio, newspapers, and magazines, and family members/friends are very similar.

Figure 4.11

Frequency of Access to Financial Information by Source



4.6.2 Financial Literacy and Other Financial Outcomes

Even though financial literacy and portfolio choice are the main research subjects within this dissertation, a few other data points provided by the bank were included in order to capture some financial behaviours. Those include whether a household has an emergency fund, have a savings account with a positive balance, have thought about retirement, have a private pension account. Hilgert, Hogarth, and Beverly (2003) have classified such financial outcomes as long-term financial behaviours because the outcomes are delayed. For example, an emergency fund would be only utilised after the actual emergency manifests itself. Such behaviours are important to analyse because if mistakes in investment or financial management are made it would be extremely difficult, if not impossible, to remedy the situation. A household that did not adequately prepare for retirement cannot go back in time and adjust the savings rate. The relationship between the level of financial literacy and behavioural financial outcomes are presented below.

Table 4.31
Financial Literacy and Other Financial Outcomes

	Sample		Low OFL		High OFL		Diff. between High and Low
Outcome	Count	Proportion	Count	Prop.	Count	Prop.	Signif.
Emergency fund	971	0.6248	283	0.5463	406	0.7838	***
Savings account	1227	0.7896	349	0.6737	431	0.8320	***
Thought about retirement	660	0.4247	166	0.3205	254	0.4903	***
Have private pension	385	0.2477	76	0.1467	179	0.3456	***
Total	1554		518		518		

*** $p < 0.01$, ** $p < 0.05$ * $p < 0.1$

According to the Table 4.31, 62.5% of the sample have an emergency fund, 79% have an active savings account (non-dormant, has a positive balance), 42.5% have thought about retirement and 24.8% have a private pension account. Further analysis demonstrated that 96.3%

of those that have contributed money to the private pension funds also appear within those who thought about retirement group. 99.1% of those who reported having an emergency fund also appeared in the savings account group.

The whole sample was divided into three equal subsamples according to the objective financial literacy test score. One third of those who scored the worst were included in the 'Low OFL' subsample and another third of those who scored the best were included in the 'High OFL' subsample. This was done in order to evaluate whether those who have higher financial literacy are likely to engage in positive long-term financial behaviours more. The results from the Table 4.31 confirmed that this is the case: 78% of those who had high financial literacy score created an emergency fund as opposed to 55% with low financial literacy. Similar distinction can be made regarding the presence of a savings account: 83% of high literacy score participants reported having one as opposed to 67% with low financial literacy score. One of the questionnaire questions inquired as to what the optimal amount of emergency fund is. As expected, the answers were very varied ranging from 10,000 Swedish krona (approximately 935 EUR or 825 GBP) up to 300,000 kronor (approximately 28,000 EUR or 24,700 GBP) with a median of approximately 140,000 Swedish kronor. As it can be seen from the table, more financially literate people think about retirement (49% v. 32%) and contribute to the private pension funds (35% v. 15%).

4.7 Summary

This chapter provided an overview of the quantitative analysis performed with a dataset provided by the commercial bank in Sweden. At first the financial literacy test was analysed from a viewpoint of the classical test theory and the item response theory. The analysis confirmed the validity of the instrument. Once the results of the financial literacy test were tabulated, it was discovered that the households in the sample had a relatively fine level of financial literacy with a mean of 7.3 and median of 8 on a 0 to 12 scale. It was discovered that there is a correlation of 0.3301 between self-reported financial literacy and objective score on the financial literacy test. The regression analysis of various determinants of financial literacy was performed where income, education, age, gender, having children, risk tolerance level, thinking about old age, and tracking household spending turned out to be significant determinants of the objective financial literacy score. A probit regression was performed to estimate the impact of the objective financial literacy on both the direct and indirect stockholding. The results confirmed that financial literacy level had an impact on participation in the stock markets.

Chapter 5. Qualitative Analysis

This section presents the findings from the qualitative analysis part of the study. As discussed previously, households' financial decisions are influenced by many behavioural and attitudinal factors that are difficult to capture within the limited data which are typically collected through surveys. Moreover, as discussed in the literature review, households are very heterogeneous in their behaviour, which adds further complexity in the analysis of their financial outcomes. This chapter expands the analysis conducted in the previous chapter by focusing on the process by which financial knowledge is acquired, and seeks to understand the barriers households may face during that process. It revisits the determinants of financial literacy studied in the previous chapter by focusing on relationships that may not have been captured by the regression analysis. Additionally, it aims to fulfil the fifth objective of the thesis, which is to understand the role of financial advisors in transferring financial knowledge, and to understand whether financial advisors can help mitigate the effects of low financial literacy.

5.1 Data Sample

Eight financial advisors were interviewed during the summer of 2019. Five of them are affiliated with the same banking institution that provided the dataset. All of them have at least four years of experience working with clients face-to-face and they have a combined total of 61 years of experience giving financial advice and 77 years of experience within the financial sector. One person is a financial advisor at the competing financial institution who spent 11 years working as a personal banker/financial advisor. For the last two years, the person is engaged with advising the high net-worth individuals. The other two are independent financial advisors that have the brokerage and financial advisor licenses. Both run financial advisory companies focusing on major household financial services including investment allocation and management. Both have a combined 27 years of experience in the financial markets/services.

The gender distribution of interviewees is five males and three females. The average age is 32, years with 26 being the youngest and 47 being the oldest. All eight have a business or finance related higher education. Four have master's degrees or higher. Five of them have changed employers in the current profession at least once. Three do not work in the capital city. Advisor profiles are provided in Appendix D.

The choice of financial advisors (FA) for interviews as opposed to the households was made for the following reasons. First of all, personal bankers/financial advisors in Sweden have a much more profound relationship with their clients as opposed to other Western European countries. An FA is assigned to a person who becomes a client of the bank from the very beginning, and it is this person with whom the client will interact if he or she wants to acquire any product from the financial institution. According to the data provided by the bank, 92% of customers have had a personal banker assigned within the past ten years and 82% of the households met with him or her at least once in a year. This process encourages trust and provides consistency within the financial services offered.

Second, interviewing the households themselves might be challenging. Given their heterogeneity (age, education, wealth, employment, family status, and other) a sample of at least 100 people would be required. Even then, given the time constraint per interview, the researcher might not be able to assemble the complete picture and map the financial behaviour. As the sample would be drawn from the bank's database, the identities of the customers would be revealed which is an undesirable outcome given the current regulatory environment within the European Union.

Third, since many households in developed countries have access to and use the financial advice, the decision whether to invest in a particular asset class can be influenced by their financial advisors and the cognitive decision-making boundaries are blended as result. Advisers themselves might have a better grasp of how a particular decision was derived.

The interview structure and procedures were consistent with hypothetico-deductive method described in the methodology chapter. As the interviewee sample pool was relatively small it was decided against usage of the professional software (such as NVIVO for example). The data segmentation and categorisation was done by the researcher twice: after the first batch of four interviews (to include additional questions) and at the very end of the last batch. Mind-mapping was used to account for other themes that influenced the stockholding decision.

5.2 Level and Importance of Financial Literacy

The first theme that was explored during the interviews was financial literacy, and in particular, whether financial advisors believed that their clients had a good level of financial literacy, whether it was important to be financially literate, and whether the level of financial literacy had changed over the years.

All of the financial advisers agreed that having a high level of financial literacy is important for achieving the desired financial outcomes. According to FA1: 'If they [customers] come to us knowing the basics, we can spend more of a valuable time explaining the products or investments as opposed to educating them on the basics. In the same way, FA5: 'Financially literate customers certainly make our life easier'.

A majority (six) of the FAs agreed that it is the basic financial literacy that is more important than advanced financial literacy. The rationale being that households that possess at least the basic understanding of financial world can advance their knowledge if they wish while those who know nothing require much more effort and time to catch up.

All the financial advisors interviewed agree that the level of financial literacy has increased over the years. Their clients became more finance-savvy and started to 'ask the right questions' (FA3). While three interviewees attributed that to the 2008 financial crisis that significantly diminished the wealth of some of the households, two others praised the initiatives implemented in the secondary schools. Furthermore, FA4 mentioned the mass proliferation of

technology: ‘I think there is no excuse to learn at least a little bit about financial world these days – you are surrounded by the news on Facebook, Twitter, news portals’.

Financial advisors were then presented with the aggregated results of the financial literacy scores and were asked to comment on them. Five of the advisers said that they were expecting them to be worse, two - about the same and one was hoping the level of financial literacy would be better. Such pessimism on behalf of advisers was not expected but could be explained by the limited exposure that they have to the clients with the lowest financial literacy levels.

5.3 Financial Literacy Domains

The first objective of this thesis is to operationalise the concept of financial literacy by developing a coherent financial literacy test that properly measures financial literacy. Therefore, the interviewees were asked an open question that required them to name the key concepts that they would want their customers to know when making financial decisions. Table 5.1 below presents the concepts and the frequencies as well as the comments provided by the interviewees.

Table 5.1
Desirable Key Financial Concepts for Clients to Know

Concept	Mentions	Comments
Compound interest calculation – numeracy skill	8	‘so that they could appreciate the power of investing’; ‘to have an idea what a specific amount of money invested will grow to’
Diversification benefit – investment literacy	7	‘many people struggle to see why they need to have different asset(s) classes in the portfolio – they think I am trying to sell them more products than they need’
Basic understanding of asset classes	7	‘many clients can distinguish between a stock and a bond, but for their types or other instruments, they are clueless’
Different risk levels of asset classes – investment literacy	6	‘you cannot advance any further in portfolio construction if they [clients] do not know it’
Inflation	4	‘it eats into client’s return’; ‘a key variable to take into consideration for any long-term portfolio’
Mortgage interest – numeracy and debt literacy	3	‘how it’s calculated and why it goes up or down is crucial’

Government protection	3	‘not all accounts even within the same bank are protected the same way by the government’
Budgeting	2	‘even some good people can’t plan their expenditures well’; ‘if no money is left at the end of the month, nothing goes into retirement fund’
Fees and commissions	2	‘many customers fail to recognise that what they pay in fees and commissions reduces their return’
Insurance	2	‘no sound financial plan without the basic insurance’
Taxation	1	‘Taxation in Sweden is tough – I wish they knew the difference between how a capital gain and an income are taxed’
Financial environment	1	‘What Stefan [Ingves – current president of Sveriges Riksbank] says has an impact on mortgages, tax rates and pensions’

Source: Interviews conducted by the author

It is gratifying to learn that the concepts identified by the financial advisors as important were included in the financial literacy test administered. The concepts have also mapped well with the major frameworks developed by the OECD, JumpStart, and the NFEC as summarised in Table 2.6 of the literature review. As a majority of research projects have previously adopted Lusardi’s “Big 3” or “Big 5” questions, it is reassuring to know that these questions represent what practitioners expect (or wish) their clients to know.

Interesting discussions emerged when the interviewees were asked to comment on the relationship between self-reported and observed financial literacy scores, which sheds some additional light on the second objective of the thesis, namely, to differentiate between subjective and objective financial literacies. While all eight financial advisors predicted a positive correlation, five expected that it would be rather weak or statistically insignificant. These were the correlation coefficients that were guessed by the advisors in the ascending order: +0.05 +0.1 +0.15 +0.20 +0.20 +0.3 +0.4 +0.6. The two highest coefficient values were predicted by the independent financial advisors. It is possible that they generally have more financially literate clients due to their nature of work. Many advisers noted that their clients tend to exhibit overconfidence in their financial knowledge or skills. According to FA4: ‘Clients that come with their own ideas in mind can get agitated once you start highlighting the

risks or other factors that might taint the suitability of a particular investment to their portfolio’. Quite a few clients have only the basic financial literacy level, but believe they possess enough knowledge or skills to create and monitor a financial portfolio, when they do not (FA4, 6, 8). The mismatch between self-reported and objective financial literacy scores can also stem from the difference in perceptions or opinions as to what level of knowledge is sufficient to be called financially literate. While a person who balances his or her budget and is proud to report to be following the business news may call him/herself literate; the financial advisor who needs to work on portfolio construction might not find that knowledge sufficient.

5.4 Motivations for Engaging with a Financial Advisor

As is discussed earlier, financial literacy is a form of human capital that is accumulated over the years. People may acquire it through various sources (refer to Section 4.6.1 on information acquisition), although some might never achieve the level required to make optimal financial decisions. One of the potential remedies is reaching out for financial advice. A natural question arises – do those who have low financial literacy actively seek out financial advice, and how effective is such advice in terms of decision to invest into risky assets?

We first discussed the motivation of the households to seek financial advice in general as well as investment advice. The advisors were asked to identify if there is a particular demographic group that asks for advice more often. The majority of them mentioned that the most active group for general financial advice is usually those of 25-35 years of age, followed by 55-65; however, 35-45s seek investment advice more often. Younger people tend to be more interested in various savings products and mortgages (and occasionally pension funds and insurance products), while mid-aged people are inclined to be more interested in insurance and investment management. The interest for financial advice also sparks for the 65-75 age category primarily for bequest motives and estate planning. The independent financial advisors also mentioned that their clients tend to be more interested in various financial services

simultaneously as opposed to bank advisors who stated that customers usually enquire about a particular product or a service.

On average, the interviewees have met their clients on a yearly basis. Notably, both independent financial advisors confirmed that they typically meet with their clients more often – on average twice a year. All of the interviewees noted that in the majority of cases, the interactions are initiated by the clients themselves. The bank that provided the data, has implemented the electronic reminder system that notifies clients with the reminder if there was no interaction with the financial advisor for more than one year. Three advisors expressed their doubt as to whether this system is effective. According to FA2: ‘I have rarely seen a client who would schedule an appointment as a result of such a reminder’. A majority of the sessions are initiated by the clients when their personal circumstances change (change of work, marriage, childbirth etc.).

The interviewees were asked whether more or less financially literate people should require their services. No particular patterns were observed from their answers. According to FA4: ‘We get very different people here; from complete newbies who cannot distinguish between basic financial products to very sophisticated investors’. Obviously, the requirements of different segments of clientele vary. People with lower levels of financial literacy typically come to inquire about savings products, insurance, consumer debt and mortgages. Occasionally, they ‘might test out the waters’ (FA7) and inquire about investment opportunities. More financially literate people often come for mortgages and investment advice. All the advisers agreed that this group tends to be more independent, they prefer ‘to do the basics online’ (FA3); ‘quite a few already have some investment ideas or specific financial instruments in mind’ (FA1). Interestingly, both independent financial advisors thought that they get more financially literate people than their colleagues at the bank. According to FA8, ‘customers who pay for my services, want to get a better return from their money, naturally they do some research

beforehand not only about me, but also about the financial environment and opportunities available’.

5.5 Determinants of Financial Literacy

This section attempts to synthesise the quantitative results of the previous chapter with what advisers observe regarding the different demographic and psychographic variables impacting on financial literacy.

5.5.1 Age

After the interviews, it became apparent that the majority of the advisers’ clients are in the 25-35 and 55-65 age ranges. The younger cohort typically enquires about mortgages and savings. The older one is typically concerned with insurance and retirement planning/optimisation.

The interviewees were asked whether different age cohorts have different levels of financial literacy and whether hump-shaped distribution observed in our data (refer to Section 4.3.2) is observed by the financial advisers as well. Four advisers stated that younger people have very varying levels of financial knowledge. ‘Those younger people that have higher education or business-related degree, do very well’ (FA5). However, there are some who struggle to grasp how ‘interest works or why inflation is bad for savings’ (FA2). Few advisers mentioned that upbringing and family financial experiences are important. FA3 asked more financially literate younger people what motivated them to come today and how do they know what they know. “Very often I would hear something similar to ‘my dad/mom/aunt told me I need to get on a property ladder/start saving/learn about retirement plans’”. FA4 told a story about a client who said that her parents had to go through foreclosure when she was 12 years old and she made a promise to never have this happen to her or her own family again, which translated into elevated interest in financial literacy.

All the advisors suggested that the clients aged 30-35 years tend to be the most financially literate. Many of them have already used some financial services themselves and were able to observe the results of the savings/investment choices. Furthermore, they tend to be very active in following the news, reading business and financial publications (FA2, 8). These are the customers that ‘want to build solid foundations’ (FA1) for their future, more responsible towards their newly formed families (FA7). They are less ‘impatient’ (FA2) or influenced by social media (FA4). Most importantly they also have some disposable income that could be channelled into savings and investments.

Half of financial advisors pointed out that those in the 40-50 age cohort tend to exhibit medium financial literacy levels. ‘Their basic financial literacy levels are ok, but advanced financial literacy is certainly lagging behind’ (FA2). FA6 added that this could also be related to high levels of risk aversion at this age while other advisors lamented on the inertia in portfolio allocations exhibited by the clients in this age category. Once the investment portfolios are formed or retirement plans are chosen, there is little incentive to stay abreast of the developments in the financial markets.

5.5.2 Gender and Relationships

Having examined relationship with age, our interviews shifted to exploring the gender differences in financial literacy. Most of the interviewees agreed with the notion that women are less financially literate than men that consistently prevails within the literature. Furthermore, advisors also noted that women’s financial knowledge is more dispersed than men. FA8 argued that ‘many women either know nothing about finance or know a lot while most of men will know at least something’. It was further enquired as to why the advisers think this relationship prevails. Three common themes emerged in our discussions:

- a) Differences in *mathematical skills* was brought up by six advisors. It is commonly perceived that men are more likely to succeed in mathematics at school. Some

interviewees attributed this to better ‘biological’ predisposition for spatial reasoning for men (FA1,3,8). At the same time, such an observation or stereotype does not explain why the majority of accountants tend to be women (FA4). One of the interviewees brought up an interesting observation about the way we, as researchers, measure the financial literacy: ‘If majority of the questions are about numeracy, we will most likely not going to get the same results between genders’ (FA2).

- b) Differences in *risk aversion* levels. All advisors interviewed agreed that women, on average, tend to be more risk averse than men. According to FA1: ‘If any kind of investments are perceived as risky to some women, so what is the point of investing your time and brainpower to learn about those? You know that you will not invest anyways’.
- c) *Differences in upbringing and societal expectations*. Literacy is a socially constructed development. As such it is influenced by various social perspectives and various contexts such as relationships, marriage, friendships, experiences etc. Children frequently model the behaviour of their parents. ‘If you grew up in a family where major financial decisions were made by a husband, chances are this will be a normal model for you when you will structure your relationship’ (FA4).

Societal norms and expectations may also reinforce particular beliefs and behaviours. According to FA8: ‘Our society has traditionally ascribed different roles to women and men within the households. Men were always portrayed as the ones in charge of the financial well-being of the family and as such are expected to make major financial decisions’. ‘I believe that there is a sustained belief in our society that women should seek financial security through marriage as opposed to being independent’ – added another advisor (FA2).

There quotes imply that decision-making authority within the household might be a reason that incentivises to be financially literate. This, however, does not explain the gender

gap for singles, divorced, or widowed individuals. One of the advisors has mentioned that she worked in a local school, teaching youth of 12 to 15 years of age the principles of economics class. According to her; ‘boys were much more interested in both financial and economic topics than girls’ (FA3).

The financial advisors interviewed pointed to the inherent differences within various domains of financial knowledge that their clients possessed. A majority have agreed that women tend to know more about how current and savings accounts function as well as are generally better with budgeting. Men, on the contrary, are more knowledgeable in the areas of debt and investing. FA3 added: ‘Women might not necessarily be more financially literate, but they definitely tend to come more prepared for the meetings than men’. In addition, it is more common for women to get advice from the family and friends before making a financial decision.

5.5.3 Income and Wealth

The majority of quantitative studies theorised positive relationship between income or wealth and a level of financial literacy. As it was mentioned in the literature review, the chain of causality can run both ways resulting in possible endogeneity problem. It is important to hear the financial advisor’s perspectives on this relationship as they are the ones who are in contact with their clients.

First of all, most advisers agreed that people with higher disposable income and higher wealth generally tend to be more financially literate. However, they have attributed various level of importance to these two factors.

Most (six) of the interviewees believed that wealth is more important than income as a determinant for financial literacy while the other two did not disagree nor agree. The reasoning was that income is a dynamic variable that tends to change over one’s lifetime. It increases due to the accumulation of the human capital and career progression; but it can also decrease due

to external shocks (e.g. health issues, disability, or redundancy). Households are faced with an intertemporal choice as to how much to spend or save out of this income on a daily basis. Despite the financial planner's advice to save and invest more once a household income is higher, not all the households do follow this advice. Wealth, on the other hand, is a more static measure that represents an accumulated sum of all the income which was not spent up to date (unless it is inherited, the situation which is discussed later in the section). Wealth also generally tends to fluctuate less over the lifetime of the household and tends to increase all the way until the retirement phase.

Few explanations of the relationship between wealth/income and the level of financial literacy emerged during the interviews. Some advisers believed that higher income can be earned due to the possession of *special skills* (or even domain specific literacies) such as the case of lawyers, managers, and surgeons. The acquisition of those skills requires high cognitive abilities, motivation, and persistence. That category of people is also more likely to possess higher financial literacy because they are better at learning (FA4, 5) or better at the information acquisition (FA8).

Some interviewees pointed out to the fact that higher income earners have a natural tendency to become more financially literate due to *more financial choices* that they have to make. This includes company-sponsored pension planning decisions (fund selection and asset allocation), tax optimisation (taxation system is more complex for high earners) and company-subsidised insurance (whole life v. term). Moreover, some companies choose to proactively educate their employees on these decisions through consultations, seminars, leaflets, and other media (FA3, 4, 8).

Wealthier clients are also motivated to become more financially literate as they need knowledge to manage their wealth. 'Obviously, they have more resources at their disposal including us [the financial advisors], that makes it easier' (FA3). However, acquisition of

financial information bears a certain cost, making it a trade-off decision. ‘For wealthy people the benefits far outweigh the costs’ – according to FA8.

Source of wealth also seems to be a differentiating factor. Those who have steadily accumulated wealth over their working careers tend to exhibit the highest level of financial literacy. Those are the ones that also tend to consult with financial advisors more (FA1, 7) and are inclined to place more trust in the financial advisor (FA7, 8). Those who have acquired wealth as a result of a windfall might or might not exhibit financial literacy, but they are ‘definitely much more impatient’ (FA3) and ‘are not always willing to learn’ (FA5). FA4 noted that typically their level of financial literacy does not improve over the years. An interesting case is presented by those who have acquired wealth due to entrepreneurial activities. They tend to have very high level of financial literacy, excelling in the investment-related questions. FA8 explains this phenomenon by stating: ‘Those people have taken substantial risks in life and, obviously they got rewarded for taking those risks in the end. What is more, they have probably managed company’s finances at one point or the other. Not surprisingly they know a few things about money and risk management as well as investments.’

5.5.4 Education

Interviewees were then asked to comment on how education impacts financial literacy. All of the advisers agreed that education is one of the most, if not ‘the single most crucial’ (FA2, 8), determinants. According to FA4; ‘people with higher education might not necessarily know more about financial management, but they are much quicker to learn about it’; can ‘absorb and comprehend information quicker’ (FA2); and ‘are generally more motivated’ (FA1).

The choice of high school subject concentration is also important. Obviously studying economics or business at a university can boost the knowledge within many domains of financial literacy. However, it can also have a negative impact. For example, it can help to develop the overconfidence or illusion of control biases. This is especially relevant to the

discussion on the objective v. subjective financial literacy. According to FA6, ‘having studied economics at university might give you a false feeling that you know it all, so, there is no need to stay up to date or read more’. FA3 highlighted that she sometimes sees more interest to learn more about finance or investment opportunities from people who have studied humanities or sciences as opposed to the business majors.

The level of education also has an impact, however not as significant as the major. As the government provides universal access to education, it is extremely rare to find a person without a comprehensive school diploma in Sweden. Most people pursue further education from professional schools or universities. Interlocutors hypothesised that people with professional training could even possess more basic financial literacy and be better at budgeting and loan management, since they start earning money at a younger age due to various apprenticeship programmes. None of the interviewees agreed to the notion that the level of higher education attained (bachelor v. masters v. PhD) is of much importance.

5.6 Determinants of Stockholding

Having analysed the determinants of financial literacy, this section focuses on the limited stockholding participation puzzle. These interviews aimed to identify groups of people which are more likely to hold risky assets in their portfolio, their motivations, as well as how they have reached the decisions to become the equity holders. The focus was also to link financial literacy and the stockholding decision.

5.6.1 Demographic Determinants of Stockholding

In this section, the main variables that were used in the probit regression (see Chapter 4) are revisited. According to the lifecycle theory, the household should begin accumulating risky assets at the lowest possible age and continue to do so (although with declining proportion) until the retirement. However, discussions with advisors revealed that this is

commonly not the case. The interviewees were asked to distinguish between various age groups and comment on their willingness to invest in various asset classes. One has to be careful not to engage in stereotyping as households are very heterogeneous. Nevertheless, some common themes were identified and are highlighted below.

During the interviews, discussions were started with the analysis of the younger group of 20 to 30 year-olds. This category mostly does not own risky assets directly but might hold those indirectly. There are few possible explanations. First of all, this segment is generally not very wealthy and does not possess sufficient income to devote to the stockholding (FA3, 5, 7, 8). Even though a majority of the graduates in Sweden do not accumulate much college debt, significant amount of money was still spent during their studies. They tend to have entry level jobs that once again do not pay sufficiently to provide much of the disposable income.

A few of the advisors have also noted that 30-year-olds are more risk-averse in comparison to the same age cohorts of previous generations. Most of them have started their college or careers during the unprecedented financial crisis of 2008 and are very familiar with what could the decline in stock market mean for a personal portfolio. According to FA3, there have been cases in her work where young clients would reject her advice to invest in the stock market based on their fear of a market crash.

Younger people of today also value a different lifestyle. They are much more mobile both in terms of career and residence. A much higher proportion of their budget is spent on travelling (FA1, 8) as opposed to housing or saving that people of younger generations tended to have in the past. According to FA7: 'Decision to invest [in general] frequently stems from experiences or interactions with other financial services. The younger generations do not save much, do not take out mortgages early, therefore there is minimal interaction with a financial institution that could nudge investing through advertisements or financial advisors.'

On the other hand, younger people (20-year-olds) are usually much less risk averse – the trait that could encourage investments into risky assets. A few advisers pointed out that for many young people, investment in the stock market has an element of ‘play’. They are willing to try out investing a small amount of money to see how the markets work but do not view such investment as a part of the long-term financial strategy.

When asked about the 30-50 age group, most of the financial advisers agreed that this group has the largest probability of owning the risky assets. While majority of those aged in their 30s tend to prioritise financial matters that relate to the family needs (accommodation, transportation, schooling), some already start to think about the retirement (FA3). Forming of a family also encourages people to exercise more self-control as well as spurs interest in the better financial management practices. Those who are approaching their 50s tend to invest with a purpose of enhancing the retirement prospects. They tend to prefer passive investment strategies and favour blue-chip dividend-paying stocks (FA4, 8).

At the age of 60, some still tend to hold risky assets. This is the age group where wealth seems to be a prominent factor. Those who have amassed substantial amount of wealth want to pass some of it to the next generation, and as such, they consciously choose to hold stocks as their holding time horizon extends beyond their life. Quite a few advisers mentioned that some older age customers get emotionally attached to the stocks they own (former employer, familiar products, even political views) that they refuse to liquidate those positions despite the advice to do so (FA3, 7). The third possible reason is a possible inertia in the household portfolio management.

All the advisers agreed that wealth and higher income would certainly increase the likelihood to own risky assets. According to FA8: ‘Wealthier people have a different risk-return profile to someone who is less well-off. They can afford to lose a certain percentage of their wealth without compromising their lifestyle.’ Furthermore, it is possible that (marginal)

transaction costs are lower for wealthy individuals as well. Similarly, FA1 noted that not only transaction but also the information acquisition costs might be lower for wealthy households. They also have access to more resources, including financial advice.

The level and type of education might also play a role. Those who have received business or economics-related higher education are more likely to hold stocks simply because of familiarity with those investment instruments. ‘These are the types of clients whom you do not need to explain how the stock market works and how a bond is different from a stock’ – added FA3.

One has to be careful about assuming that an economics graduate will certainly hold a stock. FA4 shared an excellent example of a person who is very financially literate (and financially capable) but not necessarily have an optimal allocation to risky assets.

‘I have client who is a PhD in economics, very respected economist who works in regulation and public finance. He managed to accumulate a significant amount of money during his career. Most of it is invested in statsskuldväxlar [Swedish for government debt] yielding very little interest. For years we have been battling for an increased allocation into riskier assets citing all the various research on portfolio theory. He seemed to agree with everything I said but never allowed me to have more than 10% invested in stocks. Given the amount of life insurance he has, risk aversion instinct, magnified by the recent financial crisis, prevails over prescriptive investment management theories that he used to teach.’

According to FA4, people who have a higher education degree are more likely to own a stock simply because of more developed cognitive abilities. Such people have an advantage while collecting/sorting/analysing and storing financial information which is consistent with the view of financial literacy as human capital and the autonomous theory.

Gender seemed to be a strong predictor as well. All of the advisors agreed that women tend to select less risky investments and attributed that to more risk aversion than men. Once

again, the discussion of nature v. nurture was brought up during the interviews. FA7 highlighted that many of his clients who are women (no matter whether single or married/in a relationship) have more often formulated their financial goals in terms of funding life milestones (e.g. kids college education or retirement funds) while men tended to frame goals in more aspirational way (e.g. holiday in Maldives). Few interviewees highlighted the fact that women feel more responsibility for the household's well-being than men which directly results in higher risk aversion. However, whether that responsibility and higher risk aversion is the result of the 'biological' differences or due to societal norms and expectations is impossible to distinguish and, perhaps, could form another research topic on its own.

Advisers have disagreed whether *having children* would increase propensity to invest in the stock market. Some have favoured a positive relationship citing an increased responsibility by the parents (FA3, 7, 8) to provide a better financial future for their kids that should encourage to at least get interested in the stock market or listen to the financial advice. Others have noted the lack of time to invest into one's financial literacy due to family commitments and hence lower chance of investments into risky assets (FA1, 2, 6).

Similarly, advisers disagreed on whether being an *entrepreneur* or a freelancer would aid in becoming a stockholder. On one hand, entrepreneurs have already taken a substantial amount of risk and might not be willing to accept even more, which would discourage investing in stocks (FA2, 5). On the other hand, those are the people that are familiar with risk and familiar with equity as a financial instrument in general, and therefore they might feel comfortable with extending their financial portfolio beyond the investment into their company (FA4, 7). In addition, it is important to look into the type of the business that a person owns. For example, it would be logical for some seasonal business owners to be more risk averse than for those who have built a stable company that is in a maturity phase.

Interestingly, advisors also had split opinions on whether having a *mortgage* would encourage or discourage stockholding. Some argue that real estate is an illiquid asset class, and as any other asset it has its own risk-return profile. When a flat or a house is purchased it becomes a part of the household portfolio, which increases the overall riskiness of this portfolio. When a mortgage is taken out to finance the real estate acquisition, the risk increases even further. Naturally, the household would be reluctant to add even more riskier assets to this portfolio (FA3, 4, 7). However, as more and more of the mortgage loan is paid out, the household might start investing more into other risky assets. On the other hand, some mortgage holders tend to be more avid users of financial services. Someone who has successfully saved for the mortgage down payment, evaluated various mortgage proposals, insured his or her property, has a discipline to make monthly payments, is more likely to become an active investor (FA8). Even if this person had a low level of financial literacy before taking out the mortgage, the whole process might have a positive impact on it. One can also argue that mortgages are also taken out by people who have a higher level of risk tolerance, which can also manifest in the selection of riskier securities for the household portfolio (FA1, 2).

5.6.2 Psychographic Determinants of Stockholding

The previous subsection has discussed the relationships between most common demographic characteristics and stockholding. Unfortunately, those relationships do not reveal psychological or social variables that might be of influence as well. This subsection includes a discussion on some of such variables which were mentioned in the literature review (see Section 2.5) but were not included in the econometric models due to the lack of necessary data or issues with reliability of proxies.

Every human being is affiliated with multiple *social networks* (e.g. family, friends, co-workers, religion, neighbours etc.) and assumes multiple different roles during one's lifetime. Not surprisingly, those networks do have an influence on the financial decision-making of the

household. Luckily, our financial advisers were also interested in understanding their clients and how they arrived at their various financial decisions. When sharing their observations, they mentioned that it is quite common for people to get interested in a particular product because somebody within the network has one or recommended one. According to the majority of our interviewees, work colleagues tend to have the most influence, followed by friends and only then the family members. Many interactions happen within the work colleagues during the day and those tend to have a higher level of formality. Therefore, 'it is more natural to discuss financial markets or services at work as opposed to close friends where interactions are very informal and are more linked to common interests' (FA3). Companies that provide or subsidise some financial services (e.g. insurance, pensions) might spontaneously encourage conversations about those products within the employees as well. FA4 and FA6 disclosed that quite a few people are not comfortable discussing their financial matters with distant family members due to privacy concerns.

Prior experience or *familiarity* with financial markets or instruments/services also encourages stockholding. According to FA4, 'quite a few people expressed desire to invest in stocks, because they work for a company that has a share ownership plan or because someone they know works for a public company.' A lot of clients experience domestic ownership bias by preferring to invest in a local company that they 'believe they know about' (FA1) as opposed to international companies.

In the same way, people who already have a few products within the bank are also more likely to become investors. FA6 thinks that this can be attributed to the level of trust the clients have towards the financial institution that provides brokerage services and to the financial system in general. Advisers have seen a lot of withdrawals from investment accounts during the 2008-2010. Customers may have been scared off by the financial crisis and the possibility of it to worsen; however, quite a lot cited the lack of confidence in banks and the financial

systems as one of the reasons behind withdrawals. Some customers have never returned to the risky asset classes even years after the financial crisis begun.

Another factor that might influence the decision to hold risky assets within portfolio is the presence of various *background risks* of the household members. For example, poor health requires more financial resources even in the country with a universal healthcare. People who are less healthy might prefer investments that would provide a more predictable cash flow stream, hence, prioritising fixed income instruments or preferred stocks (FA1, 8). Source and nature of income might also have an influence on the decision as well. Families that have irregular or varying pattern of income might decide to opt out of participating in the stock markets.

Psychological traits such as level of optimism one possesses, being prone to gambling, or anxiety about the future seems to have an impact on whether someone would invest into risky assets or not. According to FA5, more optimistic people generally tend to invest more into riskier assets. When presented with various possible scenarios of how the portfolio returns might occur, they tend to focus more on the positive outcomes. Those who are afraid of the future are also more likely to have a smaller or zero portion invested in the stock market as they tend to value liquidity over returns (FA2). Sadly, this is almost impossible to capture reliably without well tested instruments and extended tests. The only best proxy available for those factors is risk aversion level. However, similar to the discrepancy between subjective and objective financial literacy, the level of stated risk aversion might also be exaggerated or downplayed by the households. FA8 shared a story of a client who considered himself to be quite risk tolerant but has purchased every possible type of insurance for himself and his family. According to interviewees, it is quite common for people to consider themselves more risk tolerant than they are in practice. Coherently with Kahneman's Prospect Theory, people attach more value to losses as opposed to gains, which significantly diminishes their stated risk

tolerance during the market turmoil. All of the financial advisers have used or are still using some kind of psychographic test to determine client's risk tolerance level; however, all have mentioned that such tests are either not very reliable (three advisors) or should be used with caution (five advisors) and in conjunction with other measures (three advisors out of previous five).

Information acquisition cost was also mentioned as one of the deterring conditions to stockholding. It has explicit costs (e.g. magazine subscriptions, investment reports) and more importantly implicit costs (such as time and opportunity cost). Many households prefer not to invest in the stock markets because they consider it to be too difficult for them (FA3, 7) to create and monitor the portfolios. This observation is particularly important within the financial literacy context as the stock of financial literacy might have an impact on the acquisition costs which would be different for various households.

5.7 Financial Information Acquisition

The financial advisers were also asked to comment on how their clients acquire the financial information and whether they were able to see any trends emerging from the interactions with clients. All the advisors distinguished the internet as the primary means of information acquisition. FA1 and FA4 noted that the households typically rely on the banks' webpages as well as informational brochures to access the information about the savings products and loans but use much broader sources to find information about investments.

It is necessary to distinguish between two types of information. First type is general information about investments (which concerns issues such as what a stock is, how you buy one, if you should buy a share in a mutual fund or individual stock) and specific information about an investment financial instrument. The interviewees noted significant heterogeneity within the channels of general information acquisition. Few noted an impact of social networks, such as relatives and friends. According to FA5, it is more common to discuss financial matters

with work colleagues than immediate families in Sweden; therefore, he witnessed a lot of clients referring to portfolios of colleagues when formulating investing policies with his own clients. Such an exchange of information between co-workers is also facilitated by the companies that promote participation in the company's sponsored pension plans and/or stock ownership schemes. FA3 noted that quite a few customers referred to various companies training materials when asked to work on retirement planning questions.

Advisors could not help but notice a growing trend of relying on personal finance books and blogs for inspiration on becoming an investor as well as general information on investments. As FA1 described: 'It is fascinating and troublesome at the same time. Fascinating because it means people are interested in this matter and proactively respond and engage with the authors. Troublesome because the advice might be of a low quality or simply not applicable to a particular household financial situation.' Another advisor also agreed that bloggers are biased towards financial instruments and institutions that might sponsor them through advertising engagements (FA8).

FA4 noted that people who read personal finance literature (both print and online) tend to be more impatient and optimistic regarding the investment outcomes. He also expressed dissatisfaction with the approaches to wealth accumulation taken by the authors. Sometimes they tend to rely on behavioural economics and psychology to promote investing. For example, David Ramsey (host of the very popular personal finance TV show in the US) suggested to pay off smaller debt first (as opposed to the one with the highest interest) to feel more empowered while others advocate bucket investing (i.e. a specific investment account for each purpose) that contradicts the canonical total portfolio view taught in every investment management undergraduate class across the world. Overall, it is reasonable to conclude from the interviews that very few would turn to the financial advisors as a primary source for general information on investing.

The interviewees were asked to estimate and comment on their active involvement in recommending specific financial instruments as opposed to ideas generated by the clients. Most of the financial advisors agreed that clients rely much more on financial professionals for specific advice in security selection and portfolio construction areas as opposed to using them as sources of general information.

Few typical profiles of the investors were created during the discussions. Interviewees noted that approximately one-third of the clients usually have undertaken a considerable amount of research beforehand and come well-prepared. (FA1, 4, 8). Such clients typically expect advisors to confirm their ideas. FA4 finds that 'clients who do most of the research on their own tend to be overconfident.' They could get disappointed or even get hostile once financial advisor disagrees on the investment suitability and tries to persuade them not to include a particular financial instrument in the portfolio. Such clients tend to collect most of the specific information from financial publications/websites such as Reuters, Financial Times, Bloomberg, Dagens Industri (local business newspaper) etc.

The second type of investors would bring some investment ideas to the discussion; but those ideas usually come from the interaction with relatives, friends, and colleagues or from popular news portals. Usually those clients have a relatively good grasp of basics of investments and financial environment. Advisors FA2 and FA3 noted that quite a few of such clients' ideas develop as a reaction to some events covered in the news or accidental articles on a particular macroeconomic issue. FA5 cited the decline in the Boeing share price due to grounding of Boeing 737 MAX fleet after two catastrophes which spurred interest among his customers in buying those shares at the lower price as an example of such reactive behaviour. In the same way, FA8 has used a Sino-American trade war as an example of another theme that was frequently brought up by the clients. Considerable heterogeneity in the sources used by such clients was also noted by the interviewees. Advisers have seen articles from CNN, BBC,

Euronews, Business Insider, The Economist, Wall Street Journal, Washington post and many others. Specialised websites that cater for personal investors such as MSN Money, CNN Money, Motley Fool have also been mentioned by advisors.

The third category of clients tends to rely on financial advisors for both the general as well as specific information and advice. Those typically have lower level of financial literacy and are unable to make prudent investment decision on their own. According to FA5 and F6, those clients require a lot of advisor's time so as to bring their financial knowledge up to the level sufficient to understand how investments work. FA3 reported that some of her clients who fall into this category were even resistant to invest time into understanding the recommendation. They were interested in the "final product" but not the process and rationale for their portfolio allocation. FA5 added that resolution is also often required as their expectations of returns from financial markets might not match the ones available or their strategies. Even if expectations match, some instruments might not fit their risk tolerance level.

5.8 Summary

Chapter 5 provided an overview of the interviews conducted with financial advisors, which helped identify which of the financial literacy domains are necessary to include in the financial literacy measurement test, assisting with its validity confirmation.

The overview of the determinants of financial literacy also confirmed a significant heterogeneity among households in terms of their financial literacy levels. Interviews also explored the link between financial literacy and household portfolio choice. Particular attention was devoted to the psychographic determinants of stockholding, which could not be captured within the quantitative data analysis. The chapter concluded with an overview of various motivations to engage with financial advisors and with how households acquire financial knowledge.

Chapter 6. Discussion of the Results

6.1 Introduction

This chapter provides a discussion of the results generated in previous chapters. This section aims to link the results from the previous two chapters – Chapter 4 a quantitative data analysis based on a questionnaire, and Chapter 5 a qualitative analysis derived from interviews – and bridge them to lessons learned from the literature review in Chapter 2.

This chapter also seeks to achieve the research objectives of this thesis, formulated in the Introduction:

- (i) to operationalise the concept of financial literacy and propose a valid measurement instrument;
- (ii) to investigate the relationship between subjective (SFL) and objective (OFL) financial literacy;
- (iii) to explore the determinants of financial literacy;
- (iv) to evaluate the impact of objective financial literacy on direct and indirect participation in the stock market; and
- (v) to evaluate the role of a financial adviser in the acquisition of financial knowledge mitigating the effect of low financial literacy.

Each section below will focus on each of these objectives in turn.

6.2 Overview of Sweden's Financial Literacy Level

This thesis partly aims to expand our knowledge of the financial literacy levels of Swedish households. This section presents the results from the survey of 1544 households and positions those results within the literature overviewed in chapter 2.

Respondents of the financial literacy test answered, on average, 7.3 out of 12 questions correctly. This would be equivalent to 6.08 on a 10-point scale. This would suggest that the level of financial literacy in Sweden can be classified as adequate, since approximately 75% of

the sample answered at least half of the questions correctly. The highest literacy score was achieved among those in 45-54 age group, and it followed a predicted hump-shaped distribution. In addition, it reveals that men scored better on every question compared to women; while those who met with financial advisors (within the past three years) scored slightly higher than those who did not (7.5 v. 7.25), and the relationship is not statistically significant.

When comparing the levels of financial literacy among the Swedish population with those of other countries, the “Big 3” questions are included in order to enhance the comparability of the results of this study with previous research on various financial outcomes (as per table Table 6.1 below) The first six rows include studies that used the exact same wording of the questions, and therefore the results are directly comparable. The seventh row (italicised) includes the study by Almenberg and S  ve-S  derbergh (2011), which was also conducted in Sweden, commissioned by the Swedish Financial Supervisory Authority and included answers from approximately 1,300 respondents.

Table 6.1
Comparison of Answers to “Big 3” Questions among Countries.

Authors	Country	Year of data	Interest Rate		Inflation		Risk Diversification			Observations
			Correct	DK	Correct	DK	Correct	DK	All 3	
Lusardi and Mitchell, 2011d	USA	2009	64.90%	13.50%	64.30%	14.20%	51.80%	33.70%	30.20%	1488
Alessie, Van Rooij and Lusardi, 2011	Netherlands	2010	84.80%	8.90%	76.90%	13.50%	51.90%	33.20%	44.80%	1665
Bucher-Koenen and Lusardi, 2011	Germany	2009	82.40%	11.00%	78.40%	17.00%	61.80%	32.30%	53.20%	1059
Sekita, 2011	Japan	2010	70.50%	12.50%	58.80%	28.60%	39.50%	56.10%	27.00%	5268
Agnew, Bateman and Thorp, 2013	Australia	2012	83.10%	6.40%	69.30%	13.00%	54.70%	37.60%	42.70%	1024
Crossan, Feslier and Hurnard, 2011	New Zealand	2009	86.00%	4.00%	81.00%	5.00%	27.00%	2.00%	24.00%	850
<i>Almenberg and S��ve-S��derbergh, 2011</i>	<i>Sweden</i>	<i>2010</i>	<i>35.20%</i>	<i>15.60%</i>	<i>59.50%</i>	<i>16.50%</i>	<i>68.40%</i>	<i>18.40%</i>	<i>21.40%</i>	<i>1302</i>
Current Survey	Sweden	2018	92.50%	3.00%	85.10%	6.90%	67.40%	15.80%	61.50%	1544

Source: Various studies, compiled by the author

Under the current study, 92.5% of the respondents answered the first numeracy question correctly. The second-best result was in New Zealand (86%) and third best was in the Netherlands (84.8%). Notably, the results from this study significantly diverge from the one of

Almenberg and Säre-Söderbergh. This is primarily because their study used a similar question but worded in a different way; it specifically asked respondents to calculate the exact amount that the person would accumulate after two years in his or her account under compound interest. The original “Big 3” question is much easier as it also asks how much will be accumulated after five years, but the question provides a one-year future value as a reference point for multiple choice answers. Given that Almenberg and Säre-Söderbergh (2011) question was more complex, and that it was also presented over the phone, not surprisingly, only 35.25% of the sample was able to answer it correctly.

The second question on the understanding of inflation was answered correctly by 85.10% in Sweden. The gap between this result and the second highest result in New Zealand (81%), and third highest Germany (78.4%), is now narrower. The result is once again different from Almenberg and Säre-Söderbergh (2011) study, in which 59.5% answered correctly. Although the questions were similar, the wording of the questions was slightly different again as the original “Big 3” introduced a timeframe (one year) closer to the beginning of the question but the study under comparison introduced it at the end.

The third question (understanding of risk and diversification) was answered correctly by 67.40% of the sample. This is similar to reported value by Almenberg and Säre-Söderbergh (2011) of 68.4%. The wording of the questions was identical. The obtained result is once again higher than in the other countries (61.8% for Germany and 54.7% in Australia). The number of people who answered all three questions correctly is also higher in Sweden than in any other country. From this, it is possible to conclude that the level of financial literacy is higher among Swedish population than in other studied countries; on the other hand, the current study is also more recent, which could mean that general levels of financial literacy have broadly improved in the meantime.

6.3. The Instrumentation of Financial Literacy

The literature review revealed that many researchers either consistently use very few questions to test for financial literacy, or instead develop their own extended tests. In either case, there was very little research conducted on whether those tests measure financial literacy correctly and consistently. Seeking to narrow this gap, a unique literacy test was designed for the purpose of this thesis, which created and/or selected questions to assess one's financial literacy more efficiently.

First, it needs to be determined whether the instrument was designed as intended and whether it accurately measured levels of financial literacy. The quality of the instrument will have an impact on the validity and reliability of respondents' answers; a valid and reliable instrument should always generate similar scores regardless of how many times the test is taken. Unfortunately, a test-retest approach is not commonly available to researchers in financial literacy research area, and so, two psychometric measurement approaches were applied, namely, the classical test theory and the item response theory.

Classical test theory assumes that every observed test score is a function of the true score and the measurement error. Under this theory, the item test question difficulty was measured by the item facility (IF), and the test takers' ability was measured through item discrimination (ID). The result demonstrated that, among the twelve knowledge tests, Q4, regarding the relationship between bond prices and interest rates, delivered an IF score of 0.2445, which means only 24% of the respondents were able to answer it correctly and makes it the most difficult question of all. Overall, four other questions had an IF score lower than 0.50: Q3 (the impact of inflation), Q10 (financial instruments), and Q11 (numeracy), implying those there the most difficult questions. Furthermore, the ID scores of the twelve questions were above 0.3, which is a reasonably good result. Only one question, Q1 on numeracy (developed by Lusardi and a part of the "Big 3" questions), has an item discrimination below

0.3; this implies that this question may not necessarily be helpful in determining the financial literacy among households in developed countries.

Furthermore, two methods were applied to investigate the internal consistency of the instrument from the perspective of classical theory, which included item-test correlation analysis and Cronbach-Alpha analysis. The item-test correlation analysis was intended to measure the instrument validity, while the Cronbach-Alpha analysis aimed to estimate the internal consistency reliability of the assessment. Based on the two methods of analysis, it was calculated that the item-test correlation analysis applied on the twelve survey questions produced correlation scores ranging from 0.3913 to 0.6108. These positive correlation scores indicated that each item was able to measure knowledge that was related to that measured by the test as a whole. Additionally, the Cronbach-Alpha analysis applied also delivered an acceptable score of 0.7406 (higher than the general consensus of 0.6), which suggests that the literacy assessment is reliable and consistent.

Item response theory was applied in order to accommodate the shortcomings of the classical test theory. This theory takes into consideration both the item difficulty and the test takers' ability when the probability of a test taker to answer the question correctly is calculated. The analysis was also more effective as it involved a discrimination parameter, which measures the association between the latent trait and the item. That is, a higher discrimination parameter value results in the higher probability that a highly proficient test taker would be able to answer the test question correctly. As a result, this study then applied the one parameter and two parameter (1PL and 2PL) logistic models to fit an assortment of test results. Comparing the two models, the 2PL model fit the data significantly better.

The result of the item test theory application demonstrates that the majority of questions had high discrimination parameters and contained an appropriate level of difficulty. The IRT analysis is also more effective than the classical test theory, as it can point out the items that

require improvement. For example, the results of the 2PL model demonstrate that the first question regarding numeracy and interest rate produced the smallest differential of -2.163, which confirms it is the easiest question of the twelve, even for test-takers with low-level ability. In addition, the model suggests re-examining several questions, such as Q11 (debt numeracy) and Q5 (risk-return profile) in future studies.

In summary, the application of the above two methods confirm that the instrument - the twelve-question test – is reliable. The traditional CTT item-test correlation and Cronbach-Alpha methods demonstrate sufficient validity of the overall test. Furthermore, based on the more advanced item test theory, the twelve questions employed in the test were also found to be robust with high discrimination parameters and tend to represent various difficulty levels that fit the varying ability of test takers.

6.4 The Relationship Between Subjective and Objective Financial Literacy

This subsection discusses the relationship between objective financial literacy (OFL) and subjective financial literacy (SFL) based on information derived from a descriptive analysis and other statistical tests. OFL was obtained through an administered test, while SFL reflects the personal assessment of the test taker.

On the OFL test score, the average number of questions successfully answered was 7.3 out of 12 questions. This average was slightly lower than that of the subjective financial literacy score, which was 7.86. This slightly higher SFL score indicates that the respondents tended to be overconfident. The interviewed financial advisors also noted that their clients tended to overestimate their financial knowledge and skills. This finding is similar to that reported by Agnew and Szykman (2005), de Salvatore et al. (2018), Nejad and Javid (2018), Tang and Baker (2016), and Xia et al. (2014); in each of these cases, respondents were more overconfident than underconfident.

Age was also found to be a significant determinant affecting the relationship between the SFL score and the OFL test score. There is a strong relationship between one's self-evaluation of skills and the objective test score across all age categories. The correlation coefficient between the SFL and OFL is hump-shaped, peaking for the 55-64 age group. The average correlation was 0.33. The lowest correlation was among the 25-34 age group of 0.25. Although the highest correlation, 0.72, was reported for the 18-24 age category, this group only had 17 observations. The second highest was 0.43 for the 55-64 age group. The results are consistent with previous studies such as Almenberg and Säve-Söderbergh (2011), Hogarth and Hilgert (2002), and Lusardi and Mitchell (2011b), among others.

Moreover, the correlation analysis demonstrated that gender was a significant factor affecting the relationship between subjective and objective financial literacy scores; that is, the correlation analysis showed that self-evaluation of skills was positively and significantly correlated with their objective test score. Although the relationship between subjective and objective financial literacy skill was significant in both genders, the correlation between SFL and OFL was more influential in men than in women. This implies that men were able to assess their own level of financial literacy more accurately. However, this finding differs from de Zwaan et al. (2017) who reported no difference between gender between SFL and OFL. The difference can be attributed to the distinct demographics, as de Zwaan et al. (2017) study employed convenience sampling of Australian students.

Similarly, the significant relationship between SFL and OFL was positive and significant across levels of education, which included primary, secondary, vocational, higher professional, and university. The primary level was found to be the one in which the SFL is least correlated with OFL, although it was found to be statistically significant. Such a low correlation could be explained by lower incomes within that category, thus being less exposed to financial asset management and investment. The gap then narrowed, with all further levels

of education -- secondary up to 16, secondary up to 18, vocational, professional or university – all having a correlation coefficient ranging from 0.31 to 0.34. At university level, the significant relationship between SFL and OFL was also found for various levels of exposure to business or economic education. The analysis showed that the members of the group with higher exposure to business education tended to underestimate their own financial literacy knowledge. The group also produced the lowest correlation score among its peers. On the contrary, SFL tended to be more strongly correlated in those having more moderate exposure to business education. The significant correlation of SFL and OFL across all education levels demonstrate that exposure to education has a significant impact on one's financial literacy level. This finding is consistent with some previous studies, such as Giofré (2017), Kadoya and Khan (2019), Lusardi and Mitchel (2011b), and Xiao (1996).

The correlation analysis also demonstrated that OFL is positively and significantly correlated with SFL across all wealth categories. The highest correlation, 0.56, was reported among the category possessing the wealth in the range of EUR 120,000 to 140,000. The second highest correlation, 0.45, was among the wealthiest clients (EUR 200,000 or more). This finding suggests that less wealthy people tend to underestimate their level of financial knowledge. The significant relationship between SFL and OFL across all categories of wealth indicates their predictive ability to assess their level of financial literacy correctly.

Finally, in terms of occupation, the correlation between SFL and OFL was found to be significant only in some categories, including those employed on a contractual basis, work in one's own household, retired, disabled, and who worked as a volunteer. Among the occupations that turned out to be significant, the strongest relationship was, perhaps surprisingly, found in those working as a volunteer (0.62), while the weakest correlation was found in those employed on a contractual basis (0.31).

In summary, the correlation analysis conducted between the SFL and OFL demonstrates that there was a significant relationship between the two literacy measures across some key variables such as age, gender, education, wealth, and occupation. This significant correlation demonstrates that SFL has a predictive ability to estimate one's level of financial literacy. The results are consistent with some previous studies such as Babiarz and Robb (2014), Bannier and Neubert (2016b), Henager and Mauldin (2015), Parker et al. (2012), and Van Rooij et al. (2011b). However, this finding is different than in Guiso and Jappelli (2008), who reported a very weak relationship between the two measures from their sample in Italy.

6.5 The Determinants of Financial Literacy

The regression analysis of financial literacy determinants presented in Chapter 4 shows that some variables significantly affect households' level of financial literacy. Income was found to be one of those significant determinants. The empirical model illustrates that the role of income on one's performance on a financial literacy test score was substantial and universal, which means that it occurred across all brackets. However, its impact and level of significance are varied. The model shows that higher household income tends to be associated with a higher test score. For instance, an increase in one income bracket (from EUR 0 to 1,510) to the next (between EUR 1,151 and 1,800) significantly related to 0.529 points of improvement in the objective test score, all else being equal. On the other hand, for those with an income of more than EUR 2,600, the test score increased by 0.9408. This implies that higher-income people answer more questions correctly and display a better understanding of financial matters.

This finding is consistent with that of Hogarth and Hilgert (2002), who showed that low-income individuals tend to display less financial literacy than higher-income earners, and with that of Almenberg and S  ve-S  derbergh (2011), who found that financial literacy is lower among those with low income. Similarly, this finding is consistent with a few others, namely Al-Tamimi (2009), Lusardi and Mitchel (2011b), and Mouna and Jarbouï (2017). Fernandes et

al. (2014) reported that financial literacy education programmes had weaker effects in low-income population samples than in a general population sample, and therefore, less prone to be financially literate.

Unlike income, the model illustrated that wealth accumulation does not necessarily correspond to a higher degree of financial literacy. This finding was confirmed by the fact that nearly all brackets of wealth were not statistically significant. Of all the brackets estimated, only that between EUR 20,000 and 40,000, which was the lowest wealth bracket, showed a significant relationship with the test score (-0.5070). The negative correlation between being less wealthy and financial literacy, means that the least wealthy people are likely to be less financially literate. However, this finding does not confirm the overall relationship between one's level of wealth and the degree of financial literacy, as the other brackets showed no significant relationship with the test score. The insignificant relationship between wealth and financial literacy in this study is not consistent with some past literature that showed a positive relationship, for example, Bertaut (1998), Haliassos and Bertaut (1995), Hariharan et al. (2000), King and Leape (1998), Weagley and Gannon (1991), among others.

In addition to income and wealth, education was also found to be a significant determinant of financial literacy. The model estimation revealed a significant relationship between education and the objective test score for secondary, vocational, professional bachelor, and university-level education. This suggests that those who are more educated have a better understanding of finances. Moreover, it also suggests that university-level education indicates a higher financial literacy test score more substantially than any other education level. Interestingly, the regression coefficient for secondary education (up to 18 years) was four times higher than secondary (up to 16), which was significant at 0.01 level, implying that two additional years of schooling can make a difference. These findings are in line with those of Xiao (1996), who also reported that highly educated people were more willing to diversify their

portfolio, which propelled them to improve their financial literacy. Similarly, the results are consistent with those of Lusardi and Mitchell (2011b) and Kadoya and Khan (2019) who demonstrate a positive relationship between the level of education and levels of financial literacy.

The level of financial literacy increased with age in the regression model; these results confirm the hump-shaped relationship reported in other studies such as Hogarth and Hilgert (2002), Almenberg and S  ve-S  derbergh (2011), and Lusardi and Mitchell (2011b), among others. Age may also be related to forward-looking behaviour of thinking/planning for retirement. Likewise, this behavioural trait was also found to affect the financial literacy test score significantly. Thinking about one's old age corresponded to an increase in one's financial literacy test performance by 0.2015. This suggests that people generally tend to plan for retirement more as they get older and such preparation spurs their interest in financial knowledge acquisition. This is in line with previous studies that find that financial literacy has a positive impact on retirement planning practices (Fornero and Monticone, 2011; Lusardi and Mitchell, 2011a; Van Rooij et al., 2011).

This study also reveals that gender played a significant role in whether respondents answered test questions correctly. The model estimates that women are less financially literate than men, with an average score of 0.97 points lower than men, holding all other variables constant. This finding is consistent with previous research, such as Aggarwal and Gupta (2010), Almenberg and S  ve-S  derbergh (2011), Bhabha et al. (2014), Klapper et al. (2015), Mathivathani and Velumani (2014), Potrich et al. (2018) who all have all reported a lower degree of financial literacy in women than in men. The interviews with financial advisors have attributed such differences to disparities in mathematical skills, risk aversion and upbringing.

The model reveals a negative relationship between financial literacy and parentage, as couples with children scored 0.4703 lower on financial literacy test than those without. This

finding is consistent with Mottola (2013), who demonstrated that families with no children tend to have higher levels of financial literacy. In addition, this finding is consistent with Servon and Kaestner (2008), who report that families with one child demonstrate lower financial literacy than those with two or more, which is consistent with a negative coefficient value for the variable in the model. These earlier studies speculate that having children may correspond to higher expenditure, which diminishes a parent's opportunity to invest due to limited fund availability and hence, less interest in finance. On the other hand, Potrich et al. (2015) reported a positive relationship, stating that parents with children requires parents to prepare for their children's future, which would drive them to improve their financial literacy.

Similarly, the habit of tracking expenditures was found to be a significant determinant of financial literacy. The relationship between these two variables was positive: carefully tracking one's spending increased one's financial literacy test score by 0.2015, while holding other variables constant. People who regularly track their spending are more knowledgeable about the benefits of money management due to possessing higher level of financial literacy. In addition to tracking expenditure, the model also suggested that risk tolerance and financial literacy are positively related. This result is consistent with Yu et al. (2015), who reported that households possessing higher risk tolerance tend to invest in riskier assets which perpetuates their willingness to acquire more financial knowledge.

The final variable that had a significant impact on the financial literacy test score was homeownership; the model estimates that owning a home tends to improve one's test score by 0.3348 points in comparison to those who rent. This finding is also consistent with Heaton and Lucas (2000) and Cocco et al. (2005). It is likely that homeowners have been more engaged with making financial decisions (e.g. saving for a down payment, selecting a mortgage) which has contributed to a higher level of financial knowledge.

6.6 The Impact of Financial Literacy on Stock Market Participation

In order to understand the relationship of financial literacy and stockholding, two probit regression models were employed, which included identical independent variables as in the model of financial literacy determinants: direct stock market participation and indirect stock participation. Direct participation refers to households that directly hold stock as part of their portfolio investment, while indirect participation refers to families who participate in the stock market indirectly, such as in the form of tax-deferred retirement accounts, mutual funds, or whole-life insurance.

A lesson drawn from the literature review urged caution on the issue of potential endogeneity (Fernandes et al. 2014, Lusardi and Mitchell 2013). Therefore, two instrumental variable probit regressions were performed: business education and higher education were utilised as the instruments. The Wald test of exogeneity did not confirm the presence of endogeneity, and therefore, it was safe to perform ordinary probit regressions. As the initial regression model suffered from heteroscedasticity, a stepwise algorithm proposed by Williams (2010) was followed. The OFL score had a significant and positive effect on both variables: direct (0.17) and indirect stockholding (0.05). The average marginal effects of the financial literacy score were calculated for both of the regressions. A one-unit increase in the financial literacy score was associated with a 6.2 percentage point increase in the probability of investing in the stock market directly, and a 4.3 percentage point increase of investing indirectly. Notably, the shape of the marginal effects value graph was convex for direct stockownership. For the very low scores (close to zero) the probability of direct stock ownership was also very close to zero. As the financial literacy score improved, the odds started to increase exponentially. The graph for the average marginal effects was more linear. This observation suggests that many other variables (e.g. being prompted by a financial advisor, recommendations by relatives,

presence of workplace retirement plans) might influence one's decision to participate in the stock market indirectly.

The models also included some control variables which are discussed below. Starting with the income variable, both direct and indirect stockholding models reported one category of income to have statistically significant coefficients: EUR 1,801 to 2,600 per month. Having an income within that bracket decreased the likelihood to become a direct investor in stocks by 7.5 percentage points and an indirect investor by 6.5. All of the other income categories turned out to be insignificant.

This finding contradicts some previous research that reported income to be a strong positive determinant of participation, such as Campbell (2006), Heaton and Lucas (2000), Lahey et al (2003), Mankiw and Zeldes (1991) and Yuan, 2018. Furthermore, the finding contradicts the results of the financial literacy determinant model, where income was found to affect financial literacy positively. Thus, the comparison of the income coefficient in the two models (this model and the financial literacy determinant model) suggest that a person with a higher income (though still possibly with a higher level of financial literacy) tend to avoid holding stock. This inverse relationship can be attributed to some exogenous factors to the model. One of them could be the presence of implicit and explicit entry costs (Guiso and Jappelli, 2005); possibly, those people estimated and perceived them to be too high to enter the market. It may also be attributable to higher progressive capital gains taxes in Sweden, which might skew preferences towards other asset classes.

On the other hand, results from the wealth variable were more predictable and consistent with the reviewed literature. At the lowest category of wealth (below 40,000 EUR), the regression coefficients were negative (although not statistically significant). Obviously, households with low levels of wealth have other priorities, such as establishing an emergency fund, over investing in risky assets. Coefficients became positive, although small and not

statistically significant within the EUR 40,000 to 60,000 and EUR 60,000 to 80,000 wealth categories. However, those turned out to be positive and significant within the next four wealth categories (EUR 80,000 to 100,000; EUR 100,000 to 120,000; EUR 120,000 to 140,000). The greater willingness of people in higher wealth brackets to participate in the stock market is consistent with many studies (Bertaut, 1998; Hariharan et al., 2000; Haliassos and Bertaut, 1995; King and Leape, 1998; Weagley and Gannon, 1991). Notably, the reported coefficients for the two highest wealth brackets (EUR 140,000 to 200,000 and above EUR 200,000) are positive but not statistically significant for the direct model, and only the coefficient for the highest wealth bracket is significant ($p < 0.1$) within the indirect stock market participation model. These findings can be explained by Shum and Faig (2006), who state that households with a very high net worth will be more risk-averse than those with less wealth. It is possible that a high amount of wealth is tied to owning a family businesses or real estate, and those households may not be willing to increase their overall portfolio risk even further. This could explain why the coefficient for “EUR 200,000 and higher wealth” was positive and significant for the indirect stockholding regression as indirect investment tend to be less risky than direct due to the benefit of diversification.

In terms of education, the model reports that all levels of education are positively and significantly related to both direct and the indirect stock market participation. In other words, for any given level of education, financial knowledge is successfully transformed into stock market participation. These findings are consistent with some past studies, such as Grable (2000), Hariharan et al. (2000), Kezdi and Willis (2011), Shum and Faig (2006), and Waggle and Englis (2000). The results are also consistent with the previous finding that all educational levels (except secondary up to 16) are a significant determinant of financial literacy.

One could argue that education works as an enabler that motivates people to utilise their financial literacy knowledge into a practice of investing in stocks. Notably, the coefficients

attributable to various levels of education were more statistically significant for the indirect participation model ($p < 0.01$) than the direct ($p < 0.05$). This suggests that a person who understands the benefits of investing in the stock market and the role of diversification may be more prone to invest indirectly.

It is also worthwhile mentioning that the effects of secondary education up to 18 and profeessional bachelor (for direct participation) and vocational and professional bachelor (for indirect) were larger than that of university. This is contrary to the financial literacy determinants model's results, where university education had the highest correlation with the OFL score.

Overall, we observe here a situation where financial knowledge does not necessarily translate into a desired financial outcome, namely stockholding. This once again reminds us as to why it is important to distinguish between financial literacy and financial capability.

This finding is not in line with the studies from Guiso et al. (2002) and Xiao (1996) who report that higher level of education, such as college or a postgraduate degree, correlates with higher participation because such people tend to have more diversified portfolios. It is also possible that a university education provides knowledge that is more theoretical in nature, whereas professional bachelor and vocational education might emphasise the technicalities of personal finance more.

Risk tolerance is found to be another significant determinant of stock market participation, both direct and indirect. The model demonstrates that risk tolerance affects stock market participation positively, which means that higher risk tolerance increases the probability of becoming a stockholder. This finding is consistent with Yu et al. (2015), who reported that households with higher risk tolerance tend to invest more in sophisticated assets, including stocks. The impact of this risk tolerance is larger in direct stock holding than indirect, which is predictable as direct stock market participation requires a greater appetite for risk. In addition,

these findings are consistent with the results from the financial literacy determinant model, where risk tolerance was found to have a positive and significant effect on levels of financial literacy. Overall, it is possible to conclude that risk tolerance, financial literacy and propensity to hold stocks are all related, which supports the findings of Sjöberg and Engelberg (2009), who reported that financially literate students were more willing to take risks.

In terms of age, the stock market participation model demonstrates that this variable has a significant (albeit small) impact on direct, but not on indirect, stock holding. This result contradicts the previous findings where age was a significant determinant for the financial literacy score. The risk tolerance variable, and the presence of heterogeneous background risks may have reduced the effect of age in the model. This explanation would be in line with previous studies demonstrating that risk aversion increases as households approach retirement (Morin and Suarez, 1983; Riley and Chow, 1992, and Sung and Hanna, 1996). In short, people tend to decrease their equity holdings in the later stages of their lives. However, this finding contradicts several studies that report a positive impact (or a hump-shaped pattern) of age on participation: Ameriks and Zeldes (2004), Chambers and Schlagenhauf (2002), Guiso et al. (2003a), Holden and VanDerhei (2005), Poterba and Samwick (2007), and Weagley and Gannon (1991).

Other control variables – gender, having children, tracking, and homeownership – that were previously found to be significant determinants of financial literacy – such as were insignificant in the probit model. The findings on gender are at odds with the study from Hinz et al. (1997), who reported that women tend to have much less riskier assets, or Ameriks et al. (2003), who observed that men tend to invest in the stock market more often than women. The difference can be attributed to the sample being drawn from different geographical region. Moreover, the findings are not consistent with some previous studies that reported a positive relationship between homeownership and stock market participation, such as Cocco et al.

(2005), Heaton and Lucas (2000), and Yao and Zhang (2005). It is worth noting that the homeownership rate has been steadily declining in Sweden for the past ten years due to increased labour mobility and emigration rates, possibly leading to its decreased significance as an asset class.

6.7 Insights from Financial Advisers on Financial Literacy and Stock Market Participation

This section summarises the second part of the study, namely, the qualitative data analysis comprised of interviews conducted with financial advisers. The discussion on this part will then be linked to the previous findings from the quantitative analysis (models of financial literacy determinants and stock market participation) and compared to previous research in the two areas.

The interviews with financial advisers resulted in some statements that were relevant to or contradicted the findings of the empirical model. In terms of income, the advisers believed that higher income was earned through high levels of financial literacy and skill; they believed that high-income earners tend to be more financially literate because they are more likely to make more financial choices to manage their wealth. This is consistent with the findings of the financial literacy determinants model, where income was found to be related to higher scores on the test. The advisers' observation is also supported by previous research reporting a positive relationship between income and financial literacy (Almenberg and S  ve-S  derbergh, 2011; Al-Tamimi, 2009; Fernandes et al., 2014; Hoggarth and Hilgert, 2002; Lusardi and Mitchel, 2011b; Mouna and Jarboui, 2017).

Furthermore, the advisers agreed that high-income earners tend to participate more in the stock market. They suggested that high-income earners were more willing to participate because they simply had a bigger cash inflow that can be channelled into risky assets. This contradicts results from the stock participation model as, according to the model, high-income

earners showed no significant association with stock market participation; instead, the model generated a negative relationship between middle-income earners and stock market participation, either directly or indirectly. This inverse relationship could possibly occur because middle-income households may have insufficient disposable income to be invested in the stock market. This implies that, although financially literate, these middle-income people are likely to be risk-averse and avoid participation. Hence, the positive relationship between income and stock market participation, as suggested by advisers, was not universally valid across all income brackets.

Furthermore, the financial advisers agreed that wealthy people tend to be more financially literate due to the necessity of making decisions about wealth management. The advisers noted that wealthy entrepreneurs were more financially literate than those who had accumulated their wealth over their working careers as employees. This observation is in line with some previous studies (Bertaut, 1998; Haliassos and Bertaut, 1995; Hariharan et al., 2000; King and Leape, 1998; Weagley and Gannon, 1991) that report a positive impact of wealth on financial literacy. The model of financial literacy determinant in this study did not, however, confirm this belief of advisers; the revealed no significant impact between one's wealth level and one's degree of financial literacy, across several categories. Furthermore, the model also suggests that being self-employed or entrepreneurs provides no substantial impact on one's degree of financial literacy, counter to the advisers' beliefs.

In terms of stock market participation, the model indicated that wealth significantly affects both direct and even more indirect stock market participation. This finding is consistent with most advisers' beliefs, who stated that wealthier people tend to actively participate in the stock market because they have lower marginal transaction costs and information acquisition cost than those who are less wealthy. This finding is consistent with prior studies, such as

Bertaut (1998), Haliassos and Bertaut (1995), Hariharan et al. (2000), King and Leape (1998), Weagley and Gannon (1991).

In terms of age, the advisers reported that the majority of clients who sought advice were aged between 25 and 35, or between 55 to 65. Most advisers believed that the former group were more financially literate, which is similar to Bindhu (2013), i.e. that investors aged between 25 to 35 years old are more financially literate because they express more interest in financial market products. This observation is consistent with the financial literacy determinant model, as it also showed a significant negative relationship between the quadratic age and financial literacy, indicating that age affects financial literacy in a hump-shaped pattern, implying that middle aged individuals are more financially literate than younger and older people. This is in line with previous research by Almenberg and S  ve-S  derbergh (2011), Finke et al., (2017), Hogarth and Hilgert (2002), Huston (2017), and Lusardi and Mitchell (2011b).

However, the stock market participation model demonstrates that age does not impact participation significantly, which is notably different from financial advisors' views that those in the 30 to 50 age category tend to hold more risky assets. This is consistent with several studies that report a hump-shape in the age participation profile in all of the observed countries, reaching its peak at 45 to 55 years old and declining for those over 60: Chambers and Schlagenhauf (2002), Holden and VanDerhei (2005), Morin and Suarez (1983), Poterba and Samwick (2007), Riley and Chow (1992), and Sung and Hanna (1996).

In terms of education, all of the advisers agreed that education was a strong determinant of financial literacy. They argued that highly educated people were more responsive and participative in discussions on financial matters; they were also more motivated to learn new things and processed the information more effectively than those with a lower education. However, the advisers noted that one's field of study also played a role in possessing a certain level of financial literacy; for example, those studying economics tend to believe they were

more knowledgeable about finance, which was not entirely accurate and hence may prevent them from learning new things. Of all education levels, those who pursued professional training or received a university degree were more often willing to seek advisers' help. The advisers' opinion regarding this issue is also consistent with the financial literacy model, which demonstrated a positive relationship between education and the degree of financial literacy. More specifically, the model pointed out that a university education provided the most important financial literacy skills of all education categories. Thus, both the advisers' observation and the model delivered similar findings, which is also in line with previous studies that found a positive relationship between the level of education attained and the level of financial literacy (Giofr , 2017; Kadoya and Khan, 2019; Lusardi and Mitchell, 2011b).

In terms of stock market participation, financial advisers stated that those with higher business and economics education tended to hold more stocks. These clients are reported to understand the basic mechanism of stock markets and how they differ from bonds. The advisers believed that highly educated people have more developed cognitive abilities, which made them able to participate more in the stock market. This finding was also confirmed by the model of stock market participation. Recall that the model demonstrated a significant and positive relationship between education and direct and indirect stock market participation within all categories of educational level attained. This maps well to similar studies that determine education to be a significant factor impacting the stock market participation: Grable (2000), Guiso et al. (2002), Hariharan et al., (2000), Kezdi and Willis (2011), Shum and Faig (2006), Waggle and Englis (2000), and Xiao (1996).

In terms of gender, most advisers agreed that men were more financially literate than women. Furthermore, they also noted that women's financial knowledge is varied: many women know either very little about finance or a lot, while most men know at least something. Interestingly, the advisers revealed that women and men have different areas of interest.

Women are more familiar with current and savings accounts, while men are more knowledgeable in the areas of debt and investment, which was related to their participation preference. Moreover, most advisers agreed that men tend to hold riskier assets than women. In terms of financial literacy, these observations from advisers are consistent with results from the model of financial literacy determinants, which demonstrated that females are less financially literate than males. The advisers argued that traditional societal views partly influence this low score of financial literacy in women: it is expected that men were supposed to be the ones ‘in charge’ of the financial well-being of the family and were responsible for any financial decisions that required financial literacy.

However, although the financial literacy determinants model supported the advisers’ observations, their belief on the role of gender within the stock market participation was not confirmed by the estimated participation model as it showed no significant impact from gender on participation. Hence, although men were statistically more financially literate than women, this higher degree of financial literacy did not necessarily translate into a higher degree of participation. That is, as the advisers explained, men could be more interested in investments overall; but not necessarily in stock investments. The advisers’ statements could be biased, primarily because a lot of households approach portfolio allocation decisions jointly, as documented by Bernasek and Shwiff (2001). In addition, as suggested by Xiao (1996), the impact of gender should be analysed together with marital status.

Furthermore, most advisers agreed that having children had no significant impact on stock market participation. Some advisers agreed this may be because parents have insufficient time to learn about stock markets due to their family commitments. This finding is consistent with the empirical model, where having children was found to be an insignificant variable on stock market participation. However, some advisers believed that having children could influence one’s level of financial literacy positively, as parents would exercise their

responsibility to provide a better financial future for their children, prompting them to be more financially literate. This, however, contradicts the results of financial literacy model, which showed that having children had a negative effect on financial literacy level. Overall, the inconsistency between advisers' statements and the empirical model is to be expected, simply because previous studies also vary considerably on whether having children influences stock market participation. For example, Bucher-Koenen and Lusardi (2016) reported no significant impact between financial literacy and the number of children, while Potrich et al. (2015) demonstrated precisely the opposite.

Finally, in terms of homeownership, most financial advisers believed that this variable had a positive impact on stock market participation, which is similar to the finding from Heaton and Lucas (2000) but contradicts the findings from Cocco et al. (2005). The advisers observed that mortgage holders were more actively involved in financial matters because they were accustomed to borrowing and paying a loan, and had learned enough through that mortgage application and payment process to motivate them to learn about riskier assets. However, in terms of stock market participation, results from the empirical model provided insufficient evidence to support a significant impact of homeownership. This difference between the advisers' beliefs and the stock market participation model is again to be expected, since there is little agreement in the academic literature either.

6.8 Summary

This chapter provided an interpretation of the findings from the two sets of data analyses. First, the study demonstrated that the objective financial literacy test employed in this study is valid and reliable, based on both classical test and item test theories. Second, it was found that subjective and objective financial literacy scores were strongly correlated. The significant correlation between SFL and OFL was varied across age, education, gender, occupation, income and wealth. The empirical model of financial literacy revealed that income, education, age, the expectation of retirement, spending tracking habits, risk tolerance, and homeownership all significantly affect the level of financial literacy in Sweden in a positive way. On the other hand, the negatively significant variables affecting financial literacy in Sweden are gender and having children. Finally, in terms of the relationship between financial literacy and stock market participation, the model demonstrated that risk tolerance, middle-income bracket, education and wealth are significant determinants of stock market participation. Finally, financial advisers' beliefs matched closely with the financial literacy and stock market participation models.

Chapter 7. Conclusions and Recommendations

The purpose of this thesis was to contribute to the body of knowledge on financial literacy by studying its determinants and its impact on portfolio choice. Chapter 1 provided an introduction to the research question and the phenomenon of low levels of stock market participation. Chapter 2 contained the literature review, presented the conceptual framework of the thesis, and introduced the hypotheses. Chapter 3 explained the methodological approach of the study. Chapter 4 presented the results from a quantitative analysis of survey data. Chapter 5 discussed insights gained from interviews with financial advisors. Chapter 6 interpreted the research findings and placed them in the context of previous studies. This final chapter summarises the research findings, its implications, limitations, and suggestions for further research.

7.1 Summary of the Findings

The review of the literature revealed that many households throughout much of the world do not possess a sufficient level of financial literacy to navigate the financial environment. This may lead to unfavourable financial outcomes that limit the wealth of households; one such outcome is an insufficient amount of stocks in household's financial portfolios.

The literature review revealed a lack of systematic approach towards studying financial literacy. Multiple definitions have been proposed that focus on various aspects of financial literacy. Terms such as financial literacy, financial awareness, financial capability and even financial education are frequently used interchangeably. Also, several instruments or proxies for financial literacy are used to study financial outcomes. Among various test-based measures, the three questions developed by Lusardi and Mitchell (2011a) – originally used for the Health and Retirement survey – quickly became widespread due to their simplicity and relevance. These questions are commonly referred to as the “Big 3” questions in subsequent studies, later

expanded to the “Big 5” by Lusardi and other authors (Bumcrot et al., 2013). Several extended tests ranging from 5 to 50 questions have also been developed; few, however, have gained acceptance. For this thesis, an instrument was designed that would incorporate the “Big 5” questions (in order to ensure comparability of results), added three questions developed by van Rooij et al, 2011; Jumpstart 2004 and the Council for Economic Education (2018), with an additional unique four questions.

The instrument was tested for reliability and consistency from the perspective of both Classical Test Theory and Item Response Theory. Inter-item correlations ranged from 0.3913-0.6108 and the Cronbach alpha of 0.7406 was sufficiently high. A 2PL model was developed and better fit the data because it related the financial literacy test score with the latent trait: ability of the test takers. The 2PL model produced high discrimination parameters and contained levels of difficulties that were well-distributed across the twelve questions.

The objective financial literacy test results were compared to self-assessed or subjective financial literacy. Based on the average number of questions successfully answered on the test and the self-reported scores, overconfidence of the respondents was evident; on average, respondents overestimated their level of financial knowledge. This is not uncommon and has been revealed in some previous studies, including Agnew and Szykman (2005), de Salvatore et al. (2018), Nejad and Javid (2018), Tang and Baker (2016), and Xia et al. (2014).

Overall, this study concluded that SFL has a positive and significant relationship with OFL, which indicates that SFL can be used as a proxy for OFL if a reliable literacy test is not available to a researcher.

Eleven hypotheses were formulated to explore the determinants of objective financial literacy (refer to Table 2.5). Most of the determinants were found to positively affect levels of financial literacy, including income, education, gender, risk tolerance, tracking expenditures, planning for retirement, and being a homeowner. Three hypotheses regarding wealth, being

self-employed, and having children, were not supported by the findings: having children had a negative relationship with financial literacy levels, while being self-employed and wealth (except for a negative effect in the lowest category) both turned out to be statistically insignificant.

A model of stock market participation was created to test whether financial literacy has an impact on the decision of whether to hold stocks directly or indirectly. The independent variables utilised in both models were the same as in the model of financial literacy determinants. Out of a concern for endogeneity, the initial probit model included two instruments: business education and high school education. As the Wald test of exogeneity indicated no endogeneity within the model, an ordinary probit regression was performed. The score on objective financial literacy test was positively associated with the likelihood of a household to invest in the stock market. An increase in one point on the OFL test increases the probability of being a direct stockholder by 6.2 percentage points and of being an indirect stockholder by 4.2 percentage points. Higher wealth categories, higher levels of education attained, age, and higher risk tolerance, are all positively associated with being a stockholder.

Interviews with financial advisors have in most cases confirmed the results of the empirical models. The advisors observed that the financial literacy of their clients has improved over the years. Those in the 35 to 45 age bracket sought financial advice more often than the other age groups. Advisors also reported considerable heterogeneity in clients' level of financial literacy and stock market participation. Advisers also provided insights into factors that were not captured in the regression model, such as the power of social networks, familiarity and trust in the financial system, and the presence of idiosyncratic background risks and psychological traits.

7.2 Implications of the Findings

The first objective of the thesis was to create a reliable financial knowledge test that captures aspects of knowledge that together would enable one to successfully make basic financial decisions. A good test should be portable and replicable. Therefore, an extensive analysis of previous instrumentation efforts was conducted. Most previous researchers utilised the “Big 3” questions developed by Lusardi and Mitchell (2011b); however, there had been no validity analysis of these questions. After employing a blend of techniques taken from Classical Test Theory and the Item Response Theory, it was determined that these three questions, along with others taken from previous studies plus a few additional unique questions, together form a reliable financial literacy knowledge test.

This test has one obvious application beyond academia: practitioners can use it to evaluate the knowledge of their clients. Also, those who administer financial literacy tests in developed countries with a very high usage of banking services or participation in financial markets (like Sweden) might consider excluding some of the questions that had a lower difficulty level.

The second objective was to explore the relationship between objective and subjective financial literacies, and they were found to be related. Given that running the full financial literacy test might not be feasible in all situations, researchers can utilise the SFL as a proxy within their studies if no OFL score is available. Those whose education was related to business or economics reported the lowest correlation between their own assessments and financial literacy scores. Thus, when administering the test, future researchers should pay close attention to the composition of his or her sample when selecting respondents.

These findings are also useful for evaluating financial education or literacy programmes. As there is a gap between knowledge perception and objective knowledge, participants in such programmes may under or overestimate their knowledge. An objective financial literacy test is

recommended before the start and at the end of such programmes, in order to obtain a reliable estimate of performance.

The findings of the third research objective that addressed the determinants of the financial literacy are of interest to both practitioners and policy makers. By being able to anticipate the financial literacy level of a client from a particular demographic segment, financial advisers can tailor their meetings with clients to address anticipated deficits in their financial knowledge. Meanwhile, policy makers can focus on delivering financial education programmes that effectively target a particular segment of the population.

Overall, the research findings reveal that most households in Sweden possess a sufficient level of financial literacy; but there are groups that are lagging behind. For example, the results detected a hump-shaped relationship between age and financial literacy. Younger people and older population performed worse on the OFL test. Policy makers should therefore target those groups when designing a financial education programmes. Very few educational institutions in Sweden systematically incorporate personal finance into their curriculum. Somewhat surprisingly, university graduates lag behind their peers who received a professional education; this could signal that university curriculums need to be reviewed to incorporate more practical examples and applications of financial knowledge. Women scored lower on financial literacy than men; however, interviews revealed a considerable heterogeneity within that group. There is no doubt that financial literacy programmes should target this segment; however, they need to be designed in such a way as to incorporate more information about investments as opposed to budgeting and savings.

While comprehensive financial literacy programmes are important, the Swedish government should also incentivise families with children to become more financially literate, as the model demonstrated that having children is negatively associated with financial literacy scores; this probably occurs because parents have too little free time to learn more about

financial matters due to family commitments. The implications of this situation are twofold. First, families may not accumulate a sufficient amount of wealth to cover upbringing expenses as the children age. Second, children might perpetuate the behaviour of parents in the future. Financial institutions could promote financial products targeted for this particular segment.

The model of financial literacy pointed out a positive relationship between income and financial literacy score. This knowledge can help banks segment who to offer various financial products to, and how to present it. For example, banks need to strive to avoid technical jargon while marketing products to lower income households. The same can also apply to homeowners who, according to the model, exhibit higher levels of financial literacy. This leads to another important conclusion: consistent with the autonomous theory of financial literacy, banks should constantly engage their customers in informal financial education. This reduces information acquisition costs for households (and financial advisors' time), builds trust in the financial system, and promotes long-term customer relationships with banks.

The next objective was to explore the relationship between financial literacy and stockholding. This relationship turned out to be positive and significant for both direct and indirect stockholding. Since governments and financial advisors would like to encourage stockholding due to a shifting emphasis on defined contribution pension plans, increasing overall financial literacy levels are crucial. This is especially important in direct stock market participation, as those with very low levels of financial literacy are very unlikely to participate in the stock market directly.

Surprisingly, the financial literacy and the stock market participation models gave conflicting results regarding income and wealth. Income was a significant predictor of financial literacy; but wealth was a significant predictor of stockholding. This implies that there are also other important variables such as risk tolerance and idiosyncratic background risks that may influence participation decisions. Consequently, advisors should keep in mind that a financially

literate person will not become a stockholder by default; additional education or a nudge for action is likely to be required.

It is also worthwhile noting that a positive and significant association with stockholding is present across all levels of education. However, the coefficient associated with university degree attainment had the lowest level of significance ($p < 0.10$) for direct participation. This could mean that the financial literacy skills (if any) acquired while studying at university may not be sufficient to incentivise a person to become a stockholder. In this case, experiential, simulation-based learning could be more likely to promote stockholding.

Advisors are an invaluable link between financial institutions and household. The interviews with advisors generally confirmed the results obtained from the quantitative analysis; most advisers agreed that income, age, education, and homeownership had a positive and significant impact on financial literacy. Moreover, the advisers also agreed that wealth and education positively influence stock market participation, which was consistent with the stock market participation model. This correspondence suggests that the involvement of financial advisers in any strategy or policy formulation will accelerate the achievement of higher financial literacy and greater stock market participation.

7.3 Limitations

There are some general limitations to this research. The first is the questionnaire itself. First, it had to be brief; any attempt to increase the length of the questionnaire would likely result in respondent fatigue (Choi and Pak, 2005). This was especially important as a significant number of questionnaires were distributed with the help of financial advisers, during the meetings with their clients. The questionnaire attempted to measure objective financial literacy through the 12 questions. Five questions out of 12 were taken from Lusardi and Mitchell (2011b), and were included for consistency to ensure that the results were directly comparable. Nevertheless, such a brief questionnaire may not be sufficient to capture all of the aspects of

financial literacy that are required to make sophisticated investing and wealth accumulation decisions.

The unique data gathered helped to capture many demographic variables that are associated with various levels of objective financial literacy; however, this data might not explain the motivation to acquire more financial literacy or fully explain the decision-making process towards specific financial outcomes. Participation in the stock market is a choice made by households that is influenced by many variables, including upbringing, family dynamics, experience in handling financial matters, background risks, and psychological risk attitudes. No statistical model would be able to fully capture this complexity; nevertheless, this problem was somewhat mitigated by including interviews with financial advisers, who are familiar with the issues that their clients face. Unfortunately, advisers can only conjecture about such relationships based on their observations and conversations with clients, which is also to some extent subjective.

The study relied on cross-sectional data at a given point of time, and therefore, it is impossible to infer changes or causal relationships with any certainty. Unfortunately, longitudinal studies are costly, time-consuming, and might suffer from attrition; as a result, they are rarely used to study financial outcomes. The sample here included clients of one particular financial institution which administered the questionnaire. While the descriptive statistical analysis showed a similarity to and representativeness of the overall population, it is possible that more financially active households responded to the questionnaire than otherwise, thus exhibiting a higher level of financial literacy.

7.4 Future Research

Subsequent studies could quite easily employ the instrument developed in this thesis to estimate the probability of participation in other risky asset classes such as structured notes or derivatives. Given advances in data science and the ability to process large volumes of data

quickly, it will soon be possible to create a model that can predict the likelihood of a particular household to create a specific portfolio.

Furthermore, future studies could focus on the role of financial advisers in influencing the portfolio choices of households. This study incorporated the interviews with financial advisors primarily as observers of financial behaviours, but not as agents initiating change. It would be interesting to incorporate financial advice into the empirical models and observe how interactions with financial advisers affects the dependent variables; this would be timely, as over next few years the regulatory environment on financial advice within the EU will rapidly evolve.

This thesis focused on the demand side of financial literacy. It included the level of formal education as one of the explanatory variables; however, financial knowledge is in large part acquired informally, through online courses, financial blogs, forums, digital media subscriptions, etc. Future studies could incorporate those variables by including the supply side of financial literacy provision.

7.5 Conclusion

Overall, this thesis addressed previously identified gaps in the research on financial literacy (see section 1.3). The determinants of financial literacy, and the decisions households make when allocating their assets, are better understood, enabling us to more reliably measure financial literacy and understand its contributing factors. This consequently improves researchers', policymakers', financial advisors' and educators' ability to pursue further research, craft efficient policy decisions, better understand their clients, and create successful educational programmes.

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Appendices

Appendix A

Regression Results Obtained from Different Treatments of Outliers

	(1) TEST_SCORE (standard)	(2) TEST_SCORE (dropping outliers)	(3) TEST_SCORE (imputing median values)
NETTOHHINCOMEcats			
from EUR 1151 to EUR 1800	0.4270* (0.23)	0.6760*** (0.23)	0.5290** (0.23)
from EUR 1801 to EUR 2600	0.6135** (0.25)	0.7930*** (0.25)	0.6709*** (0.25)
more than EUR 2600	0.8677*** (0.27)	1.0495*** (0.27)	0.9408*** (0.27)
WEALTH_CAT			
20000-40000	-0.5048** (0.23)	-0.5161** (0.23)	-0.5070** (0.23)
40000-60000	-0.1612 (0.23)	-0.2102 (0.23)	-0.1744 (0.23)
60000-80000	-0.2078 (0.27)	-0.2591 (0.27)	-0.2150 (0.26)
80000-100000	-0.2716 (0.26)	-0.3724 (0.26)	-0.3094 (0.25)
100000-120000	0.1935 (0.32)	0.0952 (0.31)	0.1374 (0.31)
120000-140000	0.4694 (0.40)	0.3220 (0.40)	0.3676 (0.40)
140000-200000	0.1317 (0.44)	-0.0246 (0.44)	0.0629 (0.44)
200000 and above	0.2503 (0.54)	-0.1441 (0.55)	-0.0088 (0.53)
EDULEVEL			
secondary (up to 16)	0.2998 (0.32)	0.4794 (0.33)	0.3823 (0.32)
secondary (up to 18)	1.4605*** (0.34)	1.6904*** (0.34)	1.5522*** (0.34)
vocational	0.6516* (0.33)	0.7500** (0.34)	0.6806** (0.33)
professional bachelor	1.3253*** (0.33)	1.5468*** (0.33)	1.4255*** (0.32)
university	1.8170*** (0.35)	2.0692*** (0.36)	1.9312*** (0.35)
AGE	0.0627** (0.03)	0.0720** (0.03)	0.0650** (0.03)
AGE ²	-0.0007*** (0.00)	-0.0008*** (0.00)	-0.0008*** (0.00)
PARTNER	-0.0478 (0.17)	-0.0014 (0.17)	-0.0366 (0.17)
Sex (female)	-0.9371*** (0.14)	-1.0091*** (0.14)	-0.9700*** (0.13)
child_dummy	-0.4522*** (0.15)	-0.5090*** (0.15)	-0.4703*** (0.15)
RISK_TOLERANCE	0.3012*** (0.04)	0.2981*** (0.04)	0.3011*** (0.04)
inv_TRACKING	0.1808** (0.07)	0.2203*** (0.07)	0.2015*** (0.07)
inv_THOUGHTOLDAGE	0.2477*** (0.09)	0.2796*** (0.09)	0.2694*** (0.09)
self_emp_entrep	0.3578 (0.30)	0.2812 (0.30)	0.2672 (0.29)
own_house	0.3380** (0.15)	0.3457** (0.15)	0.3348** (0.15)
Constant	3.693*** (4.17)	3.050*** (3.46)	3.429*** (3.94)
Observations	1532	1515	1532

* p<0.10, ** p<0.05, *** p<0.01; standard errors in parenthesis.

Appendix B

Ethical Approval of Research Letter



Date: 15 March 2018

Dear Dmitrij,

Ethical Approval Application No: FREIC1718.01
Title: Impact of financial literacy on household portfolio choice

Thank you for your application to the Faculty Research Ethics & Integrity Committee (FREIC) seeking ethical approval for your proposed research.

The committee has considered your revised application and is fully satisfied that the project complies with Plymouth University's ethical standards for research involving human participants.

Approval is for the duration of the project. However, please resubmit your application to the committee if the information provided in the form alters or is likely to alter significantly.

The FREIC members wish you every success with your research.

Yours sincerely
(Sent as email attachment)

Dr James Benhin
Chair
Faculty Research Ethics & Integrity Committee
Faculty of Business

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Appendix C

Consent Form

Please tick the appropriate boxes

Yes No

Taking Part

- | | | |
|---|--------------------------|--------------------------|
| I have read and understood the project information sheet. | <input type="checkbox"/> | <input type="checkbox"/> |
| I have been given the opportunity to ask questions about the project. | <input type="checkbox"/> | <input type="checkbox"/> |
| I agree to take part in the project. | <input type="checkbox"/> | <input type="checkbox"/> |
| I agree to be audio recorded during the interview | <input type="checkbox"/> | <input type="checkbox"/> |
| I understand that my taking part is voluntary; I can withdraw from the study at any time and I do not have to give any reasons for why I no longer want to take part. | <input type="checkbox"/> | <input type="checkbox"/> |
| I want to keep my identity withheld. | <input type="checkbox"/> | <input type="checkbox"/> |

Use of the information I provide for this project only

- | | | |
|---|--------------------------|--------------------------|
| I understand my personal details such as phone number and address will not be revealed to people outside the project. | <input type="checkbox"/> | <input type="checkbox"/> |
| I understand that my words may be quoted in publications, reports, web pages, and other research outputs. | <input type="checkbox"/> | <input type="checkbox"/> |

Use of the information I provide beyond this project

- | | | |
|---|--------------------------|--------------------------|
| I agree for the data I provide to be archived by the researcher for up to 10 years. | <input type="checkbox"/> | <input type="checkbox"/> |
|---|--------------------------|--------------------------|

So we can use the information you provide legally

- | | | |
|---|--------------------------|--------------------------|
| I agree to assign the copyright I hold in any materials related to this project to Mr. Dmitriy Katkov | <input type="checkbox"/> | <input type="checkbox"/> |
|---|--------------------------|--------------------------|

PRINT NAME _____

WORK NAME _____

WORK ADDRESS _____

POSTCODE _____ COUNTRY _____

TELEPHONE _____ E-MAIL _____

I would like a copy of the summary of the research sent to me at this email address YES/NO _____

SIGNATURE _____ DATE _____

Please return the copy of this form to the interviewer.

Please keep the other copy of this form and the information sheet for your own records.

THANK YOU VERY MUCH FOR YOUR TIME!

Appendix D

Profiles of Interviewees

Participant	Age Category	Gender	Experience in years*	Independent FA?	Highest level of Education	Brokerage licence	Previous employments	Works in a capital city?	Comments
FA1	30-35	Male	8 (10)	No	Masters – finance	Yes	Two commercial banks	Yes	Worked in a small city for 2 years
FA2	30-35	Male	7 (11)	No	Bachelor – business	Yes	No	No	Frequently helps marketing department
FA3	35-40	Female	11 (11)	No	Masters – finance	Yes	Insurance company	Yes	Studying for actuary licence
FA4	25-30	Male	4 (6)	No	Bachelor – economics	No	No	Yes	Active proprietary trader himself
FA5	25-30	Female	6 (7)	No	Masters – economics	Yes	No	No	
FA6	25-30	Male	4 (5)	No	Bachelor – engineering	No	Non-financial company	Yes	
FA7	35-40	Male	9 (13)	Yes	Phd – management	Yes	Commercial bank, brokerage company	Yes	Personal Financial Planner, designation
FA8	45-50	Female	12 (14)	Yes	Bachelor – business	Yes	Pension fund provider	No	Chartered Financial Analyst, designation

* as related to financial advice, overall experience in financial sector in brackets

Appendix E

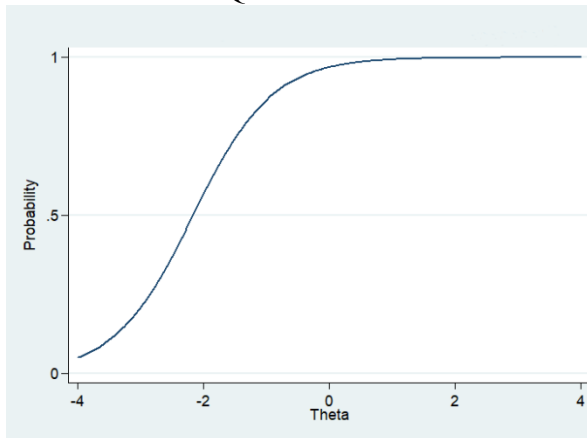
Item-test Correlations and Cronbach's Alpha

Item	Observations	Sign	Item-test correlation	Item-rest correlation	Average interitem covariance	Alpha
LQ1	1554	+	0.4065	0.3230	0.0434999	0.7316
LQ2	1554	+	0.5386	0.4382	0.0402702	0.7185
LQ3	1554	+	0.5137	0.3637	0.039238	0.7251
LQ4	1554	+	0.4076	0.2667	0.0421484	0.7360
LQ5	1554	+	0.6108	0.4896	0.0372731	0.7085
LQ6	1554	+	0.6053	0.4829	0.0373921	0.7094
LQ7	1554	+	0.6067	0.4825	0.0372708	0.7092
LQ8	1554	+	0.4691	0.3148	0.0404004	0.7314
LQ9	1554	+	0.4931	0.3463	0.0398912	0.7271
LQ10	1554	+	0.5509	0.3481	0.0395446	0.7272
LQ11	1554	+	0.3913	0.2242	0.0423061	0.7437
LQ12	1554	+	0.5993	0.4672	0.0371785	0.7108
Test scale					0.0397011	0.7406

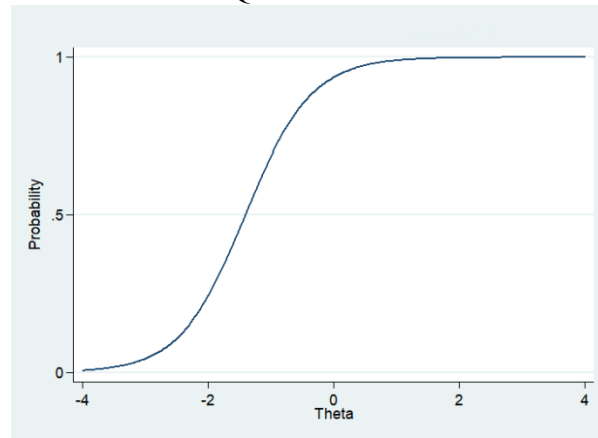
Appendix F

Item Characteristic Curves

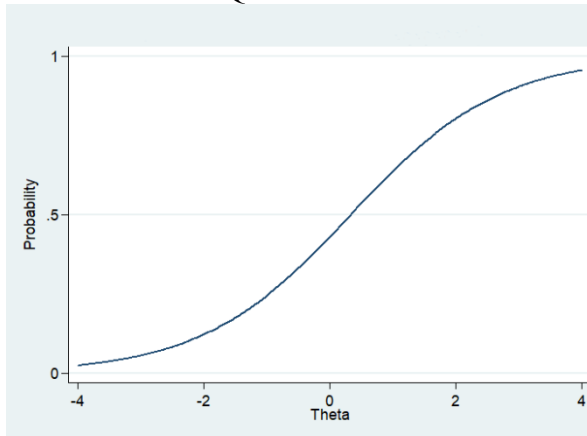
Question 1



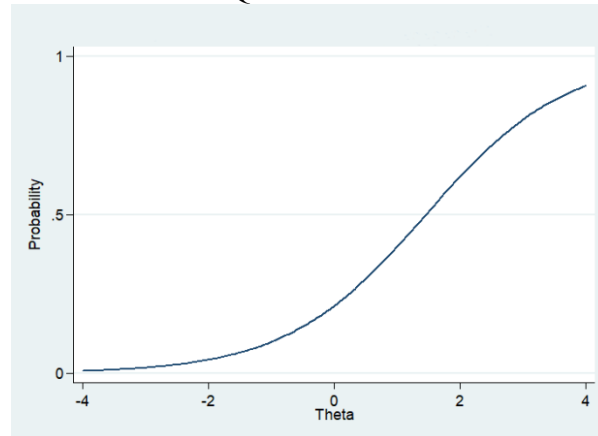
Question 2



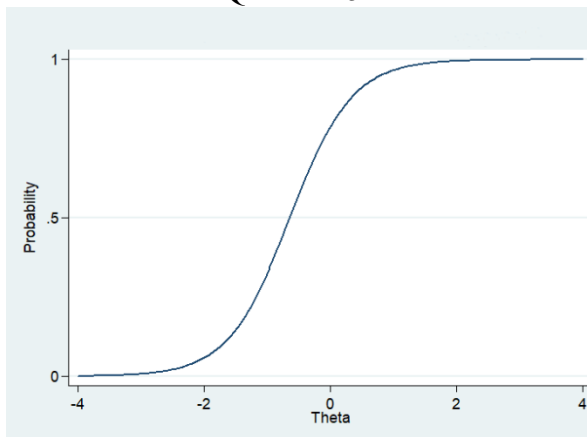
Question 3



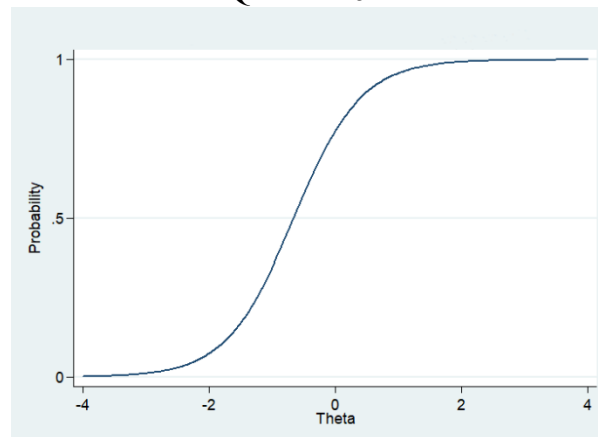
Question 4



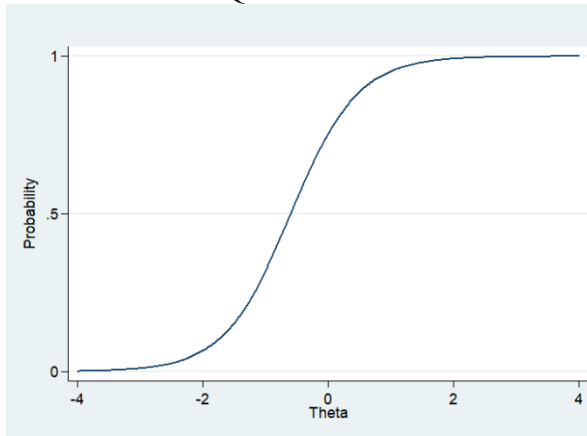
Question 5



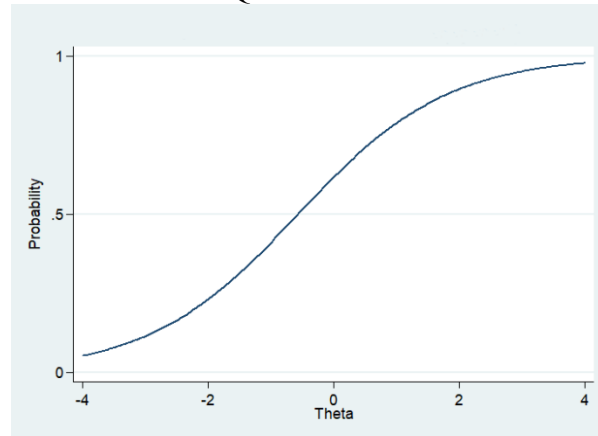
Question 6



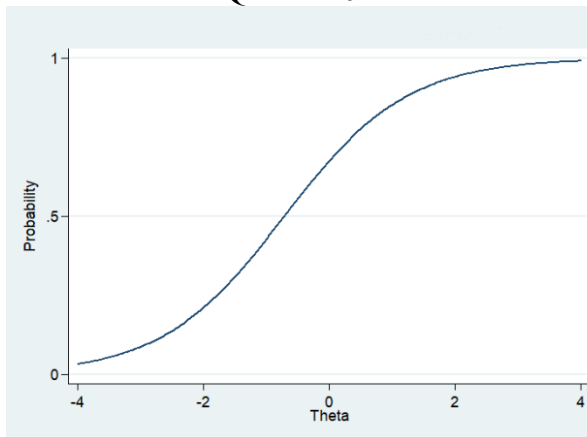
Question 7



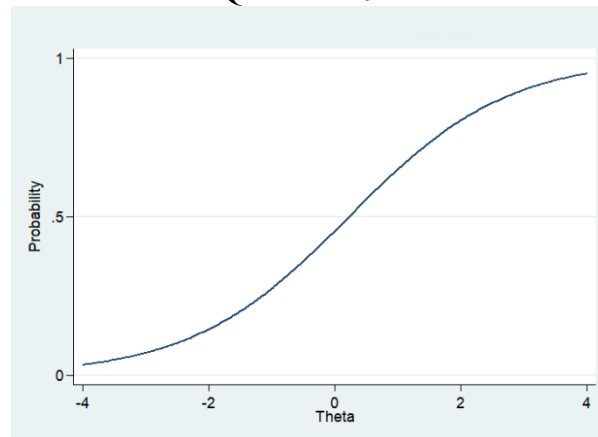
Question 8



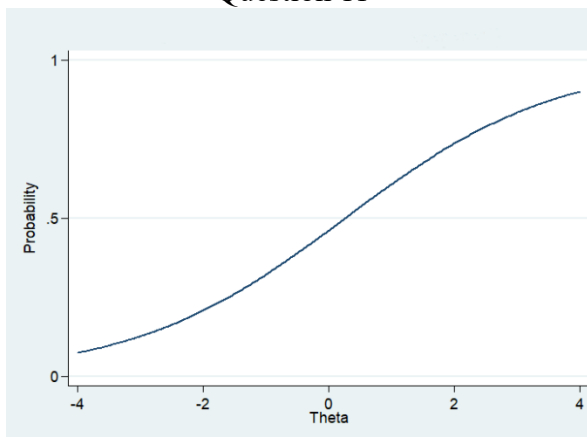
Question 9



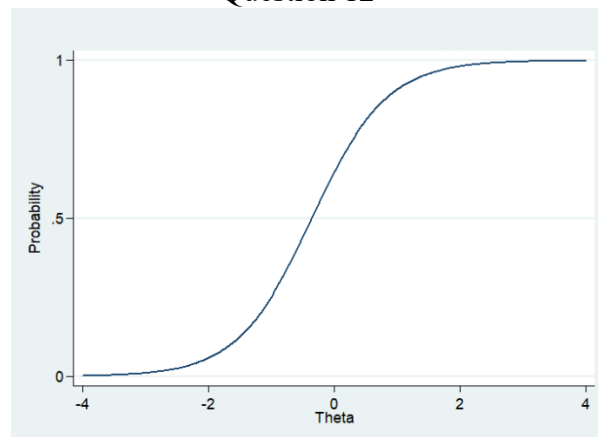
Question 10



Question 11



Question 12



Appendix G

Likelihood Ratio Test Result for an Initial Model

	STOCKS_DIRECT	STOCKS_INDIRECT
	Main model	
TEST_SCORE	0.2394899 (0.18)	0.0138455 (0.01)
INCOMECAT		
from 1151 to 1800	-0.1092038 (0.15)	-0.0024880 (0.01)
from 1801 to 2600	-0.1984113 (0.19)	-0.0115293 (0.02)
more than 2600	-0.0446494 (0.14)	0.0002373 (0.01)
WEALTH_CAT		
20000-40000	-0.2175448 (0.20)	-0.0047022 (0.01)
40000-60000	-0.0954339 (0.13)	0.0267909 (0.03)
60000-80000	-0.1130114 (0.16)	-0.0011073 (0.01)
80000-100000	-0.1069229 (0.16)	0.0284844 (0.03)
100000-120000	0.2446947 (0.23)	0.0543837 (0.09)
120000-140000	0.7877087 (0.81)	0.2727552 (0.55)
140000-200000	0.5797409 (0.74)	-0.0051291 (0.03)
200000 and above	0.1231510 (0.32)	0.0327014 (0.08)
EDULEVEL		
secondary (up to 16)	0.4034523 (0.35)	0.0641311 (0.08)
secondary (up to 18)	0.4641143 (0.39)	0.0539686 (0.07)
vocational	0.3502150 (0.32)	0.0752228 (0.09)
professional bachelor	0.3538754 (0.32)	0.0627246 (0.08)
university	0.2827183 (0.30)	0.1031588 (0.11)
AGE	0.0220005 (0.02)	-0.0028056 (0.00)
AGE2	-0.0001340 (0.00)	0.0000408 (0.00)
PARTNER	-0.0416097 (0.09)	0.0026569 (0.01)
GENDER	-0.0332854 (0.08)	-0.0058148 (0.01)
CHILD	0.0193266 (0.08)	0.0027823 (0.01)
RISK_TOLERANCE	0.4049557 (0.30)	0.0140341 (0.01)
TRACKING	0.0132454 (0.04)	-0.0027125 (0.01)
THOUGHTOLDAGE	0.0502768 (0.06)	-0.0056897 (0.01)
SELFEMPLOYED	-0.0580442 (0.15)	0.0196935 (0.02)
OWNHOUSE	0.0927033 (0.11)	0.0004827 (0.01)
Constant	-5.1533182 (3.78)	-0.1727942 (0.21)

	Variance model	
TEST_SCORE	-0.0445949 (0.03)	-0.0783979** (0.03)
INMECATS		
from 1151 to 1800	-0.0986666 (0.19)	-0.0949404 (0.29)
from 1801 to 2600	-0.0950055 (0.20)	0.1394128 (0.35)
more than 2600	-0.2892321 (0.23)	0.3849878 (0.33)
WEALTHCAT		
20000-40000	0.5642580** (0.26)	-0.3455576 (0.33)
40000-60000	0.8238579*** (0.25)	0.3329624 (0.34)
60000-80000	0.8091546*** (0.27)	-0.5101049 (0.38)
80000-100000	1.0268268*** (0.26)	0.0304010 (0.37)
100000-120000	0.8496974*** (0.33)	0.2464474 (0.89)
120000-140000	1.6924087*** (0.48)	1.0378919 (1.61)
140000-200000	1.5832044*** (0.58)	-1.4717574 (1.56)
200000 and above	0.3312474 (0.68)	-1.3858669 (1.02)
EDULEVEL		
secondary (up to 16)	-0.1142986 (0.30)	-0.2952593 (0.38)
secondary (up to 18)	-0.0192928 (0.30)	-0.4892482 (0.40)
vocational	-0.0467579 (0.31)	-0.2702104 (0.39)
professional bachelor	-0.0501039 (0.30)	-0.1067560 (0.42)
university	0.2473202 (0.32)	1.1573210 (1.41)
AGE	0.0051411 (0.02)	-0.0400772 (0.04)
AGE2	-0.0000318 (0.00)	0.0004403 (0.00)
PARTNER	0.3319646** (0.14)	0.3946290** (0.20)
GENDER (female)	0.1587014 (0.12)	0.0372197 (0.17)
child_dummy	-0.1501009 (0.13)	-0.1934458 (0.20)
RISK_TOLERANCE	-0.1132914*** (0.04)	-0.1587502*** (0.06)
inv_TRACKING	-0.0956964 (0.06)	-0.0546409 (0.11)
inv_THOUGHTOLDAGE	-0.1018120 (0.08)	-0.0965978 (0.10)
SELFEMPLOYED	0.0197425 (0.27)	-0.6211482* (0.38)
OWNHOUSE	0.0268504 (0.12)	-0.0013506 (0.19)
Observations	1532	1532
Likelihood-ratio test	60.49***	64.81***
Pseudo-R ²	0.4685	0.1954