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THREE ESSAYS ON HOUSEHOLD FINANCE

by

MIGUEL AMPUDIA FRAILE

B.A., in Business Administration, Universidad Autónoma de Madrid, 2005
M.A., in Political Economy, Boston University, 2010

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Approved by

First Reader [redacted]

Laurence Kotlikoff, Ph.D.
Professor of Economics

Second Reader [redacted]

Jordi Jaumandreu, Ph.D.
Senior Academic Researcher in Economics

Third Reader [redacted]

Michael Ehrmann, Ph.D.
Bank of Canada Director

to my parents

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MIGUEL AMPUDIA FRAILE

Boston University, Graduate School of Arts and Sciences, 2014

Major Professor: Laurence Kotlikoff, Professor of Economics

ABSTRACT

This dissertation is composed of three papers that shed light on the stock-market participation puzzle. The first article studies different aspects of the participation of Spanish households in the stock market. I start by analyzing the determinants of stockholding in a reduced form setting, quantifying the importance of different socioeconomic variables on the decision to hold stock. This is complemented by a comparison with US stocking-holding behavior, especially that of highly sophisticated households who might be expected to participate fully in the market. The second article develops and estimates a full consumption and portfolio-choice life-cycle model to help explain the behavior uncovered in the first article. This model includes a fixed cost for participation in the stock and produces empirically sensible simulations of households' stock-holding patterns by age. It shows the powerful effect that the fixed cost has in explaining the non-participation issue. Moreover, using data from Spanish households I estimate this fixed cost. The third article, co-authored with Michael Ehrmann, breaks away from classic models and delves into the importance of considering more behavioural or psychological issues to explain this puzzle. In particular, we look at the effect of past macroeconomic experiences on the households'

portfolio choice and risk-taking behaviour. We find that the average stock market return experienced by a household through its life time has a significant effect on its decision to hold stock. Moreover, disastrous events such as stock market crashes remain in people's minds and deter them from investing for a long period after the event happened.

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List of Abbreviations

DG-R	Directorate General Research
ECB	European Central Bank
EFF	Encuesta Financiera de las Familias
HFCS	Household Finance and Consumption Survey
NLS	Non Linear Least Squares
SCF	Survey of Consumer Finances
USA	United States of America

Chapter 1

Stockholding in Spain

1.1 Introduction

Standard portfolio theory, embodied in the mean-variance expected utility model, predicts that households will always hold part of their portfolio in risky assets, the exact quantity being a function of the equity premium and the volatility of the risky assets' portfolio (See Markowitz (1952) and Tobin (1958)). Despite this fact, many empirical studies[1] have shown that the majority of the population does not participate in the stock market, resulting in the well documented stockholding puzzle. The goal of this paper is twofold. First, to offer a comprehensive view of stockholding in Spain. Second, to answer the question: why households do not hold stocks? We base our analysis on the mean-variance expected utility model with entry costs. We look at how these entry costs, whether monetary or informational, can explain the lack of participation in the stock market. This study contributes to the existing literature by exploring the stockholding pattern in a country not studied before (Spain), while situating it in an international context and explicitly comparing it with the US, by analysing the effect of entry costs through the use

[1] See Guiso et al. (2002) for a collection of studies conducted in different countries.

of new proxies, and by testing the extent of these hypotheses by looking at a sample of so-called "sophisticated households".

The decision of whether to participate in the stock market or not has a significant impact on the net worth of a household over the long run. Holding stocks is risky due to price fluctuations and non-guaranteed capital; however, refraining from participation in the stock market entails a risk too. With a 6% average annual equity premium over the past century (see Kocherlakota (1996)), a household investing $100 monthly in the stockmarket for 30 years will retire with $100,452 more in savings than a household who had invested the same amounts in long term risk-free assets (such as government bonds).[2] While most households are fully aware of the former kind of risk, few of them seem concerned about the latter one, which can be thought of as an opportunity cost.

From a macroeconomic point of view, household participation in the stockmarket is also important. A high household participation rate contributes to the liquidity of capital markets, and liquid capital markets allow firms to have a reliable alternate funding channel to traditional banking. This in turn results in faster economic growth. Moreover, by participating in the stockmarket and allocating their funds among industries and sectors, agents are contributing to shape the country's economic structure.

The stockholding puzzle has been widely documented using data from different countries (e.g., Bertaut and Starr-McCluer (2000) analyses the US, R.Alessie et al. (2000) the Netherlands and Guiso and Jappelli (2000) uses data from Italy) and alternative explanations to it have been proposed such as the combination of high cost of borrowing

[2]This number is calculated as the difference in future value between two investments whose annualized returns differ by a 6%yield. It ignores the uncertainty embedded in the stock price which could cause a major drop in capital if the household retires at a particular bad time for the stock market.

and uncertain labor earnings (Davis et al. (2006)) or the heterogeneity in expectations (Vissing-Jorgensen (2003))[3]. The role of entry costs has been documented for the US by Vissing-Jorgensen (2000) using data from the Panel Study of Income Dynamics. Haliassos and Bertaut (1995) and Bertaut (1998) also identify the role of information costs in deterring stock market participation.

Our paper offers a descriptive view of the state of stockownership in Spain and a more formal analysis of the determinants of stockholding. For this we use a Heckman selection model, which allows us to look at both the decision of holding stock and the amount of stock on the portfolios of those who are holding any. We use a number of household characteristics as regressors following Guiso et al. (2003) for comparability reasons, and adding some economically meaningful variables obtained from our data set. We carry out a direct comparison with the US, which can be considered as the reference case in terms of financial markets development. We also explore the stockholding patterns of a subsample of households which are college-educated, work in the financial industry and whose net worth is above the median of the economy. From here on we will refer to these households as "sophisticated households". Lastly, we use a multivariate probit model to explore how the decision of holding stock is related to the decision of holding other types of assets.

The rest of this paper is organized as follows. Section 2 introduces the model of portfolio selection with entry costs. Section 3 explains the contents and methodology of the data (Encuesta Financiera de las Familias). Section 4 presents the results of the descriptive and econometric analysis. Section 5 concludes.

[3]See King and Leape (1998) and Haliassos and Bertaut (1995) for good reviews

1.2 The Model: Portfolio Selection with Entry Costs

In the basic expected-utility model, a household who lives for one period has to decide how to allocate its wealth among a variety of risky assets and a risk-free asset that will be liquidated at the end of the period to finance consumption. There are N states of the world indexed by i, $i = 1,...,N$. The uncertainty is described by the probability p_i that state i occurs, with $\sum_i p_i = 1$. Financial markets are assumed to be complete, meaning that for each state i, there exists an associated state price (per unit of probability) $\pi_i \geq 0$. In other words, the agent must pay $p_i\pi_i$ at the beginning of the period to increase his consumption by one unit in state i. The objective of the household is to maximize its expected utility subject to a budget constraint. This is the classical static portfolio problem of a risk-averse investor in an Arrow-Debreu economy. Formally:

$$max_{C_1,...,C_N} \sum_{i=1}^{N} p_i u(C_i) \tag{1.1}$$

$$s.t. \sum_{i=1}^{N} p_i \pi_i C_i = X \tag{1.2}$$

Since Tobin (1958), we know that, under the assumptions of the mean-variance model and in the absence of entry costs, investors will choose a combination of the safe asset and the portfolio of risky assets with the largest Sharpe ratio (the ratio of the average excess return to the standard deviation). Denote by R the gross return of the risk-free asset and by $\widetilde{R}_s$ the excess return of the portfolio of risky assets. Under CARA preferences and with $\widetilde{R}_s$ distributed normally, the optimal share invested in risky assets (w) is determined as

follows:

$$w = R\frac{E\widetilde{R}_s}{\sigma_s^2}\frac{1}{\rho}, \tag{1.3}$$

where σ_s^2 is the variance of $\widetilde{R}_s$, and ρ is the coefficient of relative risk aversion evaluated at wealth level XR. This result indicates that for positive expected returns and a finite coefficient of risk aversion every household should invest part of its wealth in risky assets. Thus, we should expect universal participation in the stock market.

In the real world, there exist entry costs to the stock market, both informational and monetary, which may prevent some households from holding stock. Investing in stocks requires to set up a brokerage account, monitor it and pay recurring maintenance fees as well as punctual operative ones. In the presence of entry costs, households compare the utility they derive from a riskless portfolio with the utility obtained from their optimal portfolio including risky assets minus the participation costs. Denoting the entry costs by EC, a household will only participate in the stock market if:

$$Eu(X(1-w)R + w(X\widetilde{R}_s - EC)) \geq u(XR) \tag{1.4}$$

The higher the investor's wealth and the larger the potential gains from the equity premium, the more likely is the investor to hold risky securities. Less wealthy households will not enter the stock market since the utility loss suffered from not participating will be lower than the utility loss caused by the fixed cost they need to pay to enter. In other words, it is rational for them to stay out of the market. The model predicts a

strong correlation between stock market participation and the investor's wealth, which can in turn explain why not all households invest in stocks. To the extent that they are correlated with entry costs, other individual characteristics may also matter. For instance, educational attainment is an important factor to overcome information costs.

1.3 The Data: Encuesta Financiera de las Familias

The Encuesta Financiera de las Familias (EFF) is a survey conducted every three years by the Bank of Spain which collects data on wealth, income, debt, consumption and demographic characteristics from a representative sample of Spanish households. The first survey was conducted in 2002, followed by a second wave in 2005[4]. The latter one contains a refreshment sample and a panel, with around half of the households interviewed in 2002 being interviewed again in 2005. For our study we will make use of the 2005 wave since it is the most current one.

The 2005 sample contains information on 5,962 households who were interviewed in person between October 2004 and May 2005. Of the total number of households, 2,580 were also interviewed in 2002 and therefore constitute a panel. The survey is divided in the following sections: demographics, real assets and their associated debts, other debts, financial assets, pension plans and life insurance, labor market situation and labor income for each household member, non-labor income in the previous calendar year, means of payments and consumption.

A desirable characteristic of the EFF is the oversampling of wealthy households. Many types of financial assets are only held by the wealthiest households and therefore it is

[4]A new wave was conducted in 2008 but the data was not available at the time the paper was written.

necessary to pay special attention to this group not only for representativeness of the population but also of the aggregate wealth. The missing values have been multiply imputed using relevant econometric techniques. All standard errors calculated in this paper are adjusted for the multiple imputation. For a detailed explanation of the survey methodology Bover (2008).

1.4 Results

The studies done for other European countries and the US indicate that the level of participation of the general population in the stock market is low, ranging from 7% to 27% for direct participation and from 15% to 54% for indirect participation in 1998 (Guiso et al. (2003)). We should expect to find a similar pattern for Spain. Moreover, a few characteristics of the Spanish case indicate that we can expect an even lower participation rate. In the first place, Spanish households show a relatively high preference for owning their main residence (81.3% of Spanish households own their primary residence, while only 68.3% of US households do so). Investment in housing usually compromises all the available savings of the household, especially in the case of younger ones, which precludes them from investing in other type of assets. Secondly, the level of financial literacy of Spanish households is low relative to that of other developed countries. Jappelli (2010) compares the level of economic literacy (used as a proxy for financial literacy) using data from the IMD World Competitiveness Yearbook from 1995 to 2004, and ranks Spain far behind the US and the rest of western European countries (except Italy).

For our econometric analysis in section 3.2, we will analyse the Spanish case and we will compare it explicitly and in detail with the US one. For this comparison, we will make

use of the Survey of Consumer Finances (SCF). The reason for doing the comparison with the US is twofold. First, the US can be considered as a benchmark case of financial development and participation in financial markets. Second, both the EFF and the SCF provide us with some extra benefits that we cannot find in any other surveys. In the first place, due to the close structure of both surveys, we can do a comparison using exactly the same variables in our analysis. In addition, and more importantly, both the EFF and the SCF provide an oversampling of rich households which allows to capture the whole distribution of wealth in the population. For a detailed explanation on the SCF data see Bucks et al. (2009).

1.4.1 Descriptive analysis

In order to assess the holding of risky assets by households two different measures are employed. The first one, referred to as direct stock, consists of traded and non-traded stocks held directly by the households. The second one, indirect stock holding, is a broader measure which includes mutual funds which invest mainly in stock[5]. Note that we do not include participation through pension plans since we do not have data on their specific asset composition.

The level of households' participation in the stock market in Spain is low. In 2005, 13.05% of Spanish households held stock directly and 16.68% of them did so indirectly. These figures are clearly far from universal participation and relatively low compared with other European countries (for data of 1998, only Italy showed a lower participation rate).

[5] Although we have information on households owning other financial products which could be consider riskier and more sophisticated than stocks (i.e. options, futures and swaps) we do not include them here since we do not have information about their market value (this is a deliberate point made in the survey construction since it is sometimes not possible to know the value of such products and even if known it is not very relevant due to the non-linearity of their pay-offs). Anyway, there are only 4 households who declare holding these type of products and not holding stock.

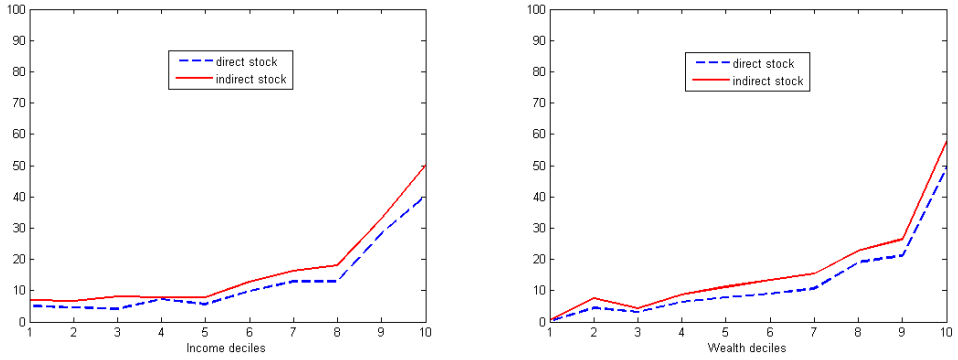
Table 1.1: Households owning stocks by demographic characteristics

	Direct stock	S.E.	Indirect stock	S.E.
All sample	13.1	(0.67)	16.7	(0.75)
College degree	31.6	(2.4)	37.8	(2.4)
No college degree	9.2	(0.6)	12.3	(0.7)
Age 16-30	8.5	(2.4)	10.4	(2.7)
Age 31-40	10.2	(1.4)	14.0	(1.7)
Age 41-50	14.4	(1.5)	19.6	(1.7)
Age 51-60	20.0	(1.9)	22.7	(2.0)
Age 61-70	13.8	(1.6)	17.2	(1.7)
Age 70+	9.0	(1.2)	12.7	(1.4)
I wealth quartile	2.3	(0.6)	3.8	(0.9)
II wealth quartile	6.2	(1.1)	8.9	(1.2)
III wealth quartile	11.6	(1.3)	15.7	(1.4)
IV wealth quartile	32.1	(1.8)	38.4	(1.9)
I income quartile	4.7	(0.9)	6.9	(1.0)
II income quartile	5.8	(0.9)	7.7	(1.0)
III income quartile	11.9	(1.5)	15.4	(1.7)
IV income quartile	29.8	(1.9)	36.7	(2.1)

(All values are percentages.)

Table 1 shows that 31.62% of households with a college degree held stock directly; whereas among those households who do not hold a college degree, the statistic drops to 9.19%. For the indirect holding of stocks the values are 37.80% and 12.30% respectively. When looking at the age of the households holding stock, the data shows a hump-shaped pattern; with ownership increasing with age, peaking at the age group 51-60 and decreasing afterwards. The distribution along levels of income is flat for the first income deciles, starts growing slowly when the median of the distribution is reached and grows substantially faster for the last two deciles of the distribution. This pattern is exhibited in both the direct and indirect stock holding measures (see Figure 1). Wealth and stockholding are positively and monotonically related, with large increases in between deciles for the richest households; 22.29% of households own stock directly and 27.81% do so indirectly in the next to last decile. The numbers for the last decile are 49.19% and 57.25% respectively.

Figure 1·1: Percentage of households owning stocks directly or indirectly.



(a) By income deciles

(b) By wealth deciles

1.4.2 Econometric analysis

The existence of entry costs, whether these are informational or monetary, will result in richer and more educated households exhibiting a higher participation rate in the stock market. In order to test this hypothesis, and following the many studies done for diverse countries,[6] and in particular the work of Guiso et al. (2003), we regress stockownership on a series of variables including income, wealth and education. The econometric analysis can be carried out following different methods. There are two regressions to run, one for stockownership and one for the share that the stock owned represents in the overall portfolio. Moreover, it makes sense to think that there is a correlation between the decision of whether to hold risky financial assets or not and the decision on the amount of these assets held. For this reason, the most favoured treatment in the literature is to make use of a sample selection model[7]. We follow this approach by modelling the demand for stocks as a two-stage decision process, first households make a participation decision and then

[6]Studies for the US, the UK, Italy, Germany and the Netherlands are collected in Guiso et al. (2002).
[7]See Bertaut and Starr-McCluer (2000).

they decide on the amount of assets they want to hold.

For comparability purposes, following Guiso et al. (2003), the following independent variables are included in the regression: age, income, wealth, education, marital status and family size. Income, wealth and education are variables which exhibit a high positive correlation; it is important, therefore, to disentangle the effect that each one of them can have on the decision to hold stocks. Traditional portfolio theory tells us that wealth should not affect the decision of whether to hold stocks or not, since these (or an equivalent risky asset) should be part of every household's properly-diversified portfolio. However, if there are entry costs, we should expect wealth to play a key role in the stock ownership decision.

In order to use the Heckman selection model, it is necessary to specify suitable identification restrictions; that is, variables which affect the decision of whether to hold risky financial assets or not, but that they do not affect the decision of the amount of the assets that will be held. The variables we employ are: the use of on-line banking and the fact that the household head works in the financial industry. We argue that these two variables have an important effect on the fixed cost of participating in the stock market but a negligible one on the variable cost of investment. Once an investor has set up a brokerage account and he has learned the operative details, sending orders to the market has a very low cost (a phone call maximum), and therefore it cannot be reduced much more. However, the fixed cost of entering is higher, and it seems reasonable to think that it can be lowered if the potential investor works in the financial industry (thus lowering the informational cost) or uses the internet to handle his financial operations (which lowers both the informational and the financial cost). To justify our choice of selection variables we also report the results of running a simple OLS regression instead of the Heckman

selection model. The coefficients reported in both models differ substantially, thus indicating that our selection variables are meaningful (see the Appendix for the full results of the OLS regression for both the Spanish and US data).[8]

Results for the selection model for both Spain and the US are contained in tables 2 and 3. For comparability purposes and ease of interpretation, the coefficients we report for the first-stage regression of the selection model represent the effect of the different explanatory variables on the probability of owning stock. Age is not significant in the lower bins (up to age 50 in Spain and up to age 40 in the US), but it is significant at the 1% level for the bins containing ages over the aforementioned ones. This pattern of behaviour might seem at odds with what traditional financial planning advocates for, but the result is consistent with the findings of Guiso et al. (2003) for the US, the UK, Germany, France and the Netherlands. Age plays a more important role in the case of the US, especially for the upper bins. Both income and wealth are highly significant (at the 1% level) and have a significant effect on the decision of holding stock, being the effect bigger in both cases for Spain. Education is also significant at the 1% level. The effect of this variable is almost double for the US case compared with Spain.

Now we look at the variables that we believe could have an impact on the decision of holding stock if entry costs were present. These are, for Spain, the use of on-line banking and whether the household head works in the financial industry or not; and for the US, how much does the household shops around when looking for investment opportunities. We also want to control for the attitude towards risk of the households when investing

[8]Note that for the US case we use as our selection variable 'degree of research done before buying an investing product', following Bertaut and Starr-McCluer (2000). Due to privacy concerns the FRB does not release publicly the information we would need to construct the selection variables we use in the Spanish case.

Table 1.2: Heckman selection model: Direct stock holding

	Spain		US	
	Ownership	Share	Ownership	Share
Married	0.051***	-0.032	0.105***	0.018
	(0.012)	(0.023)	(0.007)	(0.017)
Family size	0.0004	-0.013	-0.008***	0.006
	(0.005)	(0.009)	(0.003)	(0.003)
College	0.109***	-0.011	0.189***	0.037
	(0.011)	(0.022)	(0.005)	(0.027)
Age 31 to 40	0.007	-0.013	0.004	-0.075***
	(0.032)	(0.073)	(0.013)	(0.020)
Age 41 to 50	0.042	-0.051	0.077***	-0.047**
	(0.030)	(0.072)	(0.012)	(0.022)
Age 51 to 60	0.110***	-0.049	0.114***	0.031
	(0.030)	(0.073)	(0.011)	(0.025)
Age 61 to 70	0.139***	-0.024	0.166***	0.062**
	(0.030)	(0.072)	(0.012)	(0.030)
Age 70+	0.173***	0.047	0.251***	0.199***
	(0.030)	(0.074)	(0.012)	(0.038)
Income	6.31e-07***	-5.60e-10	5.27e-09***	1.86e-09***
	(1.04e-07)	(3.20e-08)	(7.02e-10)	(6.38e-10)
Net wealth	5.24e-08***	4.10e-09***	3.61e-10***	4.80e-10***
	(4.20e-09)	(5.18e-09)	(4.19e-11)	(5.27e-11)
Seeking some risk	0.202***	-0.035	0.188***	0.085***
	(0.011)	(0.026)	(0.007)	(0.029)
Seeking fair risk	0.181***	0.059*	0.249***	0.123***
	(0.026)	(0.038)	(0.008)	(0.037)
Seeking a lot of risk	0.160***	0.067	0.269***	0.158***
	(0.041)	(0.059)	(0.013)	(0.040)
Work in finance	0.080***			
	(0.022)			
Use on-line banking	0.059***			
	(0.013)			
Degree of shopping			0.012***	
			(0.002)	
Constant	-2.086***	0.569***	-2.200***	-0.035
	(0.134)	(0.100)	(0.050)	(0.125)
Mills ratio	-0.115***		0.138***	
	0.032		0.054	
Observations	5,962	5,962	4,418	4,418

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.3: Heckman selection model: Indirect stock holding

	Spain		US	
	Ownership	Share	Ownership	Share
Married	0.044***	-0.027	0.139***	-0.034***
	(0.012)	(0.020)	(0.006)	(0.010)
Family size	-0.005	-0.016**	-0.018***	-0.004
	(0.005)	(0.008)	(0.002)	(0.003)
College	0.108***	0.002	0.182***	0.013
	(0.012)	(0.020)	(0.005)	(0.011)
Age 31 to 40	0.050*	0.01	0.090***	0.044***
	(0.034)	(0.069)	(0.010)	(0.015)
Age 41 to 50	0.089***	0.017	0.182***	0.067***
	(0.032)	(0.068)	(0.010)	(0.017)
Age 51 to 60	0.131***	0.011	0.201***	0.073***
	(0.033)	(0.069)	(0.010)	(0.017)
Age 61 to 70	0.187***	0.045	0.213***	0.081***
	(0.033)	(0.069)	(0.011)	(0.018)
Age 70+	0.220***	0.131**	0.237***	0.138***
	(0.032)	(0.071)	(0.011)	(0.019)
Income	1.24e-06***	6.30e-08**	4.00e-08***	1.51e-09***
	(1.42e-07)	(3.10e-08)	(4.48e-09)	(4.45e-10)
Net wealth	6.68e-08***	4.50e-09***	1.86e-09***	2.91e-10***
	(5.47e-09)	(1.20e-09)	(2.31e-10)	(4.41e-11)
Seeking some risk	0.218***	0.004	0.237***	0.029*
	(0.012)	(0.022)	(0.006)	(0.016)
Seeking fair risk	0.181***	0.093***	0.301***	0.100***
	(0.030)	(0.036)	(0.007)	(0.018)
Seeking a lot of risk	0.135***	0.189***	0.223***	0.128***
	(0.046)	(0.055)	(0.013)	(0.019)
Work in finance	0.097***			
	(0.024)			
Use on-line banking	0.080***			
	(0.014)			
Degree of shopping			0.011***	
			(0.002)	
Constant	-2.014***	0.559***	-2.200***	0.413***
	(0.134)	(0.088)	(0.050)	(0.045)
Mills ratio	-0.092***		-0.052**	
	0.029		0.024	
Observations	5,962	5,962	4,418	4,418

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

their assets. It could be that the results obtained are just derived from the fact that richer and more educated households are less risk averse and this is why they are willing to participate more in the stock market.

First of all, controlling for the risk attitude of the households explains an important part of the puzzle by itself. The variable reflecting the household's attitude towards risk when making an investment is significant for both countries for the case when the household is willing to take on some risk, the case when the household is willing to take on substantial risk and the case when the household is willing to take on a lot of financial risk (the results for this last variable are not very reliable due to the small number of observations available). For Spain, the effects on the probability of holding stock decrease with the amount of risk the household is willing to take, while in the US we observe the opposite pattern; the more risk the household is willing to assume, the higher the probability he owns stock. In all cases, the effects are substantial in absolute terms, being willing to bear on some risk when investing increases the probability of owning stock by 0.20 percentage points in Spain and by 0.18 percentage points in the US. These effects are also important in their relative size, being much so for Spain, where we find an effect as large as twice the effect of having a college degree. The fact that the risk attitude plays a role in the holding of stocks is an indication of the households' misinformation about the stock market. A frictionless model will have households owning stock no matter what their attitude towards risk is. This one should influence the share of stock held, but not the participation decision. It is also important to note the relative size of this effect and the fact that seeking some or substantial risk have an effect of the same dimension. This is not surprising since we are looking at the decision of just holding stock, a decision which

we expect to be positive for any agent willing to take on any financial risk. We would expect that households willing to take on different amounts of risk would differ on the amount of risky assets that they hold, but not on the decision whether to hold them or not.

We also look at the effect of the household being an on-line banking user. The fact that stocks can be bought and sold through on-line brokers brings down participation and information costs. On-line trading is usually less costly than the traditional telephone or physical services in terms of fees, plus it is less time consuming and allows the investor to access a great wealth of information with reduced effort. The effect of being an on-line banking user is significant at the 1% level.

If information costs are one of the reasons why households do not participate in the stock market, a higher participation rate should be expected from those households working in the financial services industry. This is exactly what we find, with households whose head works in the financial services industry having a probability of owning stock much higher than those working in other industries.

For the US, the effect of shopping around when looking for investment opportunities is also significant at the 1% level.

Summarizing, the main factors affecting stock holding in both countries are age, income, wealth and education. Age is a more important factor in the US than in Spain, while income and wealth have a bigger effect in Spain. The effect of education is almost double in the US than in Spain and the risk aversion exhibited by the household has opposite effects on both countries (in the US, the more financial risk a household is willing to assume the higher the probability it owns stock, while the opposite is observed for Spain).

These differences may reflect the unequal degree of development of financial markets in both countries. The higher degree of competition and development existing in the US results in more complex markets but with lower entry costs. Investors in the US have more options to choose from when making their investment decisions, more information and access to a more diverse supply of service providers (brokers, financial advisors, fund managers...). This complexity results in education and age playing a more important role in the investment decision. On the other hand, the more competition present in the market makes it cheaper to own stock. Because of this, income and wealth play a more important role in the stock holding decision in Spain.

The results for the share of funds allocated to stocks differ greatly between the direct or indirect holding of stocks. In the first case, the only significant variable is the net wealth of the household, while in the latter case, family size, old age, income, wealth and attitude towards financial risk are all significant at the 5% level. These results are contradictory to both what classical financial theory and conventional financial advise postulate. According to the basic mean-variance model, rich households should behave as scaled-up version of less wealthy ones if we are controlling for risk aversion. The results in Tables 3 and 4 show that the share of stock is still positively correlated with wealth, although the quantitative effect is very small. With respect to age, the behaviour of households is opposite to the one advocated by conventional financial wisdom; older households hold a higher share of their portfolios in risky financial assets. The results for the US reveal some differences with Spain. Age, income, wealth and risk aversion all play a role, not only in the share of risky assets held for the case of indirect stock, but also for the direct one. The disagreement with classical financial theory and conventional financial advise is only but magnified in

the American case.

Following the work of Christelis et al. (2012) we can go one step further in our country comparison and decompose the difference between the stock market participation rate observed in both countries into two components: a part that corresponds to the structural difference between countries and a part which is due to the difference in household characteristics[9] . In order to perform this exercise we estimate a probit model for each country using the same regressors in both cases. Note that we cannot make use of the Heckman selection model we have already estimated since the selection variables are different for each country. More specifically, the procedure consists on first estimating a probit model for each country and with it constructing the average predicted probability of participating in the stock market (p^{US} for the US and p^{S} for Spain). Then, we construct the average predicted probability of participation for each country if they faced the coefficients of the other country ($\hat{p}^{US}$ and $\hat{p}^{S}$). The difference in participation rates can be decomposed into two components:

$$p^{US} - p^{S} = (p^{US} - \hat{p}^{US}) + (\hat{p}^{US} - p^{S}), \tag{1.5}$$

The first term is what Christelis et al. (2012) refer to as "covariate effects", which is the difference in participation rates that arises because of the differences in household characteristics across countries. The second term, the "coefficient effects", capture the difference in participation rates arising from differences between the estimated coefficients.

Table 4 contains the results of the estimation[10]. The predicted difference in partic-

[9] I am thankful to an anonymous referee for suggesting this comparison

[10] Full estimation results can be found in appendix C

Table 1.4: Decomposition of stock market participation rates

	Total difference	Difference due to covariates	Difference due to coefficients
Direct stock	0.0704	0.1054	-0.0350
Indirect stock	0.2185	0.1657	0.0528

(All values are percentages.)

ipation for direct stock between the US and Spain is 7.04 pp, all of which (and more) comes from the difference between household characteristics. If US households had the same characteristics as Spanish ones, they would participate in the stock market 3.50 pp less than actual Spanish households do. In the case of indirect stockholding, the predicted difference in participation is of 21.85 pp. In this case, most of the difference is also attributed to differences in household characteristics. If US households were to have the same characteristics as Spanish households, their rate of participation will only be 5.28 pp higher than the one of current Spanish households.

1.4.3 Sophisticated households

All the results presented above show that the existence of monetary and informational entry costs play a role in the decision of holding risky assets. In order to see if the existence of these costs alone can explain the stockholding puzzle, or if, by the contrary, further explanations should be explored, we look at the risky assets portfolio of a selected subsample of the Spanish households. Specifically, we are going to select households from which, as indicated by their demographic characteristics, we should expect unanimous participation in the stock market. These will be households in which the reference person or his/her partner hold a college degree and work in the financial industry. Plus, we will only look at households that are above the median wealth. Not surprisingly, these

households have a much higher degree of participation in the stock market than the average one: 62.13% of them hold stock directly and 72.33% do so if we include the holding of mutual funds invested mainly in stocks. However, this is still well far from universal participation. And we are looking at an extremely restrictive sample (only 128 of the 5962 households, or 2.14% of the sample, comply with all these criteria)[11]. If we cannot find universal participation (not even close to it) even among these households, it is clear that there have to be more factors affecting the decision of owning stock. It is hard to imagine which extra frictions could be introduced in the literature's reference model, and it may be necessary to explore alternative theoretical models to explain this puzzle. This is obviously beyond the scope of this paper.

We can also compare these results with a sample of sophisticated households from the US. Unfortunately, we cannot identify which household heads work in the financial industry in the SCF data. Members of the household are asked the industry they work for, but due to privacy concerns, the FRB has collapsed the answer codes to this question, such that we cannot distinguish the financial sector from Repair and Maintenance, Security Services, Employment and Business Support Services, Software Publishing and Data Processing. We argue that the impact of this distortion should not be high (see the Appendix B for a detailed explanation for this affirmation). So we are going to define the US sophisticated households as those in which the household head or his/her partner hold a college degree, work in one of the aforementioned industries and whose wealth is above the median of the population.

[11] Because the sample size is so small the estimations present large standard errors. Even still, the results are statistically far from universal participation. The 95% confidence interval for holding direct stock is 44.7%-79.6% and for indirect stock 56.7%-88.0%.

Since we are dealing with very small samples, and therefore the high standard errors of our estimates could make more difficult to get useful information from the comparison, we are going to use bootstrapping to get the values for our estimates and their standard errors. Using 100,000 bootstrapped samples, 47.03% (s.d of 1.07%) of the US sophisticated households hold stock directly and 80.77% (0.85%) do so indirectly.[12] For their Spanish counterparts, the estimates are 62.13% (4.28%) and 72.33% (3.94%), respectively. So Spanish sophisticated households hold substantially more direct stock but substantially less indirect one. These results are consistent with what we found for the general population.

Table 5 shows the degree of participation in each asset category of both sophisticated households and all the households in the sample. The main conclusion to be drawn is that sophisticated households hold more diversified portfolios. The proportion of these households that hold each asset category is higher than the proportion of households that hold the asset for the whole population. Although the difference is specially significant for the different financial assets: 50.8% vs 8.7% for mutual funds, 78.8% vs 28.5% for pension funds, 58.7% vs 23.3% for life insurance, 26.1% vs 16.5% for CD's and savings accounts[13], 7.7% vs 1.5% for bonds; sophisticated households are also more prone to own real assets, 97.7% vs 81.3% for the main home and 58.0% vs 34.5% for other real estate. It is important to note that the sample of sophisticated households exhibits a much higher average net wealth than the full sample of households, and thus, the results from Table

[12]The number for the indirect stock holding does not include participation through pension plans in order to make it comparable with the Spanish case. If we were to include this one, the participation rate will be 85.42% (0.76%), not changing any of our conclusions.

[13]Specifically, this category includes all kind of savings accounts and deposits which cannot be used for making payments through a debit card or a check

Table 1.5: Portfolio structure of sophisticated households

	Sophisticated households		All households	
Main house	97.7%	(2.1)	81.3%	(0.8)
Other real estate	58.0%	(9.4)	34.5%	(0.9)
CD's	26.1%	(7.6)	16.5%	(0.7)
Stocks	61.5%	(9.0)	13.1%	(0.7)
Mutual funds	50.8%	(9.8)	8.7%	(0.6)
Pension funds	78.8%	(6.8)	28.5%	(0.9)
Life insurance	58.7%	(9.3)	23.3%	(0.9)
Bonds	7.7%	(4.3)	1.5%	(0.2)
Observations	128		5962	

(Values in table indicate percentage of households owning each type of asset)
(Values in parenthesis indicate standard errors)

4 may be driven by wealth. This is not relevant. We have arbitrarily defined a sample of sophisticated households with the idea of capturing households from who we expect an overwhelming participation in the stock market. The specific characteristics that make them participate more are not important here, just the fact that they do participate more.

1.4.4 Multivariate probit

The decision whether to hold stocks or not is part of the overall portfolio composition problem. This implies that households should make this decision at the same time they decide whether to hold other financial assets, real assets or debt. The interest of studying these decisions jointly is clear since the household is constrained by limited funds which it should distribute among the different competing investment opportunities. A clear example of this are younger households who face the purchase of their first main residence [14].

Using our extensive data it is possible to study all these decisions with one model.

[14] See King and Leape (1998) and Bertaut and Starr-McCluer (2000) for studies examining joint portfolio decisions

In particular, we are going to estimate a multivariate probit model in order to analyse the decision of holding different types of assets. The model we estimate looks at whether the household owns stock, safe financial assets, real assets, businesses, pension plans and consumer debt. The explanatory variables are the same as before. The model is estimated using Geweke, Hajivassiliou and Keane's simulation method to approximate the multivariate normal distribution (Green (1997)).

Results are displayed in Table 6. In order to be able to compare the magnitude of the impact of our different variables, the coefficients we report represent the effect on the probability of holding the specific asset. The effect of age on the households' portfolio composition decision is mixed. Mainly, age seems not to be a significant factor in the ownership of most assets. However, age plays a role when looking at businesses ownership for the oldest households, who are substantially less likely to hold them. Also, age is significant at the 5% level for the decision to hold a pension plan. Not surprisingly, households in their working period of their life span are more likely to hold pension plans that those already retired. The effect is greater as we come close to the retirement age (households in between ages 51 and 60 are 0.21 points more probable to hold a pension plan than the reference group) and shows a negative and highly significant coefficient after this one. Age has also an effect on the decision to hold debt. Households in between the ages of 30 and 50 are more likely to hold some kind of debt, while this probability starts decreasing with age after the 60 year mark. This result can be explained by the desire to conduct some consumption smoothing, and it is fully consistent with the life-cycle model.

Having a college degree increases the probability of holding stock and subscribing to a pension plan. This is an expected result in the presence of information costs that the

household has to overcome in order to invest in more sophisticated financial products. The effect of college education is negative on the probability of owning real assets and businesses. This last result is surprising since it would somehow indicate that more educated households are more risk averse or less entrepreneurial. However, the fact that these households present a higher probability of owning stock also indicates that these households have more options where to look for risk. In fact, the size of the effect of both variables is equivalent, around 0.07 points. Lastly, the coefficient for the debt equation is negative and significant at the 1% level.

The effect of wealth is significant at the 1% level and positive for all categories of assets except for safe assets, for which wealth is not significant at the 10% level. The effect on consumer debt is negative and significant at the 5% level. When wealth is small, the reward for seeking out different investments is not high enough to compensate for the cost of this search, but as the wealth of the households increases, not looking out for different investments other than safe assets has in fact a high opportunity cost. Income has a significant and positive effect in the case of stocks, safe assets, pension plans and debt.

As might be expected, risk aversion plays a role in the decision to hold stocks, businesses and safe assets. The effect is positive for the first two and negative for the last. The size of the effect is remarkable for the decision to hold stock, households who seek more risk in their investments are 0.17 points more probable to invest in stock. It is interesting to note that risk aversion does not play a role in the decision of whether to hold debt or not.

Working in the financial industry has a positive and significant effect on the decision to

hold stocks, pension plans and debt, and a negative and significant effect of the decision to hold housing and businesses. This seems to indicate the existence of some sort of "professional bias". Although it is not in the scope of this paper, it would be interesting to see if these households are holding more efficient portfolios, or by the contrary, this "professional bias" is leading them to a higher exposure to financial assets than desirable. Looking at the results from the previous section, our conjecture is that these households are facing the first situation.

The effect of using on-line banking is positive and significant at the 5% for the cases of holding stocks, bank accounts and pension plans, being the effect on the first and last variables relatively substantial. This is not surprising if we take the on-line banking variable as a determinant of household financial sophistication, or at least as a tool to reduce the costs of entering any of these markets.

Lastly, we look at the correlation among assets. There is a positive, and significant at the 5% level, correlation between the decision of holding stocks and the decision of holding safe assets, and a positive and significant correlation between the decision of holding stocks and decision of holding pension plans. On the other hand, the correlation is negative for the decision of holding stock and the decision of holding housing and between the decision of holding stock and the decision of holding debt. The decision of holding safe assets is negatively correlated with that of holding housing and positively correlated with that of holding debt. The decision of holding housing is positively correlated with that of holding debt, as they are the decisions of holding pension plans and debt.

Table 1.6: Multivariate probit

	Stocks		Safe assets		Housing		Businesses		Pension plans		Consumer debt	
	coefficient	S.E.	coefficient	S.E.	coefficient	S.E.	coefficient	S.E.	coefficient	S.E.	coefficient	S.E.
Constant	-8.892***	0.337	0.465	0.411	-5.533***	0.547	-7.202***	0.343	-6.067***	0.286	-1.518***	0.249
Married	0.002	0.011	0.006	0.005	0.009**	0.004	0.035***	0.010	0.031***	0.012	0.059***	0.012
College	0.068***	0.011	0.015**	0.007	-0.019***	0.005	-0.071***	0.011	0.043***	0.012	-0.075***	0.013
Age 31 to 40	0.009	0.035	-0.027*	0.015	0.003	0.007	0.009	0.029	0.136***	0.035	0.053*	0.029
Age 41 to 50	-0.006	0.034	-0.018	0.015	0.008	0.008	-0.000	0.028	0.197***	0.034	0.054**	0.028
Age 51 to 60	0.011	0.034	-0.016	0.015	-0.001	0.008	0.007	0.028	0.217***	0.034	0.021	0.029
Age 61 to 70	0.078**	0.034	-0.004	0.015	-0.006	0.008	-0.086***	0.029	0.064*	0.035	-0.092***	0.029
Age more than 70	0.120***	0.007	-0.102	0.015	0.017**	0.007	-0.233***	0.031	-0.172***	0.036	-.261***	0.030
Log income	0.064***	0.007	0.011***	0.003	-0.007***	0.002	0.017***	0.006	0.071***	0.007	0.029***	0.007
Log wealth	0.091***	0.005	-0.001	0.002	0.030***	0.001	0.081***	0.004	0.045***	0.004	-0.007**	0.003
Seeking some risk	0.183***	0.011	0.003	0.007	-0.005	0.006	0.030***	0.010	0.042***	0.013	-0.015	0.014
Seeking fair risk	0.170***	0.029	-0.033***	0.012	-0.029***	0.012	0.024	0.021	0.027	0.029	0.031	0.028
Seeking a lot of risk	0.108**	0.044	-0.036**	0.018	0.011	0.027	0.068**	0.033	0.027	0.045	0.134***	0.043
Work finance	0.075***	0.024	-0.007	0.013	-0.002	0.011	-0.086***	0.022	0.072***	0.025	0.050**	0.025
Use on-line banking	0.063***	0.013	0.018**	0.008	0.005	0.006	0.008	0.011	0.066***	0.013	0.007	0.014
ρ with stocks	-	-	0.174***	0.049	-0.237***	0.068	-0.055*	0.030	0.159***	0.027	-0.084	0.027
ρ with safe assets	-	-	-	-	-0.133	0.084	-0.016	0.041	0.006	0.035	-0.087***	0.034
ρ with housing	-	-	-	-	-	-	0.127***	0.045	-0.090**	0.039	0.107***	0.039
ρ with businesses	-	-	-	-	-	-	-	-	0.100***	0.027	0.128***	0.027
ρ with pension plan	-	-	-	-	-	-	-	-	-	-	0.065***	0.025

Observations: 5,726
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

1.5 Conclusion

The participation rate of Spanish households in the stock market is low, both in absolute and relative standards. Spain is among the European countries which exhibit a lower participation rate and it is far behind the US. We have shown that this can be partially explained by the existence of monetary and informational entry costs, wealthier and more educated households have a higher probability of owning stock than their counterparts. However, the existence of these costs alone is not sufficient to reconcile the universal participation rate that standard portfolio theory predicts with what we observed in our data. When we look at a sample of wealthy sophisticated households who should not find entry costs as an impediment to own stocks, there is still an important percentage of them who are not participating in the stock market at all. We believe that this calls for a more structural approach in order to explain the stockholding puzzle. We also showed how the decision of holding stock is positively correlated with the decision of holding safe financial assets and the decision of holding pension plans and negatively correlated with the decision of holding real estate and debt.

Chapter 2

Consumption and Portfolio Choice Over the Life-Cycle

2.1 Introduction

Every household faces consumption and investment decisions over their life span. Because of their ubiquity and importance, these issues have attracted much interest in the economics literature. The portfolio choice decision in a life-cycle model framework was first studied by Samuelson (1969) and Merton (1969) who derived analytical solutions in both discrete and continuous time for a standard life-cycle model with complete markets. These models presented households participating in the stock market unanimously, a prediction which contrasts sharply with the observed household behaviour. Limited stock market participation by households is a well documented fact. Guiso et al. (2003) report direct participation rates between 7% and 27% for a variety of European countries [1]. When also including participation in stocks through mutual funds participation rates vary between 15% and 54%. Data from the Household Finance and Consumption Survey (HFCS) con-

[1] The countries in the study are France, Germany, Italy, Sweden and the UK and the reference year is 1999

firms this fact when looking at most Euro area countries in a more recent period [2]; direct stock market participation rate ranges from 0.8% to 33.6%.

Such contrast between the economic theory prediction and the actual household behaviour has come to be known as the stock market participation puzzle and it has attracted much research attention. Moreover, even only looking at the households that do participate in the stock market, what we observe is a hump-shaped participation pattern, with young households staying out of the stock market, then increasing their participation as they age and decreasing it again after retirement (Ameriks and Zeldes (2004) and Campbell (2006)). This is also contrary to traditional financial advise which encourages a participation pattern negatively correlated with age.

In this paper I attempt to reconcile the predictions of a stochastic life-cycle model for consumption and portfolio choice with the observed limited holding of risky assets by introducing a fixed cost of investing in the stock market. The simulation of the model produces a hump-shaped investment pattern similar to that observed in the data. I also estimate the model using data from Spanish households. The model incorporates uncertain labor income, borrowing restrictions and a fixed cost for investing in the risky asset. Using data from a survey of households I estimate the risk aversion coefficient and the fixed investment cost. The introduction of the fixed cost allows me to match stock market participation relatively well.

Since the seminal work of Samuelson and Merton, authors have explored a variety of market frictions on the standard life-cycle model in order to explain the observed house-

[2]The participating countries in the survey are Belgium, Germany, Greece, Spain, France, Italy, Cyprus, Luxembourg, Malta, Netherlands, Austria, Portugal, Slovenia, Slovakia and Finland; and the reference period is 2008-2010

holds' behaviour. One important line of research focus on the introduction of uninsurable labor income to the standard stochastic life-cycle model. Cocco et al. (2005) show that in a setting of incomplete markets, labor income acts as a substitute for risk-free asset holdings. These authors calibrate a life-cycle model with uninsurable labour income risk and borrowing constraints. Their simulations produce a portfolio choice pattern along the life-cycle in line with what traditional financial planners advise, young households invest heavily in risky assets and they reduce their participation as they age. However, participation rates are still high compared with the data and their calibrated risk aversion coefficient of 10 is considered very high (this value is, for example, what Mehra-Prescott a priori impose as an upper bound).

Haliassos and Bertaut (1995) offered a comprehensive review of potential explanations and their contribution to the matter. In the first place, they point to several factors which although contribute to resolve the equity premium puzzle, do not play a role in the resolution of the stock participation puzzle. Among those we find non-separable utility (habit persistence), the degree of risk aversion, heterogeneity of opinions or liquidity constraints. However, they find that inertia and departures from expected-utility maximisation do contribute in explaining the puzzle. The authors argue that inertia may arise from cultural influences and from costly information. Using calibrations from a life-cycle model they show how moderate inertia can deter stockholding. This line of research has been largely extended (we offer a detailed review of this literature in section 2) creating convincing support for the importance of the role of entry costs in explaining the stock market participation puzzle. Following this literature and building on the stochastic life-cycle model of Cocco et al. (2005) I add a fixed cost of investing in the risky asset which produces

realistic portfolio structures using a more appropriate risk aversion coefficient.

Apart from analyzing the simulations produced by the model, I estimate this one by solving for the set of parameters which produce results that best match the behaviour observed in a cross-section of Spanish households. In particular, I estimate the risk aversion coefficient and the per period fixed cost of investing in the risky asset. The model produces portfolio choices in line with those observed in the data when the fixed cost for investing in the risky asset is high enough. I estimate a risk aversion coefficient of 0.297 and a fixed cost of 4,377 euros.

The paper is related to several lines of literature. In the first place, the model specification and solving is based on the work of Cocco et al. (2005). From their standard specification we introduce a cost of participating in the stock market. Previous literature on finite time life-cycle models include Bertaut and Haliassos (1997), Davis and Willen (2000) and Gakidis (1999). The importance of investment costs has been studied by Basak and Cuoco (1998), Cocco et al. (1999), Polkovnichenko (2000) or Vissing-Jorgensen (2002).

The second part of my work consists on an estimation exercise. I estimate the risk aversion coefficient and the fixed cost of participation. Gourinchas and Parker (2002) estimate the time preference rate and the risk-aversion coefficient using a structural model of consumption over the life cycle. They use a Simulated Method of Moments and disaggregate their results by education level and occupation sector.

The rest of the paper is organized as follows. Section 2 briefly reviews the different approaches that have been employed in the literature to model and quantify costs of participating in the stock market, and places this paper in the context of previous literature. Section 3 presents the standard life cycle model expanded with the introduction of the

entry cost. Section 4 explains the numerical techniques used for solving it. The following section describes the calibration of the non-financial deterministic income process. Section 6 presents the results of the model by performing simulations. This is followed by a description of the data, the Encuesta Financiera de las Familias, that will be used for the estimation of the model. Section 9 presents the results of the estimation. Section 10 concludes.

2.2 The role of entry costs in the stock market participation decision

As we have already pointed out, the existence of entry costs is one of the most promising explanations for understanding the stock market participation puzzle. In this section we explore the theoretical underpinnings of this hypothesis and we review the empirical results of those who have exploited this research path. In the basic expected utility model, in which a household who lives for one period has to decide how to allocate its wealth among a variety of risky assets and a risk-free asset that will be liquidated at the end of the period to finance consumption, every household will invest part of its wealth in risky assets for positive expected returns and a finite coefficient of risk aversion. In the presence of entry costs, the decision on the share of wealth invested in risky assets will depend on the investor's wealth and the size of the equity premium. If the combination of this two is not high enough to overcome the entry costs, the household will stay out of the stock market[3].

There is literature exploring the role of entry costs in a variety of models, ranging

[3]For a formal description of the model see Guiso et al. (2003)

from the static mean-variance portfolio model to large-scale intertemporal models (see Basak and Cuoco (1998), Cocco et al. (1999), Polkovnichenko (2000) or Vissing-Jorgensen (2002)). Moreover, these costs have been modelled in a variety of different ways. Haliassos and Bertaut (1995) calibrate a small scale life-cycle model and determine the per period fixed cost needed to keep a household out of the stock market for each risk aversion coefficient. They assume households life for three periods, each one of them representing 20 years of adult life. They calibrate their model for two different historical return distributions, the ones offered by Mehra and Prescott (1985) and Siegel (1992); and they distinguish between two types of households according to their income profile. For the Mehra-Prescott return structure, they estimate a cost equivalent to the income of around 150 working days for the first 20 years of life and a quarter of this for the next 20 years when setting the degree of relative risk aversion to 2. For a risk aversion of 10, regarded by the authors as an upper bound for the representative agent, the cost would be equivalent to around 30 workdays for the first 20 years of adult life and a quarter of this for the next 20 years. To put these figures in perspective, and according to the income process for a high-income household, this would amount to figures of $25,000 for the first 20 years of life and $9,375 for the 20 subsequent years for the risk aversion coefficient of 2 and to $5,000 and $1,875 respectively for a risk aversion coefficient of 10. Vissing-Jorgensen (2000) considers three different types of cost structures: a per period participation cost, a one-time entry cost and a trading cost involving two components, a fixed and a variable part. Acknowledging that the household's expected lifetime utility maximization problem does not have a closed form solution, she looks at the structure of the participation decision policy function and then estimates a reduced form model based on this structure. Under

assumptions for the share of wealth invested in stocks and the certainty equivalent excess return on stocks over T-bills she is able to quantify the size of the per period participation cost. In particular, for the case where the fraction of wealth invested in stocks matches the one observed in a sample year using PSID data, she estimates a median participation cost of $350 for each year.

As we just said, the existence of fixed entry costs has been a prevalent explanation for the households' limited stock market participation. These entry costs should not be understood as only monetary costs, but in a wider sense which includes aspects such as time and effort. For a household to invest in the stock market, it will usually imply previous research of non-trivial financial information plus monitoring of the existing portfolio. King and Leape (1987) report that about 40% of those households which do not hold stocks in the Survey of Consumer Financial Decisions do so because "they did not know enough about the stock market". More recently, Alessie et al. (2011) document a strong positive association between advanced financial literacy and stock market participation, after controlling for education, income and wealth of the household.

Moreover, there are other factors that can amplify fixed participation costs such as social interactions or lack of financial literacy. When a perceived investment view is rooted within a country's society, social interactions help maintaining this prevalent view. In countries where stock market investment is perceived as too risky, or even reckless, there is some sort of "social cost" which should also be included in the fixed cost of participation. Hong et al. (2004) provide evidence that sociability fosters stock market participation, while Bogan (2008) shows that stockholding is more widespread among frequent Internet users (who have easier access to financial information).

My approach in the modelling of the fixed per period participation cost differs from the aforementioned ones in the sense that I estimate jointly the risk aversion coefficient and the participation cost in a structural life-cycle model. Moreover, I consider the fixed cost to be proportional to the share of the portfolio invested in stock in order to offer a more realistic treatment of non-monetary costs (the time and effort devoted to monitor one's portfolio will not be the same if the household has all its wealth invested in stock or if the proportion invested is only a small one).

2.3 The Model: Consumption and Portfolio choice over the life-cycle

A household lives up to period T and retires at age R, where R and T are both deterministic and $R < T$. It starts life at age t_0, also deterministic, and thus lives for T-t_0 years. The household's goal is to maximize life time utility:

$$max \sum_{t=t_0}^{T} \beta^{t-1} u(C_t) \tag{2.1}$$

where $u(C)$ is a constant relative risk aversion utility function $u(C) = C^{1-\rho}/(1-\rho)$ and β is the discount factor.

The timing of the events is as follows. The household starts the period with a pre-determined wealth and at the beginning of the period the household receives an income Y_t. After receiving the income we denote its total wealth by X_t (this is what in related literature has been referred to as cash-on-hand). The income received has a deterministic component and it also receives a temporary stochastic shock which is normally distributed.

After the income is realized the agent must choose how much to consume (C_t) and how much of its savings it will invest in a risky asset (S_t) and in a risk-free asset (B_t). There is a fixed cost for investing in the risky asset. S_t represents the amount invested after paying the fixed cost, which is represented by $Cost_t$. The return on the risk-free asset ($\bar{R}$) is constant and the return on the risky asset ($\widetilde{R}_t$) is stochastic. Formally, the household is subject to the following constraints:

$$X_t = B_t + S_t + C_t + Cost_t \tag{2.2}$$

$$X_{t+1} = B_t\bar{R} + \widetilde{R}_t S_t + Y_{t+1} \tag{2.3}$$

The income process is composed of a deterministic component,P_t plus a transitory shock, ϵ_t. We calibrate a different deterministic component according to the education level of the household head (the details of this calibration are explained in section 5). The transitory shock follows a normal distribution with mean 0 and variance σ_y^2.

$$Y_t = P_t + \epsilon_t, \quad \text{with} \quad \epsilon_t \sim N(0, \sigma_y^2) \tag{2.4}$$

The return on the risky asset is stochastic around a mean μ, to which we add a shock which is normally distributed with mean 0 and variance σ_r^2.

$$\widetilde{R}_t = \mu + \zeta_t, \quad \text{with} \quad \zeta_t \sim N(0, \sigma_r^2) \tag{2.5}$$

$$B_t \geq 0 \qquad S_t \geq 0, \quad for\, t \leq T \tag{2.6}$$

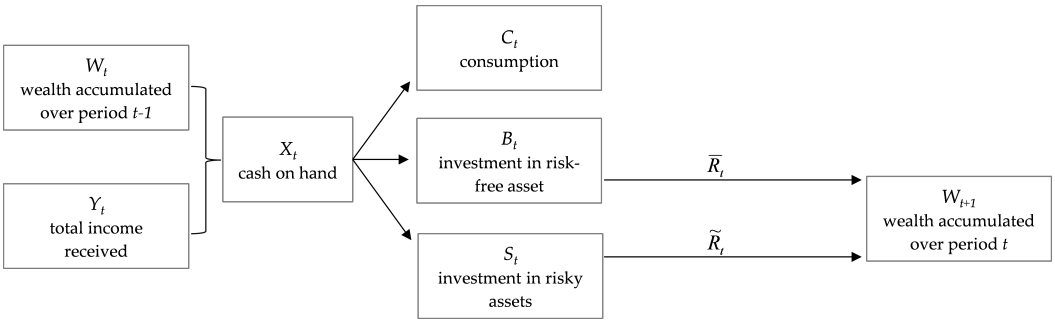
For the matter of simplicity and following the literature (see Cocco et al. (2005)) I define α_t as the share of savings invested in the risky asset. We denote by Fx the fixed cost a household would pay if he were to invest all his portfolio in the risky asset. The actual cost paid by each household would be $\alpha_t * Fx$. Thus the actual cost paid is proportional to the share of the portfolio invested in the risky asset. Given these assumptions, at each point in time the household must decide on its consumption level, C_t, and how much to invest in a risky asset, α_t. These decisions are only influenced by the wealth it holds, X_t, and the point in time at which he is making the decision, t. Therefore, we have two state variables and two control variables. When introducing this notation we can express B_t, S_t and $Cost_t$ as follows, $B_t = (1-\alpha_t)*(X_t - C_t)$, $S_t = \alpha_t * (X_t - Ct - Fx)$ and $Cost_t = \alpha_t Fx$. The Bellman equation for this problem is given by:

$$V(X_t) = \max_{C_t, \alpha_t} \left[u(C_t) + \beta E V(X_{t+1}) \right] \quad for\, t < T \tag{2.7}$$

where,

$$X_{t+1} = \alpha_t \widetilde{R}_t (X_t - Fx - C_t) + (1 - \alpha_t) \bar{R} (X_t - C_t) + Y_{t+1} \tag{2.8}$$

Figure 2·1: Time line of events.



This model, although relatively simple, captures the essential characteristics of the life-cycle portfolio choice problem. By keeping the dimensionality of the problem small we are able to have a manageable large scale model, which can capture more specific aspects of the households' life-cycle (e.g. different phases along the professional career).

Figure 1 describes the household's decision process within period t according to the dynamic life-cycle model and recaps the explanations given so far. At the beginning of period t, the household carries on wealth from last period (W_t) and also receives income for the current period (Y_t). The sum of the two (X_t), or cash-on-hand, represents the total amount of cash the household has at its disposal for its consumption and saving decisions. Therefore, the household decides how much to consume (C_t) and how much to invest in bonds (B_t) and in risky assets (S_t). The return on bonds ($\bar{R}$) is deterministic and the return on the risky asset ($\widetilde{R}_t$) is stochastic. At the end of period t, the accumulated wealth is W_{t+1}, which will be carry on to the next period.

2.4 Numerical solution

The model cannot be solved analytically. I solve it by using backward recursion dynamic programming and by applying standard numerical techniques (Judd (1998)). In order to

apply this method the first thing is to discretize the different continuous control and state variables. I use a grid of 70 points for consumption and wealth and a grid of 6 points for the share of the portfolio invested in risky assets. I tried increasing the fineness of the grid but the difference in the results was negligible and came at a substantial computing cost. I use a Gaussian quadrature technique to approximate the continuous integrals associated with the stochastic shocks (both for the labor income process and the risky asset return process). I discretize both processes using 3 nodes, which is common in the literature and it is enough to capture the nature of the distribution. The values for the nodes and the weights are taken from Judd (1998). I start by solving at period T. At that point, the solution is trivial since the household consumes all its remaining wealth. This gives me the policy functions and the value function for period T. I then proceed to period T-1, where I solve a 2 period maximization problem by using the transition equation and the value function for period T. Similarly, this gives me the policy functions and value function for period T-1. I keep repeating the process backwards until period 1. I use linear interpolation in order to evaluate the value function and the policy functions in points of cash-on-hand lying outside the pre specified grid. Other interpolation methods, such as cubic spline interpolation, were also tried, but they did not provide any significant improvement in accuracy and came at a substantial computing time cost.

2.5 Income calibration process

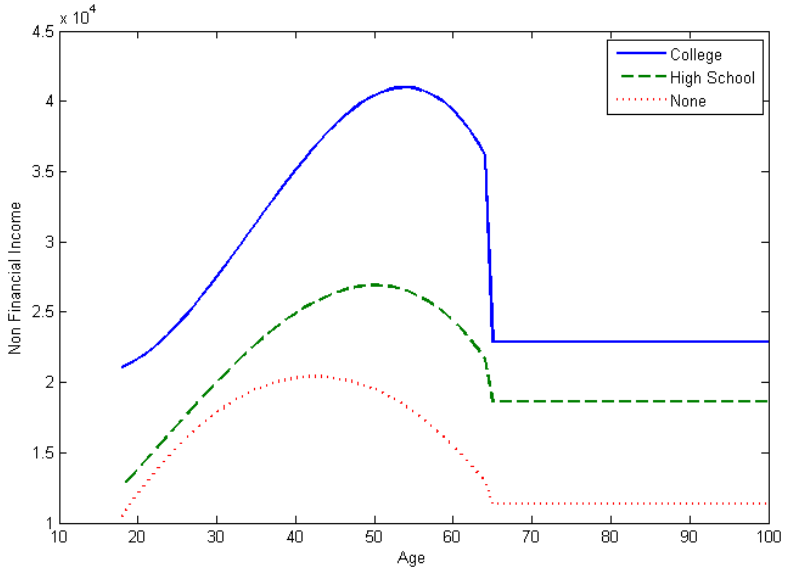
Income follows an exogenous process which receives a temporary random shock (normally distributed) each period. Following Carroll (1997), there is also a low probability (0.05) state of unemployment in each period. In the periods when the household is unemployed

it earns no income.

The exogenous path P_t is calibrated with the available data by regressing a household's non-financial income on a third degree polynomial on age and controlling by household size. I define non-financial income as total reported labor income including non monetary perks plus different pensions received from the government, unemployment compensation, private unemployment insurance and transfers from relatives, all this for both head of household and if present his spouse. Since income-age profiles differ greatly by the level of education (see Attanasio (1995), and Hubbard et al. (1995)), following Cocco et al. (2005), I divide the sample into three groups: those with a college degree, those with high school degree and those with none; and I calibrate a different income path for each one of them. In their retirement period (from ages 65 to 100 in my baseline simulations) households receive a constant income, which corresponds to a percentage of their last working year's income and which is not subject to uncertainty. I determine this 'replacement ratio' for each of the three groups separately by dividing the average salary of households above the age of 64 by the average salary of households aged 64.

The shape of the three exogenous income paths is shown in Figure 2. The first thing to note is the expected hump-shape profile exhibited by the three education groups, with an upwards and rightwards shift of the paths coming from the education level. The curvature of the functions is a direct result of the evolution of the salary structure at the different professional careers. The point in life where the maximum income is reached increases with the education level, with employees with higher skills managing to maintain an increasing non financial income for a longer period of time, which reflects the fact that jobs requiring a higher education usually offer longer professional careers with more opportunities for

Figure 2·2: Exogenous non financial income process.



promotion. The fact that we see a decline between the maximum income reached and the income prior to retirement is caused because we have set the retirement age exogenously to the age of 65 (the legal retirement age in Spain), which does not account for early retirement cases, which in the data there is a non-negligible number of households which are retired and less than 65 years old. The drop in non financial income when entering the retirement period is substantially larger for households with more education, a result coming from the institutional design of the public pension system, in which pensions are capped at a determined amount.

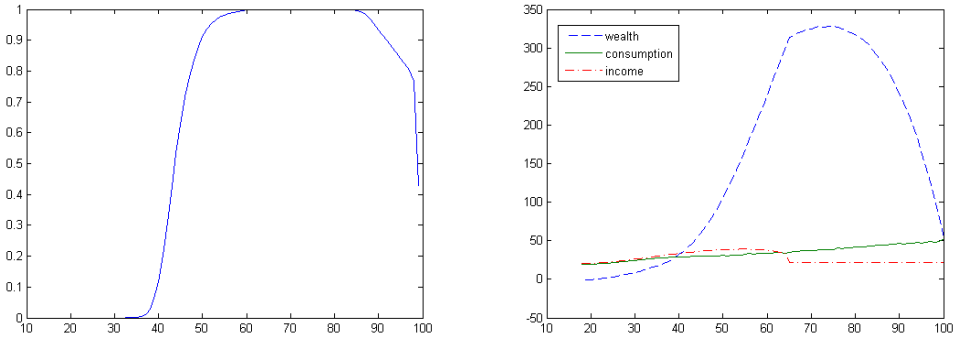
2.6 Model Simulation

In order to understand the predictions and implications of the model I simulate a household life 10,000 times under the baseline parameters shown in Table 1. Households start their life at age 18 and die at age 100. They retire when they reach the age of 65. I set the

Table 2.1: Baseline parameters for simulation

Parameter description	Parameter value
Starting age (t_0)	18
Death age (T)	100
Retirement age (K)	65
Time preference parameter (β)	0.9615
Risk aversion coefficient (ρ)	2
Stock market participation cost (PC) (in euros)	1000
Risk-free rate of return ($\bar{R}$)	2%
Mean return on stocks (μ)	6%
Std. deviation of stock returns (σ_r)	15.7%
Variance of transitory income shocks (σ_y^2)	0.0738
Probability of unemployment (p)	0.05

Figure 2·3: Life-cycle model simulations



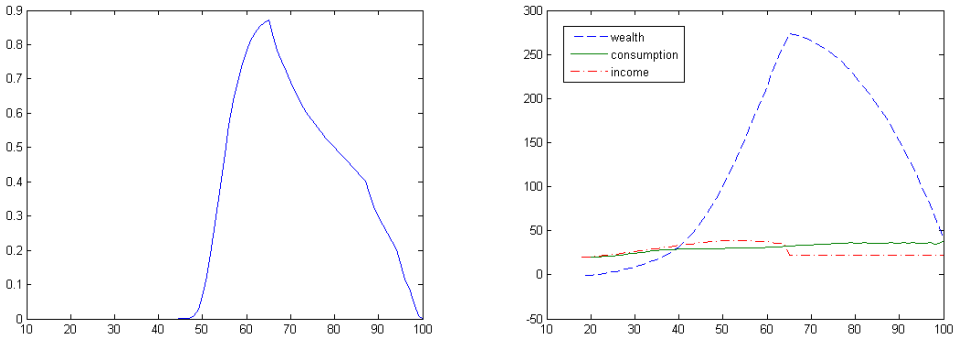
(a) Share of funds invested in stocks (b) Consumption, wealth and income profiles

risk aversion coefficient,ρ, to a value of 2 and the time preference parameter,β, to a value of 0.9615, both in line with numbers found in the previous literature (Gourinchas and Parker (2002) estimations lie in the ranges of 0.282-2.290 for the risk aversion coefficient and 0.930-0.962 for the time preference parameter). The values for the different return and the variance of the transitory income shocks are taken from Cocco et al. (2005) and the probability of unemployment p from Carroll (1997).

Figure 2.3.b shows average profiles for income, consumption and wealth and Figure 2.3.a shows the average profile for the share of the portfolio invested in stocks.

The portfolio share invested in stocks is zero for the first ten years of life, it starts to

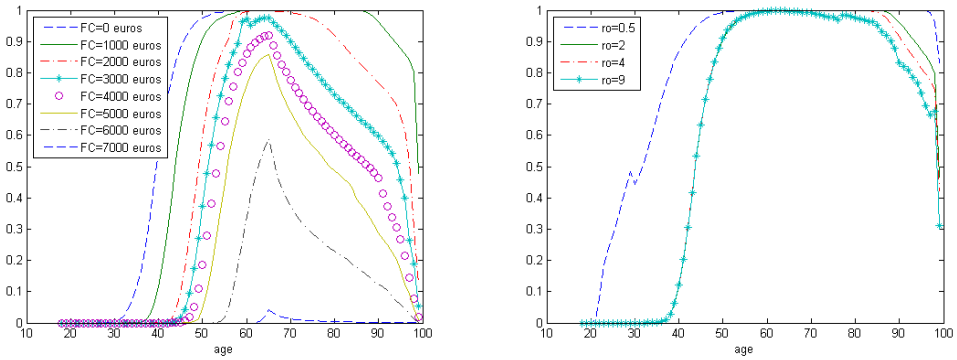
Figure 2·4: Life-cycle model simulations: increasing fixed costs



(a) Share of funds invested in stocks (b) Consumption, wealth and income profiles

increase around age 30, it reaches full participation at age 55 in order to stay constant for most of the household's remaining life and it starts to decrease around age 85. This pattern is mainly caused by the existence of fixed costs for investing in the stock market (for a given degree of risk aversion). In the early stages of life, the household's wealth is low and therefore the fixed costs are enough to deter it from investing in the risky asset. As the household accumulates wealth it starts investing part of its savings in the risky asset until reaching full participation and enjoying the benefits of the equity premium. It is important to note that the stochastic nature of the income process also has an impact on the life-cycle path of portfolio allocation. In my model, the riskiness of the income process (represented both by the temporary stochastic shocks and the unemployment shock) has a crowding out effect on the share of funds invested in risky assets. This is consistent with the results of Cocco et al. (2005). However, the fixed costs override this effect and allow us to see life-cycle paths consistent with the data. These fixed costs have a powerful effect on the portfolio allocation decision. In figures 2.4.a and 2.4.b we simulate the model again for the same parameters as the reference case, but we increase the fixed cost to

Figure 2·5: Life-cycle model simulations: the effect of fixed costs and risk aversion coefficient

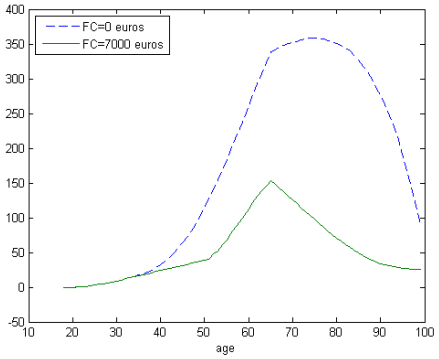


(a) Share of funds invested in stocks

(b) Share of funds invested in stocks

5,000 euros per period. The average household delays its entrance in the stock market by almost 20 years, never reaches full participation and decreases its participation during retirement age. Figure 2.5 shows the sensitivity of the portfolio choice decision to the varying degrees of fixed costs faced by the household. We can see that there is a direct negative relationship between the level of the fixed cost and the amount invested in the risky asset. The higher the fixed cost, the later in life the household starts investing in the risky asset, the smaller the share it invests at its maximum and the faster it reduces its investment along retirement. A fixed cost of 8,000 euros maintains the household out of the stock market during its entire life. The effect of the risk aversion coefficient is also as expected, the more risk averse the household is, the smaller its investment in the risky asset. But the size of the effect is very small compared to the one of the fixed costs. As we can see in Figure 2.5.b, when we increase the coefficient of relative risk aversion from 2 to 9 (keeping the fixed costs constant) the household behaves in the same exact manner up to age 65 and at this age it starts reducing its investment in the risky asset faster, creating a gap of around 20% in the portfolio share invested in stocks.

Figure 2·6: Stock market participation effect on wealth



The household engages on consumption smoothing over its life cycle. The consumption stream follows a continuously increasing path dictated by the binding borrowing constraints in the early periods of life (when the household can barely consume more than its income and wealth is near zero) and the excess of wealth accumulation subject to uncertainty provided by the equity premium at later ages. The wealth profile exhibits the expected hump shape, with the household accumulating assets until retirement and running them down as it ages towards death. Reduced participation in the stock market, caused by the increase in fixed costs, has an impact on the wealth accumulated by the household and consequently on its consumption capability. We can refer to this decrease on consumption levels as the risk from not participating in the stock market. It is an opportunity cost which is often ignored, but as we can see in figure 2.6 it can have a substantial impact on the household's welfare. This figure shows the wealth accumulation path for a household which is not investing in the risky asset (which occurs when the fixed costs are 7,000 euros) and for a household which displays an investment pattern as shown in figure 5 (in this case the fixed costs are 0 euros).

2.7 The Data: Encuesta Financiera de las Familias

The Encuesta Financiera de las Familias (EFF) is a survey conducted every three years by the Bank of Spain which collects data on wealth, income, debt, consumption and demographic characteristics from a representative sample of Spanish households. The first survey was conducted in 2002, followed by a second wave in 2005[4]. The latter one contains a refreshment sample and a panel, with around half of the households interviewed in 2002 being interviewed again in 2005. For this study I will make use of the 2005 wave since it is the most current one.

The 2005 sample contains information on 5,962 households who were interviewed in person between October 2004 and May 2005. Of the total number of households, 2,580 were also interviewed in 2002 and therefore constitute a panel. The survey is divided in the following sections: demographics, real assets and their associated debts, other debts, financial assets, pension plans and life insurance, labor market situation and labor income for each household member, non-labor income in the previous calendar year, means of payments and consumption.

The EFF is a unique data set in the sense that it contains information on wealth, income and total consumption. Not even other household surveys which are very similar in their nature to the EFF, such as the US Survey of Consumer Finances or the Italian Survey on Household Income and Wealth, contain data as appropriate for our purposes, since in the surveys we have just mentioned only partial measures of consumption are offered.

An extra desirable characteristic of the EFF is the oversampling of wealthy households.

[4] A new wave was conducted in 2008 but the data is not available yet.

Many types of financial assets are only held by the wealthiest households and therefore it is necessary to pay special attention to this group not only for representativeness of the population but also of aggregate wealth. It is also important to mention that all the missing values have been imputed using relevant econometric techniques. The imputation process produces 5 data sets in order to capture best the uncertainty related to the imputation itself. For a detailed explanation of the survey methodology and the imputation process see Bover (2008).

I only make use of the observations of those households who declare that their current income is not higher or lower than usual and who expect a similar income level in the future. I consider that these households do not suffer shocks to their permanent income. I also get rid of those households whose consumption exceeds 60,000 euros. My final sample consists of 2,400 households.

Descriptive statistics for the relevant variables are shown in the Appendix. The median net wealth for the households in the sample is 176,357 euros with a mean of 256,961 euros, the relationship between the two indicates a certain degree of wealth inequality. The mean income is 31,546 euros and the mean total consumption is 13,865 euros. 16.7% of the households participate in the stock market, while only 1.5 % of them hold bonds.

2.8 Model Estimation

By using the policy functions of the life-cycle model described in section 2.6 and the EFF data, I can estimate the model parameters. In particular, I estimate the coefficient of risk aversion and the fixed cost of participating in the stock market.

I perform the estimation by Non Linear Least Squares. The goal is to find the param-

eters which minimize an objective function representing a measure of the error the model is making compared to the data. I have two outcome variables in my model and thus two errors: one for consumption and one for the share of funds invested in the risky asset. Since it is not possible to find parameters that minimize both sum of squared errors, it is necessary to assign some weight to each error in order to construct the objective function. I perform a two stage approach in order to determine the optimal weighting matrix. In the first stage, the weighting matrix is the identity matrix, which assigns equal weights are assigned to both errors. Then, with the errors obtained from the first stage estimation I construct a covariance matrix whose inverse will be used as the weighting matrix in the second stage.

If we denote by y_{1i} each observation for consumption in the sample, by y_{2i} each observation for share of funds invested in the risky asset, and by $\hat{y}_{1i}$ and $\hat{y}_{2i}$ the respective predictions of the model for the two variables, the estimation procedure is as follows:

$$\min_{\theta} \begin{bmatrix} \sum_i (y_{1i} - \hat{y}_{1i}(\theta)) \\ \sum_i (y_{2i} - \hat{y}_{2i}(\theta)) \end{bmatrix}' * I_2 * \begin{bmatrix} \sum_i (y_{1i} - \hat{y}_{1i}(\theta)) \\ \sum_i (y_{2i} - \hat{y}_{2i}(\theta)) \end{bmatrix} \tag{2.9}$$

$$\min_{\theta} \begin{bmatrix} \sum_i (y_{1i} - \hat{y}_{1i}(\theta)) \\ \sum_i (y_{2i} - \hat{y}_{2i}(\theta)) \end{bmatrix}' * \hat{\Sigma}^{-1} * \begin{bmatrix} \sum_i (y_{1i} - \hat{y}_{1i}(\theta)) \\ \sum_i (y_{2i} - \hat{y}_{2i}(\theta)) \end{bmatrix} \tag{2.10}$$

$$where \quad \hat{\Sigma} = (1/N)\hat{u}'\hat{u} \quad with \ \hat{u} = [\hat{u}_c \ \hat{u}_\alpha] \ from \, the \, first \, stage \, estimation. \tag{2.11}$$

I also construct standard errors for our estimates. If we define by G the matrix containing the partial derivatives for both policy functions with respect to the two coefficients we are estimating, the variance of our estimators is defined by:

$$var(\hat{\theta}) = (1/N) * (G' * (\hat{\Sigma}^{-1}) * G)^{-1} \tag{2.12}$$

where

$$\hat{G} = (1/N) * \begin{bmatrix} \sum_i \nabla_\rho (y_{1i} - \hat{y}_{1i}(\theta)) & \sum_i \nabla_{FC} (y_{1i} - \hat{y}_{1i}(\theta)) \\ \sum_i \nabla_\rho (y_{2i} - \hat{y}_{2i}(\theta)) & \sum_i \nabla_{FC} (y_{2i} - \hat{y}_{2i}(\theta)) \end{bmatrix} \tag{2.13}$$

The result of my estimation yields a risk aversion parameter of 0.297 with a standard error of 0.026 and a fixed cost of 4,377 euros with a standard error of 140.5. The risk aversion parameter estimation is relatively low but within the range of estimations found in the literature. Gourinchas and Parker (2002) estimate the coefficient of relative risk aversion to be 0.5140 by solving a life-cycle model of consumption. When disaggregating the estimation by the levels of education their estimations lie in the range 0.282-2.290. The estimation of the fixed cost is 4,377 euros annually. This represents the amount paid when 100% of the available funds are invested in stocks. If 6.2% of funds are invested in stocks (the average share for Spanish households) then the annual cost of participation will be 271.37 euros.

Haliassos and Bertaut (1995) calibrate a life-cycle model and determine the level of fixed cost needed to keep a household out of the stock market for each risk aversion coefficient. When using Mehra and Prescott (1985) results for the average stock market

return and its standard deviation, they establish the threshold around 60% of annual income for the first 20 years of adult live and around 15% of annual income for the next 20 years, for a relative risk aversion coefficient of 2. These costs decrease as risk aversion increases, reaching a low of 6.25% of annual income for the first 20 years of adult live and around 1.6% of annual income for the next 20 years for a relative risk aversion coefficient of 20. Vissing-Jorgensen (2000) considers 3 different types of costs: a per period stock market participation cost, a fixed cost of trading stock and a variable cost of trading stock. She finds evidence of the first two affecting the household's decision of whether to participate in the stock market or not, and she estimates that a per period cost of 260 dollars in year 2000 prices is enough to explain the decision of 75% of non participants.

Table 2 shows the result of the estimation disaggregated by education levels. There is not a clear pattern and the results are therefore difficult to interpret. The risk aversion coefficient is 0.93 for those households with a "less than high school" education, 2.29 for those households with a high school degree and 0.30 for those with a college degree [5]. However, note that the coefficient for those with the intermediate education level is very poorly estimated (the standard error is 7.35) so we cannot make any claims regarding the overall pattern. What we can say is that the most educated households are less risk averse than the least educated ones. Regarding the fixed costs for investing in the risky asset the estimated values for the three education levels are 4,340 euros, 3,390 euros and 4,890 euros. As with the risk aversion coefficient there is no direct correspondence between the education level and the fixed costs. We could argue that this is the result of

[5] Interestingly enough, the range of values is almost identical to that provided by Gourinchas and Parker (2002), 0.282-2.290, although there is no correspondence between my estimation and theirs when looking at each education level

two forces which are acting together. On the one hand, more educated households have more knowledge about financial instruments and probably access to better deals (since the correlation between education and wealth is high). On the other hand, we can expect more educated households to have a higher opportunity cost of investing in the risky asset, the time spent researching and monitoring their investments is more costly for them than for less educated households due to the income gap. The prevalence of one force or the other as the education level increases could explain the pattern observed.

Table 2.2: Estimation results by education level

	Risk aversion coefficient	Fixed costs
All households	0.297	4,377
	(0.026)	(140.5)
Less than high school	0.93	4,340
	(0.34)	(1.4)
High school	2.29	3,390
	(7.35)	(0.4)
Less than high school	0.30	4,890
	(0.07)	(381.3)

(Standard errors in parenthesis)

2.9 Conclusion

In this paper I develop a stochastic life cycle model of consumption and portfolio choice with uncertain income and a fixed cost of investing in the risky asset. This model shows how younger households retract from participating in the stock market until they have accumulated certain wealth. At some point they start increasing their participation rate reaching its highest at around their retirement age. The age at which they start participating and the extend of this participation depends on the level of fixed cost introduced in the model. The participation pattern is also negatively correlated with the uncertainty

in the income process and positively correlated with the education level of the household; both results in line with general findings in the literature.

I use data from the Encuesta Financiera de las Familias (EFF) in order to estimate the parameter of risk aversion and the level of fixed cost that produce consumption levels and participation rated closer to those observed in the Spanish households. I perform the estimation by Non Linear Least Squares and I estimate a risk aversion parameter of 0.297 with a standard error of 0.026 and a fixed cost of 4,377 euros with a standard error of 140.5.

A potential avenue of future research would be to explore households' heterogeneity in different dimensions. For example, the risk aversion coefficient and the level of fixed costs could be estimated by households' net wealth or income quintiles.

Table 2.3: Summary statistics

	Mean	Std. deviation	p10	Median	p90	Observations
Age	52.3	0.3	32	51	74	5962
Net wealth	256961.0	6630.6	2022	176357	520477	5962
Financial assets	31151.3	1660.4	250	6000	65000	5962
Income	31545.5	690.0	6856	22998	61598	5962
Consumption: non-durables	11070.0	262.4	4200	9600	20400	5962
Consumption: durables	2795.1	235.0	0	120	10000	5962
Consumption: total	13865.1	363.6	4776	10818	27647	5962
Stock participation	16.7	0.7	0	0	1	5962
Stock balances	54441.3	5583.3	1253	12000	104000	1829
Bond participation	1.5	0.2	0	0	0	5962
Bond balances	34963.4	5233.2	2404	24000	91221	170

Notes: All values in euros except for stock participation (%), bond participation (%) and age. Standard errors corrected for multiple imputation.

Chapter 3

Macroeconomic Experiences and Households' Risk-Taking Behaviour

3.1 Introduction

There is ample evidence that risk aversion has increased in the course of the global financial crisis, across a range of economic agents. Financial markets show a higher degree of risk aversion Bekaert and Hoerova (2013), banks have become more risk averse in their lending practices Bassett et al. (2012), and also households have been found to be more risk averse following the experience of the financial crisis Guiso et al. (2012). This suggests that risk aversion varies over time, and depends on the experiences that economic agents have made. Time-varying risk aversion has been explored in a number of papers related to financial markets, and has been shown to allow matching several empirical facts, like the counter-cyclicality of asset return risk premia Constantinides (1990); Campbell and Cochrane (1999). Also, Bekaert et al. (2013) illustrate that risk aversion in financial markets is responsive to monetary policy, with lax monetary policy leading to a substantial

decline in risk aversion. In contrast to the evidence for financial markets, much less is known with regard to possible time variations in the risk aversion of consumers or households. Guiso and Paiella (2008) show that risk aversion increases in response to heightened income uncertainty or if individuals become liquidity constrained. Guiso et al. (2012) study clients of banks, and find measures of risk aversion to have increased substantially after the crisis. Furthermore, these changes are correlated with changes in the clients' portfolio choices, suggesting that extreme negative events have substantial repercussions on risk aversion and household finances. Beyond the immediate reaction to adverse events, a recent paper by Malmendier and Nagel (2011) has shown that households' risk taking is furthermore affected by the experience that they have made over longer time spans. They show that risk aversion of U.S. households decreases with the real stock market returns they have experienced over their lifetime, and that this pattern is also reflected in their portfolio decisions (as households with less favourable experiences are less inclined to hold stocks in the first place, and furthermore hold smaller amounts in case they participate in the stock market). This evidence contradicts the assumption maintained in standard economic models that economic agents have stable risk preferences, and adds to a literature that studies the effect of the environment and personal experiences on the formation of preferences and economic behaviour. Several factors have been identified as important in that regard. Experiences of inflation, for instance, are relevant having experienced higher inflation tends to lower happiness Blanchflower (2007), increase inflation expectations Lombardelli and Saleheen (2003), Malmendier and Nagel (2009), and inflation aversion Ehrmann and Tzamourani (2012). Having grown up during recessionary times also matters for future preferences: as Alesina and P.Giuliano (2011) and Giuliano and

Spilimbergo (2009) demonstrate, such individuals are more likely to hold the belief that success in life depends more on luck than on effort, and therefore have a more favourable attitude towards re-distributional policies. Beyond these macroeconomic factors, also an individual's experience of financial market performance shapes her behaviour: Kaustia and Knupfer (2008) show that investors are more likely to subscribe to initial public offerings (IPO) on the stock market if their previous IPO investments have performed relatively well, and Choi et al. (2009) suggest that investors over-extrapolate from their personal experience when they make their savings decisions. Of course, also the socio-economic background of an individual affects beliefs and behaviour. As reported in Dohmen et al. (2011a), the educational background of an individual's parents affects her willingness to take risks. Guiso et al. (2004) measure social capital in a region by the electoral turnout and the willingness to donate blood, and find that in high social capital regions in Italy, more households invest in stocks, a pattern that even persists if the individual leaves the region. Finally, using data on German households, Alesina and N.Fuchs-Schundeln (2007) have identified persistent effects of communism on attitudes towards the role of the state in providing social services, insurance or redistribution. If we accept that individual experiences shape beliefs and behaviour, another question is how long these patterns persist. As just mentioned, both the findings in Alesina and N.Fuchs-Schundeln (2007) and in Guiso et al. (2004) suggest that there is quite some persistence. Malmendier and Nagel (2011), estimating the impact of financial market experience on risk aversion and risk taking, find that more distant experiences are relatively less important than more recent ones, but that their impact remains noticeable for some decades. Their findings also suggest that young individuals are particularly affected by more recent events. The current paper uses the

methodology and the approach developed by Malmendier and Nagel (2011) and applies it to a novel dataset on household finances, the Eurosystem Household Finance and Consumption Survey (HFCS). This dataset provides information on self-assessed risk aversion and participation in financial markets, along with a large number of important control variables, in a harmonised fashion for several countries in the euro area. Our data cover more than 58,000 households in Austria, Belgium, Finland, France, Germany, Greece, Italy, Luxembourg, the Netherlands, Spain and Portugal, i.e. in eleven different countries of the euro area[1]. The data show considerable variation in the experienced stock market returns both within and across countries. While our measure of self-assessed risk aversion varies relatively little, stock market participation is also widely different across countries, ranging from an average of 3% in Greece to 22% in Finland. Among stockholding households, the average share of stocks in total liquid assets is smallest in Germany and the Netherlands with 16%, and largest in Finland and Greece with 34%. This substantial cross-country variation is crucial for the current paper, as it allows the identification of experience effects separately from age effects despite the fact that only one wave of the survey is currently available. Our estimates of the effects of life-time experiences on risk aversion and stock holdings among euro area households are fully in line with those identified in Malmendier and Nagel (2011). They are statistically significant and economically substantial. To give just a few examples, households at the 90th percentile of the distribution of experienced stock returns are 8 percentage points less likely to report a high level of risk aversion than households at the 10th percentile of the distribution of experienced

[1]The HFCS also contains data for Cyprus, Malta, Slovakia and Slovenia. As we could not obtain sufficiently long historical data for the stock market performance of these countries, we had to discard them from the analysis.

stock returns. The corresponding effect for the United States identified in Malmendier and Nagel (2011) is 9 percentage points. For the propensity to hold stocks, the 90th-percentile household in the euro area is 12 percentage points more likely to be invested in the stock market than the 10th-percentile household, as compared to a 10 percentage point difference in the United States While these estimates match those reported in Malmendier and Nagel (2011) very closely, our evidence for Europe suggests that the effect of experienced stock market returns is less persistent than in the United States. For instance, the results in Malmendier and Nagel (2011) imply that a 30-year old individual assigns a weight of 4.7% to the experience made 10 years ago. For Europe, we estimate a weight of 2.7%. While smaller quantitatively, the results still imply that stock return experiences matter for risk aversion and stock market participation for several years. The paper then moves on to testing whether the experience of extreme events also has a bearing on stock market participation. Counting the number of times an individual has seen nominal stock market returns decline by more than 20% in a given year, we once more find substantial effects for each additional experienced event of this type, the tendency to hold stocks shrinks by 2 percentage points. Over the interdecile range of the experience distribution, this amounts to a 9 percentage point difference in stockholdings. These findings relate to a previous literature on rare disasters (like stock market crashes but also other events like wars) and financial markets. Rietz (1988) and subsequently Barro (2006), Barro (2009) showed that models which take into account the probability of rare disasters can help explaining inter alia the equity premium puzzle. Taking this idea further, Alan (2012) studied whether household portfolio decisions can also be explained by the perceived risk of stock market crashes. While she rejects this hypothesis for the better educated and wealthy households,

there is supportive evidence among the less educated households. Dohmen et al. (2011b) have documented that households' expectations of future stock market returns are very heterogeneous, and affect participation and investment patterns. In this paper we argue that the beyond socio-demographic factors, households experiences of disastrous events are an important factor in shaping their portfolio decisions, possibly via return expectations. The paper therefore provides further evidence supporting the relevance of time-varying risk aversion of households, which has repercussions on their actual behaviour. These findings have important policy implications. It is a well-known fact that households are generally underinvested in the stock market, a phenomenon that has been dubbed the 'stock-holding' puzzle Haliassos and Bertaut (1995); Campbell (2006). The puzzle is particularly pronounced in Europe, where household stock market participation is even lower than in the United States. This is especially problematic given that households have been made more and more responsible for their own finances after retirement van Rooij et al. (2011). The findings in the current paper imply that stock market participation will likely be further depressed due to the recent experience of the 2008 stock market crash, suggesting an even more pronounced underinvestment of European households in the stock market in the times to come. The paper proceeds as follows: Section 2 provides more detail on the underlying data and the econometric methodologies that we employ. Section 3 reports the main findings regarding the effect of individuals' stock market experiences on risk aversion and stock market participation, and provides the results of several robustness tests. Section 4 expands the evidence by focusing on the consequences of extreme events. Section 5 concludes.

3.2 Data and Methodology

3.2.1 Data

In order to conduct our analysis we will combine household-level data from the HFCS and historical data for stock returns. The HFCS provides ex-ante comparable data for 15 euro area countries (all euro area countries with the exception of Estonia and Ireland[2] As we could not obtain sufficiently long historical data for the stock market performance of Cyprus, Malta, Slovakia and Slovenia, we had to discard them from the analysis. Our data cover more than 58,000 households in 11 euro area countries, namely Austria, Belgium, Finland, France, Germany, Greece, Italy, Luxembourg, the Netherlands, Spain and Portugal. The HFCS contains information regarding socio-demographic variables, assets, liabilities, income and consumption for a sample of households that is representative both at the national and the euro area level. A set of population weights is provided in order to ensure the representativity of the sample. All our calculations use these population weights. In section 3.2 we perform unweighted calculations as part of our robustness checks. Another important feature of the HFCS is that missing observations (i.e. questions that were not answered by the respondent households) are multiply imputed as a matter of fact, five datasets are provided, an issue that we will take into account when assessing the statistical significance of our estimates[3]. The first wave of the HFCS was conducted around 2010, but the reference periods have not been fully harmonised. In particular, the reference period for the Spanish data is 2008/2009, whereas it is 2009 for

[2]For more details on the survey, see $http://www.ecb.europa.eu/home/html/researcher_hfcn.en.html$. The results from the first wave are described in detail in Finance and Network (2013b).

[3]Variables necessary to construct wealth and income aggregates are multiply imputed in each country. Some countries imputed other variables, too. For more information see section 6 and subsection 9.2.7 of Finance and Network (2013a), which describes the most relevant methodological features of the survey, including information on sampling design and weighting.

Greece. We account for these differences when calculating respondents' life-time experiences. It is important to note, however, that all the households in our sample have lived through the 2008 financial crisis. From the HFCS we are going to retrieve our dependent variables and a set of control variables. In particular, the variables of interest are the household's self-reported risk aversion, whether it participates in the stock market or not, and the share of liquid assets invested in stocks. For determining the household's risk aversion we use the following question: *'Which of the following statements comes closest to describing the amount of financial risk that you (and your husband/wife/partner) are willing to take when you save or make investments?'* The respondent can choose one of the following options: 1. Take substantial financial risks expecting to earn substantial returns, 2. Take above average financial risks expecting to earn above average returns, 3. Take average financial risks expecting to earn average returns or 4. Not willing to take any financial risk[4]. For the stock market participation decision, we consider that a household participates in the stock market if it holds any stocks directly or it is invested in mutual funds which invest predominantly in equity. For the share of liquid assets invested in stocks we define liquid assets as the sum of the value of sight accounts, savings accounts, mutual funds, bonds, ownership of non self-employment private businesses, shares and managed accounts[5]. In all our model specifications we will control for age, income,

[4]Unfortunately, this question has not been asked in France and Finland. Also, it has not been imputed for all countries, which somewhat restricts the available sample size. Note that the HFCS variable asks for risk aversion, in contrast to the variable used in Malmendier and Nagel (2011), which relates to risk tolerance. Both variables are measured in discrete steps from 1 to 4, but high values for the U.S. variable correspond to low values for our variable and vice versa.

[5]Malmendier and Nagel (2011) also include stocks held in retirement accounts, a variable that is not available for the HFCS. In the robustness section, we will include households that have invested in voluntary pension schemes to get closer to the definition of Malmendier and Nagel (2011).

education, the stock of liquid assets, whether the reference person[6] is married, retired, has children or works in the financial sector. The exact list of variables used can be found in the appendix. Again, the controls follow Malmendier and Nagel (2011), with the exception of the financial sector affiliation, which we added because it might affect the household's tendency to hold stocks. Finally, we also control for country-fixed effects, given that the literature has found differences in stock ownership to be primarily linked to differences in economic environments between European countries Christelis et al. (2012). In order to construct the stock market experiences which the households in our sample have lived through, we use long-term historical time series obtained from Global Financial Data. We use real stock returns (deflated with consumer prices) from 1930 until the year prior to the survey. Since the data do not go back further in time than 1930 (1932 in Portugal), we treat all households born before 1930 as if they were born in 1930 (1932 in Portugal)[7]. We furthermore generate a variable that measures how often a household has experienced a substantial drop in stock prices, which we define as an annual return of below -20%. Such a decline could come about due to a genuine stock market crash, or alternatively through a sustained but more gradual decline. Since our data are annual, we cannot distinguish between the two. Of course, we will subject the results to a robustness test where the definition of a stock price drop is altered. Note that we base this variable on nominal

[6]Throughout the paper household and reference person should be seen as interchangeable concepts. For example, when we talk about the age of the household it is understood that we are referring to the age of the reference person. The household reference person is chosen according to the international standards of the so-called Canberra Group (UNECE (2011)). This definition uses the following sequential steps to determine a unique reference person in the household: i) household type, (ii) the person with the highest income, (iii) the eldest person.

[7]This affects 3636 households. Dropping them from the sample does not change the results in any relevant manner as we will see, experiences before 1930 would anyway get a negligible weight in determining household behaviour in the present times. For Greece, the stock market returns series by Global Financial Data only extend back to 1953, but we were able to expand the series back to 1930 using data provided to us by the Bank of Greece.

returns, whereas the overall stock market experiences were calculated using real returns. The reason is that for smaller movements in the stock market, what matters for consumers is the real return they can make with their investment, whereas stock market crashes are typically defined using nominal returns. A robustness test using real returns to define crashes does not alter our results.

3.2.2 Methodology

We are interested in studying the effect of past experiences on the attitude towards risk and the portfolio-choice decisions of households. Following Malmendier and Nagel (2011), we synthesise the life-time experienced returns of a household using a weighted average of these returns conditional on a weighting parameter λ. The weighting scheme is flexible enough to allow households to give either higher or lower weights to more recently experienced returns. In particular, for each household i in country c, the experienced return is constructed as follows:

$$A_{ic}(\lambda) = \sum_{k=1}^{age_i - 1} w_i(k, \lambda) R^c_{T-k} \tag{3.1}$$

$$w_i(k, \lambda) = \frac{(age_i - k)^\lambda}{\sum_{k=1}^{age_i - 1} (age_i - k)^\lambda} \tag{3.2}$$

R^c_{T-k} denotes the stock market return in year T-k (where T is the reference period of the survey) in country c. The weights $w_i(k, \lambda)$ depend on the age of the household and a weighting parameter λ which determines the shape of the weighting function (in particular whether the slope is positive, negative or flat), and the steepness of the slope.

To understand the form of the weighting function, Figure 1 depicts possible weights for the example of a 50-year-old household, using different values of λ : -0.2, which corresponds to an increasing weighting function (where the distant past matters more than

the more recent past); 1, which implies linearly decreasing weights; and 5, a concavely decreasing weighting function. Generally, a negative λ implies that the household places higher weight on more distant experiences, whereas a positive λ indicates that more recent returns are given a higher weight. As λ increases, the effect of past returns fades away more quickly and more recent returns are given a relatively higher weight.

Figure 1 here

When calculating life-time experiences in this manner, we impose a number of assumptions. First, we assume that the relevant horizon extends back to the year of birth. This assumption turns out not to be critical, as we will show by varying the start of the relevant horizon, once to include 10 years prior to birth, and once to start 10 years after birth. A second assumption is that all households experience stock market returns, whether they are actually holding stocks or not. Third, we assume that it is the national stock market returns that matter, and thereby implicitly that the reference person did not live abroad or experienced stock market returns in another country by some other means, e.g. by holding an internationally diversified portfolio. We think of the latter as a realistic assumption due to the well-known home bias in portfolios, and will subject the former to a robustness test by excluding all households that were not born in the country of residence. We are going to estimate λ from the data. In general, our regression models will have the following form:

$$y_{ic} = \alpha_c + \beta A_{ic}(\lambda) + \delta x_{ic} + \epsilon_{ic} \tag{3.3}$$

where y_{ic} denotes the measure for risk aversion, the variable indicating whether or not a household participates in the stock markets, or the share of stocks in liquid assets. α_c are

the country fixed effects, x_{ic} the various control variables, and ϵ_{ic} is a residual. Note that $A_{ic}(\lambda)$ is a non-linear term, such that we have to use non-linear estimation techniques, irrespective of the remaining model specification[8].

We first look at the effect of experiences on the self-assessed risk aversion of the household. Since the dependent variable takes four values ordered according to the degree of financial risk willing to take, we use an ordered probit model for the estimation. When our dependent variable is the stock market participation decision we use a probit model, and when we look at the share of the portfolio invested in stocks we use a tobit model. When the experienced return is our independent variable of interest, we first estimate the model on a tight grid of lambdas and then we use the results of this estimation as the initial values for further non-linear optimization. As we mentioned before, once λ is set, the non-linearity introduced by the weighted return disappears (there is still non-linearity due to the probit, ordered probit or tobit). This procedure ensures avoiding local maximums, apart from substantially reducing computation time.

Our other independent variable of interest is the number of stock market crashes experienced. We define a stock market crash as a year in which the nominal stock market return was less than -20%[9].

For the model specifications dealing with this independent variable we do not include a weighting function, thereby implicitly assuming that the effects of crashes persist and accumulate. Therefore, it is important to allow for a non-linear effect, which we will do by

[8]Note that this model identifies experience effects via the variation of experiences over age and across countries. In the paper by Malmendier and Nagel (2011), identification was achieved by using several waves of the U.S. SCF, such that experiences vary over age and across waves.

[9]In the robustness checks section we also test for larger declines of -40%, and find substantially stronger effects.

using a quadratic term, such that the model is estimated as follows:

$$y_{ic} = \alpha_c + \beta_1 S_{ic} + \beta_2 S_{ic}^2 + \delta x_{ic} + \epsilon_{ic} \tag{3.4}$$

All variables are described as in equation (3), and S_{ic} is the number of experienced stock market crashes.

When estimating our econometric models, like Malmendier and Nagel (2011) we use weights to account for the fact that the survey does not always represent the same fraction of the overall population across countries. Our weights re-adjust each observation to reflect their relative importance for the euro area as a whole. In so doing, we also follow Faiella (2010) and Magee et al. (1998), which recommend the use of weights for two similar surveys, namely the Italian SHIW and the Canadian SCF. They argue that in surveys with complex survey design the use of weights protects against the omission of relevant information, which otherwise would have to be modelled explicitly by incorporating all available geographic and operational variables that determine sampling rates. Another reason for using weights is due to the possibility of endogenous sampling Solon et al. (2013), as the HFCS oversamples wealthy households, and given that stock market participation varies with wealth.

3.2.3 Descriptive statistics

Table 1 provides descriptive statistics for risk aversion, households' stock market participation and the share of liquid assets invested in stocks. Self-assessed risk aversion shows little variation, both within and across countries. In eight of the nine countries where this variable is available (remember that this question was not asked in Finland and France),

the median household reports the highest level of risk aversion (coded as 4). Italy is the only exception with a median of 3. The mean figure is 3.6 for the euro area as a whole, and it varies from 3.3 in Italy to 3.9 in Portugal. Overall, these results are not very different from what was found for U.S. households in Malmendier and Nagel (2011) putting their variable on the same scale as ours would result in a mean value of 3.2. Still, as we will see subsequently, despite the low variability of this variable, it is sufficient to estimate meaningful results.

Table 1 here

Participation rates in stock markets are very low (see the second panel of Table 1), only 13% of households report some stock holdings. Importantly, however, there is considerable variation across countries, with participation rates ranging from 3% in Greece to 22% in Finland. Conditional on stock-market participation, euro area households keep 23% of their liquid assets in stocks. Also this figure, displayed in the third panel of Table 1, varies across countries. The mean ranges from 16% in Germany and the Netherlands to 34% in Finland and Greece. Interestingly, there is also a substantial amount of variation within countries. There are many household with very small amounts of stocks in their portfolios, as shown by the tiny numbers for the 10th percentile, whereas the 90th percentile household in several countries holds substantial amounts in stocks (e.g. above 80% in Spain, Greece and Finland)[10].

Table 2 here

[10]Note that the dependent variable in our regressions will not be conditional on stock holdings, i.e. we include also households that do not hold stocks in our sample.

Table 2 provides a first look at our main explanatory variables. In the upper panel, we report summary statistics for the experienced stock market returns of households, A_{ic}. They are calculated using a weighting factor of $\lambda = 4.5$, which is close to the estimates that we will report below. There is substantial variability in the experiences across and within countries: they range from 4% in Italy to 13% in Finland. The variation within countries is largest in Greece where the 10th percentile of the return distribution is 3% and the 90th percentile is 13%.

These figures suggest that there is substantial variability in real stock market returns. Importantly, this variation is largely due to differences in nominal returns, and only to a small extent explained by differences in inflation rates. Table 3 shows the correlations between each country's nominal stock market return for the whole sample 1930-2010. Correlations are rarely higher than 0.5, and in a few cases they even take negative values.

Table 3 here

When we look at the number of protracted stock market declines or genuine stock market crashes that households have experienced (reported in the second panel of Table 2), we once more see substantial variability across and within countries. The mean number of stock market downturns that households have experienced ranges from 3.4 in Austria to 11.6 in Portugal. In most countries, the difference between the 10th and 90th percentiles of the distribution is larger than 6 events. To summarise, the descriptive statistics show that there is substantial variation in our dependent and explanatory variables both across and within countries. We will now turn to studying how an individual's experience affects risk aversion and stock market participation.

3.3 The effect of experiences on risk aversion and stock market participation

3.3.1 Benchmark results

Table 4 provides the first set of results. It reports the estimated coefficients of the ordered probit model explaining self-reported risk aversion. Note that the standard errors take account of the multiply imputed nature of the data, thereby properly reflecting the uncertainty of the imputed values. Several of the control variables are relevant. Higher income and a higher stock of liquid assets tend to increase risk aversion, even though for both variables there are important non-linearities as suggested by the statistical significance of the squared terms. The retired are somewhat more risk averse than other households, an effect that is found on top of an increasing risk aversion with age (the latter has already been documented in the literature, see Dohmen et al. (2011a)). Education also seems to matter, with higher levels of education being associated with a lower reported risk aversion. Our control for respondents who are working in the financial sector is highly statistically significant, and suggests that these individuals are less risk averse. Finally, also the country fixed effects appear to be relevant, with Italians being less risk averse than Germans, and respondents in Belgium, Spain, Luxembourg, the Netherlands and Portugal reporting a higher level of risk aversion than their counterparts in Germany.

Table 4 here

Moving to the two main parameters of interest, β and λ, the estimated coefficients suggest that both are relevant and point into the expected direction. The weighting parameter λ is estimated to be 4, considerably larger than the corresponding estimate for

the United States, which was provided by Malmendier and Nagel (2011) as 1.8, and therefore pointing to a higher decay factor in Europe. To take the example of a 30-year old individual, a European would assign a weight of 15.8% for the previous year's experience, whereas a U.S. household would give it only a weight of 8.1%. Despite this large initial difference, memory is still rather persistent also for the European household, who is estimated to assign a weight of 3.6% to experiences made 10 years ago (whereas the number in the United States amounts to 4.7%). Taking the example of an individual with a longer life history, the relevance of past experience becomes even more apparent: according to our estimates, a 50-year old person would weigh the most recent year with 9.7%, and the experience made a decade ago with 4.3%. Even the stock market returns experienced 20 years ago would enter the weighting function with 1.4As expected, the coefficient estimate for β indicates that higher experienced returns tend to lower risk aversion. To get a feeling for the economic magnitudes, Table 4 also reports average marginal effects, and shows that an increase in experienced returns by 1 percentage point makes households 1.4 percentage points less likely to be very risk averse. Comparing the average of the fitted probabilities at the 90th percentile of the distribution of experienced returns with the average of the fitted probabilities at the 10th percentile yields a difference of 7.9 percentage points. This effect is substantial in magnitude, and matches closely the 8.8 percentage points that were identified by Malmendier and Nagel (2011) for the United States[11].

The next question to study is whether there are any repercussions on actual stock market participation. This is taken up in Table 5, which reports the results from the probit

[11] The difference between the 90th and the 10th percentile are broadly comparable between the euro area and the United States. At the respectively estimated λ, it amounts to (11.9%-6.2%=5.7%) for the United States, and to (9.3%-4.2%=5.1%) in the euro area.

model explaining the households' participation decision. Once more, a number of control variables appear to be significant. Participation is found to increase for households with high liquid assets, high education and working in the financial sector. Compared to Germany, stock market participation is higher in Belgium and France, and lower in Austria, Luxembourg and Portugal.

Table 5 here

As before, the parameter λ is significantly estimated, and at 5.3 larger than what was found for the United States (1.3). Once again, however, the parameter still implies that memories persist for the 30-year old, experiences had 10 years ago receive a weight of 2.7%, for a 50-year old, it amounts to 4.1%. Also β is statistically significant. Based on the marginal effect and the interdecile range reported in Table 5, it is apparent that the magnitude is economically important a one percentage point higher experienced stock return increases the propensity to hold stocks by 2 percentage points, and the difference in stock market participation along the interdecile range of the stock market experiences amounts to 11.5 percentage points, which is rather close to the 10 percentage points estimated by Malmendier and Nagel (2011).

The third test is conducted on the share of liquid assets invested in stocks, with results provided in Table 6. These results are based on a tobit model, such that the coefficients are now directly interpretable. The share of stocks in the liquid assets held by financial sector employees is 23 percentage points higher than among other households. Furthermore, the share of stocks rises with the stock of liquid assets and education (college graduates have

a 19 percentage point higher share of stock investments than households with less than a high school degree).

Table 6 here

As previously, we estimate statistically significant parameters for λ and β[12]. Comparing households on the interdecile range suggests that those at the 90th percentile of the distribution invest 4 percentage points more in stocks than those at the 10th percentile (once more, these numbers are comparable with those for the United States).

3.3.2 Robustness tests

We have subjected our results to a large number of robustness tests. First of all, in analogy to Malmendier and Nagel (2011), we have also tested whether similar results can be obtained for bond market experiences and their effects on bond holdings[13]. Judging from the descriptive statistics, there is much less variability in bond market returns than in stock market returns. In large parts, this is of course due to the near complete convergence of government bond yields in the euro area in between 1999 and 2010 Ehrmann et al. (2011). For instance, average experienced returns range from 1.44% in Greece to 5.53% in Finland, and the difference between the 10th and the 90th percentile of the return distribution within a country does not exceed 2 percentage points in any case. Accordingly,

[12]Note that our estimates of λ are quite different for the effect of experiences on risk aversion, stock market participation and the share of stocks in liquid assets, whereas they are rather similar across these three models in Malmendier and Nagel (2011). Conceptually, however, we do not see any reason why they would need to be similar across the three specification, given that they measure very different concepts, which might be affected by previous experiences differently.

[13]Bond returns are calculated for long-term bonds. As bond returns for Luxembourg are not available prior to 1947, we exclude Luxemburgish households born before 1947. The bond holdings are defined in analogy to the stock holdings as directly held bonds or investments in mutual funds that themselves predominantly invest in bonds.

we would expect our results to be weaker than for stock holdings. Comparing the estimates for β and λ reported in Table 7, from the benchmark model in row (1) with those for bond markets in row (2), it is apparent that we estimate a rather similar coefficient for λ, at 3.99 (compared to 5.33 for stocks). The parameter β, in contrast, is only marginally significant for the bond market participation decision.

Table 7 here

The remaining robustness tests, reported in rows (3) to (13) of Table 7, go back to explaining the stock market participation decision as a function of stock market experiences. The first of these allows for an additional effect of experienced stock market volatility. For that purpose, we added the experienced stock market volatility (calculated as the weighted standard deviation of the respondents' life time experience, using the previously estimated λ as weighting parameter) to the benchmark regression. As can be seen from row (3) of Table 7, our results remain robust. While the experienced volatility itself lowers stock market participation in a statistically significant manner, the effect of the experienced returns and the weighting parameters are basically unaltered.

Results are also stable for the robustness test in row (4), where we broadened the definition of stock holdings to not only include direct stock holdings and investments in mutual funds that themselves predominantly invest in stocks, but furthermore also investments in voluntary pension plans. This change in definition raises the stock market participation rate of euro area households from 13% to 39%. Still, all results go through.

For the subsequent robustness test, we reran our estimations without using population weights. Here, the quantitative results change, but qualitatively remain robust. The

experienced stock returns exert a smaller effect on stock holdings, and the weighting parameter is substantially larger, indicating that the more recent experiences matter more. Where do these differences come from? The new set of results treats each observation equally, whereas before observations reflected the countries' population shares in the euro area. Looking at Table 1, it is evident that countries like France and in particular Finland receive much more prominence in the new estimation (as they have by far the largest samples in the survey, exceeding their population share), whereas the relevance of for instance German observations diminishes when using an unweighted regression (as the around 3,500 households representing Germany in the HFCS make up for 6% of the overall sample, whereas the German households effectively account for around 29% of the euro area household population). The change in coefficients does therefore point to differences in the economic significance of the effects across the various countries. As we will see below, these differences are tightly related to how severely the countries were hit by the 2008 stock market crash. Finland and France were among the more strongly affected countries compared to Germany, and in the countries with more severe stock market crashes, the most recent experience receives a rather strong weight.

The fifth robustness included an additional regressor, namely the bond returns that households have experienced over their lifetimes (keeping the weighting parameter from the robustness test provided in row (1), i.e. when explaining bond market participation with experienced bond returns). As one would expect, this somewhat diminishes the quantitative importance of the experienced stock returns, but does not change the picture qualitatively (see row (6) of Table 7). The next two rows of Table 7 show how our results change if we vary the experience horizon of respondents, by either including 10 years

prior to birth, or by starting 10 years after birth. In both cases, the magnitudes of our parameters change somewhat, but without affecting the overall results in any meaningful manner. In row (9), we also show that including risk aversion as an additional regressor has barely any impact on the results. The degree of risk aversion is clearly a determinant of the decision whether to hold stock or not, but we do no not include it in our baseline specification to avoid any endogeneity issues.

Row (10) of the table shows the result for a regression in which we exclude immigrants from the sample. Specifically, we drop all households who were borne in a country different from the one they have been interviewed in, as immigrants are more likely to have been exposed to stock market returns in countries other than their country of residence. We exclude France, Spain and the Netherlands since we do not have information on the country of birth of the household for these households. Again, all our results hold[14] . Finally, as a way to test for possible spurious correlations, we run a placebo experiment[15]. For that purpose, we randomly assigned a different nationality to each cohort in a given country (for instance, all 35 year-old households in France were randomly allocated a nationality other than the French one, all 36-year old French households were independently assigned a random nationality, etc.). With this placebo allocation of nationalities, we then re-ran our estimations. As can be seen from row (11) of Table 7, the pseudo lifetime experiences are not found to significantly affect stock market participation.

[14]As it can be seen in Table 7 the coefficients for this robustness check differ from the ones in the baseline specification, but this is due to the different samples used. When we run the baseline specification excluding France, Spain and the Netherlands the results are almost identical.

[15]We are grateful to Dimitris Georgarakos for suggesting this idea.

3.4 Any difference for extreme events?

The experience of the stock market crash in 2008 is bound to still be vividly remembered by stock market participants. Many of these have lost substantial amounts of wealth, which in turn has been shown to affect risk-taking Necker and Ziegelmeyer (2013). A natural question is therefore whether extreme events like stock market crashes influence beliefs and behaviours in a more persistent manner than less extreme experiences. Related evidence supporting this hypothesis is provided by Ehrmann and Tzamourani (2012), who show that the effect of experienced inflation on inflation aversion fades away in general, whereas memories of hyperinflation tend to stay in people's minds and affect attitudes in a much more persistent manner.

Table 8 here

Table 8 reports the estimates of the effect of stock market crashes or protracted stock market declines on risk aversion. Note that this specification does not contain a λ factor, i.e. we simply count the number of such experiences the individuals have made over their lifetimes and enter this as an explanatory variable (thereby already assuming that these experiences remain an important factor in influencing risk aversion and stock market participation, and that they are additive). The results indicate that for each additional such experience, the propensity to report a high level of risk aversion increases by 1 percentage point. Looking at the interdecile range, this amounts to a difference of 3.4 percentage points. While this number might not sound overly large, it is important to note that many of the stock market declines were experienced a considerable time ago (more

than 70% before 1990, 45% before 1970). These numbers take into account a non-linearity in the effects: the squared number of experienced events enters with a significant negative sign, suggesting that with increasing numbers of experienced stock market downturns the increase in risk aversion becomes less pronounced.

Also the propensity to hold stocks is affected in a similar fashion, as can be seen from Table 9. Here, the fitted probabilities along the interdecile range generate a difference in stockholding propensities of 8.5%, i.e. nearly as much as the differences generated by the interdecile range in the experience of stock market returns themselves. In contrast, the share of liquid assets invested in stocks does not seem to be affected by the number of experienced stock market downturns (given that the parameter estimates reported in Table 10 are statistically insignificant), suggesting that the effect is more on whether or not to hold stocks than on how much to hold in stocks

Tables 9 and 10 here

We extended the analysis in several dimensions, focusing in particular on stock market participation, in line with the literature on rare events and household finance. These extensions, as well as a number of robustness tests, are reported in Table 11 which repeats the average marginal effect obtained in the benchmark estimations from Table 9 in row (1). First, we combined regression models (3) and (4) by including both Sic, the number of experienced stock market downturns, and A_{ic}, the experienced returns. The results show that the effect of experienced returns and the weighting parameter λ barely change in the new specification compared to the previous results, whereas the number of

experienced downturns (reported in row (2) of Table 11) exerts an additional effect on the participation decision.

Table 11 here

We have furthermore extended equation (4) by allowing for a separate effect of stock market booms (which we defined in analogy to downturns as nominal annual returns in excess of 20%). We find that booms are much less relevant than downturns (the coefficient, not shown in the table, is insignificant). Even though one might expect that more households are inclined to invest in the stock market during boom times (and stay invested subsequently), this effect is not evident in the data. In contrast, the coefficient estimates for the effect of downturns remain basically unaltered (row (3) of Table 11).

Due to the fact that the survey was conducted just after the 2008 stock market crash, all households in our sample have experienced at least one crash. To get at the importance of the most recent crash on household portfolios, we made use of the fact that the 2008 crash was hitting the various countries in our sample in rather different ways. Based on the analysis in Bekaert et al. (2012), we split the countries into those that were affected by the crisis least (namely Austria, Belgium, Germany, Spain, Luxembourg and the Netherlands, which on average saw their stock markets decline by 36%), and those where stock markets were severely hit (i.e. Finland, France, Greece, Italy and Portgual, with an average drop of 52%), and then repeated the analysis of Section 3 separately for each country group. The results are provided as the two bottom rows of Table 7. There are remarkable differences across the two groups: whereas our results are robust for the countries that got hit less badly, the weighting parameter λ in the more strongly affected countries is estimated at

10.9, whereas the experienced returns themselves are not found to have significant effects. This implies that in these countries the experience of the recent crisis overshadows the earlier experiences, which receive much smaller weight in households' decisions. It also helps explaining why λ is estimated to be so much higher for Europe than in the United States (given that Malmendier and Nagel (2011) used several waves of the SCF, therefore also covering the years prior to the recent crisis).

Finally, we also subjected our findings in this section to a number of robustness tests, by i) changing the definition of a downturn to cases where annual nominal stock returns were below -40%, ii) including voluntary pension plans in our definition of stock holdings, iii) estimating the models without using population weights, iv) including the household's self-reported risk aversion as an additional regressor, and v) excluding immigrants from the sample. Results are reported in rows 4 to 8 of Table 11. This table shows that for more extreme events, the effects are substantially larger, as well as when we broaden the definition of stock holding to include those households with pension plans. The average marginal effect becomes insignificant if we run the regression unweighted and if we drop the immigrants from the sample (which also implies dropping France, Spain and the Netherlands because of data availability).

We also conduct a placebo experiment analogous to the one explained in the previous section. Once we randomly assign the number of crashes experienced, the effect of this placebo variable is not significant. This supports the validity of our results.

3.5 Conclusions

This paper has studied to what extent the experiences of households shape their risk aversion, their inclination to participate in stock markets and the amounts that they are willing to invest in stocks. It has applied the approach developed by Malmendier and Nagel (2011) and extended the evidence to Europe, using the Eurosystem Household Finance and Consumption Survey, a novel dataset on household finances covering more than 58,000 households in eleven different countries of the euro area. The data show considerable variation in the experienced stock market returns, stock market participation and the invested amounts both within and across countries. Our estimates show that experienced stock market returns exert statistically significant and economically substantial effects on households' risk aversion and portfolio decisions, even if we find that more distant experiences receive a somewhat lower (but still substantial) weight than the corresponding findings for the United States. This evidence adds to the literature on time-variations in the risk aversion of households and its determinants, as well as on the factors that shape households' portfolio decisions, emphasising the importance of personal experiences on the formation of preferences and economic behaviour. The paper then moved on to testing whether the experience of extreme stock market downturns also has a bearing on risk aversion and stock market participation. Also here, the effects are substantial and importantly come on top of the experienced average stock market returns. Rietz (1988), Barro (2006), Barro (2009) and Alan (2012) have demonstrated that expectations of rare disasters can help explaining financial market behaviour and partially also household decisions. Our evidence suggests some heterogeneity in this pattern, in the sense that households' experiences of disastrous events are an important factor in shaping their portfolio deci-

sions. These findings have important policy implications. Households are known to be generally underinvested in the stock market (and even more so in Europe than in the United States), especially in light of the fact that they have been made more and more responsible for their own finances after retirement. Especially the young and households in countries where the stock market crash in 2008 was particularly severe tend to give a strong weight to the recent past when forming their participation decision. This, in turn, implies an even more pronounced underinvestment in stocks among these European households in the times to come.

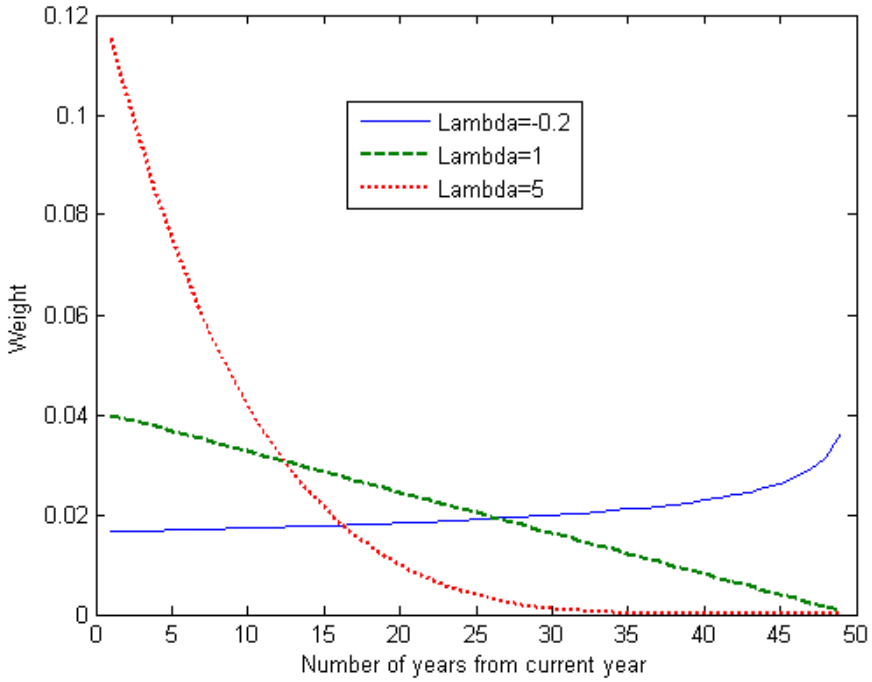


Figure 3·1: Examples of weighting functions for a 50-year old household

Notes:The figure plots weighting functions for a 50-year old household according to equations (1) and (2), for different values of λ.

Table 3.1: Summary statistics: risk aversion, stock market participation and the share of liquid assets invested in stocks

Country	Mean	Std. deviation	p10	Median	p90	Observations
Self-assesed risk aversion						
Austria	3.52	0.71	3	4	4	2340
Belgium	3.67	0.60	3	4	4	2307
Germany	3.61	0.56	3	4	4	3467
Spain	3.81	0.47	3	4	4	6197
Finland	.	.	.	.	.	0
France	.	.	.	.	.	0
Greece	3.69	0.66	3	4	4	2971
Italy	3.30	0.79	2	3	4	7951
Luxembourg	3.72	0.53	3	4	4	950
Netherlands	3.69	0.52	3	4	4	1253
Portugal	3.90	0.38	4	4	4	4365
Euro Area	3.59	0.64	3	4	4	31801
Stock market participation						
Austria	0.08	0.28	0	0	0	2380
Belgium	0.20	0.40	0	0	1	2327
Germany	0.16	0.37	0	0	1	3565
Spain	0.11	0.31	0	0	1	6197
Finland	0.22	0.41	0	0	1	10989
France	0.16	0.37	0	0	1	15006
Greece	0.03	0.17	0	0	0	2971
Italy	0.06	0.23	0	0	0	7951
Luxembourg	0.18	0.39	0	0	1	950
Netherlands	0.15	0.36	0	0	1	1301
Portugal	0.05	0.22	0	0	0	4404
Euro Area	0.13	0.34	0	0	1	58041
Share of liquid assets invested in stocks						
Austria	0.18	0.25	0.00	0.05	0.55	209
Belgium	0.22	0.27	0.00	0.12	0.63	592
Germany	0.16	0.22	0.00	0.06	0.48	864
Spain	0.32	0.30	0.00	0.21	0.83	1441
Finland	0.34	0.30	0.03	0.23	0.84	2996
France	0.29	0.29	0.00	0.20	0.77	3546
Greece	0.34	0.32	0.00	0.28	0.91	84
Italy	0.28	0.28	0.00	0.21	0.74	518
Luxembourg	0.18	0.28	0.00	0.01	0.64	225
Netherlands	0.16	0.24	0.00	0.07	0.48	255
Portugal	0.26	0.28	0.00	0.14	0.75	238
Euro Area	0.23	0.27	0.00	0.13	0.69	10967

Notes - The table shows summary statistics for risk aversion (top panel), for whether or not households hold stocks (middle panel), and for the share of stocks in liquid assets, conditional on stock ownership (bottom panel). Note that in the econometric estimation of the share of stocks in liquid assets, we do not condition on stock ownership. Rather, we include all households that do not hold stocks with a zero value, and estimate a tobit model to account for censoring at zero.

Source: Eurosystem Household Finance and Consumption Survey, own calculations.

Table 3.2: Summary statistics: lifetime experiences

Country	Mean	Std. deviation	p10	Median	p90	Observations
Experienced average real stock return (λ=4.5)						
Austria	10.62	0.37	10.09	10.65	11.16	2380
Belgium	6.85	1.12	5.11	7.16	8.05	2327
Germany	8.06	0.15	7.84	8.06	8.26	3565
Spain	7.93	1.65	5.64	8.52	9.41	6197
Finland	12.95	2.81	8.28	14.07	15.57	10989
France	7.48	1.26	5.44	7.83	8.84	15006
Greece	8.84	3.83	3.19	10.15	12.73	2971
Italy	3.86	1.39	1.93	4.16	5.38	7951
Luxembourg	10.39	0.37	9.82	10.41	10.86	950
Netherlands	7.50	1.11	5.87	7.67	8.84	1301
Portugal	8.86	0.91	7.60	8.92	10.12	4404
Euro Area	7.32	2.27	4.24	7.94	9.33	58041
Number of stock market crashes experienced						
Austria	3.39	2.55	1	3	8	2380
Belgium	4.96	1.49	3	5	7	2327
Germany	5.62	1.98	3	6	8	3565
Spain	6.68	2.06	4	6	10	6197
Finland	6.75	2.17	4	6	10	10989
France	7.82	2.49	5	7	12	15006
Greece	10.19	2.69	8	9	14	2971
Italy	10.97	2.49	8	11	14	7951
Luxembourg	4.40	1.82	3	4	8	950
Netherlands	5.06	1.31	3	5	7	1301
Portugal	11.62	2.01	9	12	13	4404
Euro Area	7.37	3.14	3	7	12	58041

Notes - The table shows summary statistics for experienced stock returns (calculated according to equations (1) and (2) with a λ of 4.5 (upper panel), and for the number of experienced stock market crashes or prolonged downturns (defined as annual nominal returns below -20%).
Source: Eurosystem Household Finance and Consumption Survey, own calculations.

Table 3.3: Correlations between nominal stock market returns, 1930-2010

	Austria	Belgium	Germany	Spain	Finland	France	Greece	Italy	Luxembourg	Netherlands	Portugal
Austria	1.00	0.42	0.44	0.39	0.11	0.44	0.42	0.46	0.40	0.36	0.10
Belgium		1.00	0.47	0.49	0.42	0.58	0.18	0.46	0.75	0.57	0.14
Germany			1.00	0.27	0.32	0.36	0.03	0.30	0.46	0.60	0.08
Spain				1.00	0.40	0.46	0.28	0.45	0.37	0.37	0.28
Finland					1.00	0.34	-0.05	0.12	0.50	0.39	0.17
France						1.00	0.25	0.44	0.47	0.52	0.05
Greece							1.00	0.39	-0.08	-0.06	0.02
Italy								1.00	0.38	0.33	0.24
Luxembourg									1.00	0.51	0.25
Netherlands										1.00	0.13
Portugal											1.00

Notes - The table shows correlations between annual national nominal stock market returns, 1930-2010.

Table 3.4: Stock market participation

		Coefficient	Std. error	t-statistic
Weighting parameter (λ)		3.977	0.618	6.440
Experienced return (β)		-4.967	1.472	-3.374
Average marginal effect	Risk aversion=1 (low)	0.100	0.031	3.227
	Risk aversion=2	0.475	0.142	3.344
	Risk aversion=3	1.004	0.298	3.366
	Risk aversion=4 (high)	-1.580	0.469	-3.369
Fitted prob at p90-p10	Risk aversion=1 (low)	0.005	0.000	27.305
	Risk aversion=2	0.022	0.001	29.797
	Risk aversion=3	0.045	0.001	31.154
	Risk aversion=4 (high)	-0.072	0.002	-30.682
Log income		0.205	0.094	2.178
Log income squared		-0.014	0.005	-2.793
Number of children		0.040	0.039	1.023
Number of children squared		-0.004	0.013	-0.332
Log liquid assets		0.122	0.015	8.102
Log liquid assets squared		-0.014	0.001	-11.258
Retired		0.073	0.042	1.730
College		-0.324	0.043	-7.509
High school		-0.200	0.038	-5.243
Age		0.019	0.008	2.393
Age squared		0.000	0.000	-0.325
Married		0.036	0.033	1.099
Financial sector employee		-0.234	0.057	-4.075
Austria		-0.023	0.058	-0.400
Belgium		0.198	0.052	3.794
Spain		0.429	0.051	8.359
Greece		0.076	0.081	0.929
Italy		-0.938	0.073	-12.898
Luxembourg		0.584	0.072	8.151
Netherlands		0.201	0.059	3.423
Portugal		0.708	0.057	12.463
Pseudo R squared			0.11	

Notes - The table shows estimated coefficients of the ordered probit model according to equation (3), explaining households' self-reported risk aversion. For the effect of experienced returns, the table also reports average marginal effects for each category of the ordered probit, and the average of the fitted probability at the 90th percentile minus the average fitted probability at the 10th percentile of the distribution of experienced returns, for each category of the ordered probit.

Table 3.5: The effect of experienced stock market returns on stock market participation

	Coefficient	Std. error	t-statistic
Experienced return	15.17	3.76	4.04
Weighting parameter	5.33	1.41	3.77
Average Marginal Effect	0.02	0.00	5.89
Fitted prob at p90 - p10	0.11	0.00	52.17
Log Income	-0.14	0.31	-0.46
Log Income squared	0.01	0.01	0.95
Children	-0.01	0.04	-0.20
Children squared	-0.00	0.01	-0.14
Log Liquid assets	0.30	0.12	2.38
Log Liquid assets squared	0.01	0.01	1.25
Retired	-0.04	0.05	-0.79
College	0.39	0.05	8.09
High School	0.21	0.04	4.62
Age	0.01	0.01	0.47
Age squared	-0.00	0.00	-1.52
Married	-0.03	0.04	-0.71
Financial sector	0.66	0.08	8.21
Austria	-1.01	0.12	-8.59
Belgium	0.20	0.09	2.19
Spain	0.13	0.17	0.77
Finland	-0.20	0.35	-0.58
France	0.33	0.08	3.91
Greece	-0.45	0.34	-1.32
Italy	0.20	0.14	1.50
Luxembourg	-0.74	0.14	-5.46
Netherlands	0.09	0.10	0.91
Portugal	-0.34	0.10	-3.51
Pseudo R squared		0.31	

Notes - The table shows estimated coefficients of the probit model according to equation (3), explaining households' participation in stock markets. For the effect of experienced returns, the table also reports average marginal effects and the average of the fitted probability at the 90th percentile minus the average fitted probability at the 10th percentile of the distribution of experienced returns.

Table 3.6: The effect of experienced stock market returns on the share of liquid assets invested in stocks

	Coefficient	Std. error	t-statistic
Experienced return	3.20	1.49	2.15
Weighting parameter	8.35	3.72	2.24
Fitted prob at p90 - p10	0.04	0.00	12.67
Log Income	0.07	0.22	0.30
Log Income squared	0.00	0.01	0.07
Children	-0.01	0.02	-0.70
Children squared	0.00	0.01	0.67
Log Liquid assets	0.23	0.06	4.09
Log Liquid assets squared	-0.00	0.00	-0.85
Retired	-0.01	0.02	-0.29
College	0.19	0.03	7.05
High School	0.14	0.02	5.85
Age	0.01	0.01	1.69
Age squared	-0.00	0.00	-2.26
Married	-0.01	0.02	-0.34
Financial sector	0.23	0.03	6.68
Austria	-0.32	0.06	-5.26
Belgium	0.14	0.05	2.79
Spain	0.31	0.10	3.02
Finland	0.35	0.14	2.53
France	0.30	0.04	7.14
Greece	0.11	0.16	0.67
Italy	0.09	0.07	1.26
Luxembourg	-0.26	0.06	-3.94
Netherlands	0.07	0.06	1.30
Portugal	0.03	0.04	0.66
Pseudo R squared		0.28	

Notes - The table shows estimated coefficients of the tobit model according to equation (3), explaining the share of stocks in liquid assets. For the effect of experienced returns, the table also reports the average of the fitted probability at the 90th percentile minus the average fitted probability at the 10th percentile of the distribution of experienced returns.

Table 3.7: Robustness checks: stock market participation

	Experienced Return (β)			**Weighting parameter** (λ)			Pseudo R-squared
	Coefficient	Std. error	t-statistic	Coefficient	Std. error	t-statistic	
(1) Benchmark model	15.17	3.76	4.04	5.33	1.41	3.77	0.31
(2) Explaining bond holdings with bond returns	27.78	14.92	1.86	3.99	0.33	12.18	0.36
(3) Adding experienced volatility	16.78	3.79	4.42	5.09	0.93	5.45	0.31
(4) Stock holdings include voluntary pension plans	15.22	2.74	5.56	5.31	0.50	10.58	0.24
(5) Unweighted estimation	4.68	0.81	5.76	10.05	1.49	6.75	0.34
(6) Adding experienced bond returns	10.85	2.31	4.69	6.11	0.25	24.88	0.31
(7) Longer experience horizon (10 years before birth)	10.54	1.95	5.40	3.87	0.35	11.16	0.31
(8) Shorter experience horizon (10 years after birth)	21.10	3.49	6.04	6.49	0.21	30.76	0.31
(9) Adding risk aversion	13.34	2.84	4.70	5.83	0.49	11.84	0.35
(10) Excluding immigrants	6.57	0.95	6.94	10.04	0.57	17.70	0.33
(11) Placebo experiment	-0.35	0.62	-0.57	5.33	[fixed]	[fixed]	0.31
(12) Countries with a mild 2008 stock market decline	16.02	3.27	4.90	5.52	0.92	5.98	0.29
(13) Countries with a severe 2008 stock market decline	1.81	1.57	1.16	10.90	1.12	9.69	0.34

Notes - The table shows estimated coefficients β and λ of the probit model according to equation (3). Row (1) repeats the benchmark results, explaining households' participation in stock markets. Row (2) explains participation in bond markets as a function of experienced bond returns. Rows (3) to (13) explain participation in stock markets. Row (3) adds the experienced stock market volatility. Row (4) is based on a broader definition of stock holdings, also including investments in voluntary pension plans. Row (5) provides unweighted results. Row (6) additionally includes the bond returns that households have experienced over their lifetimes. Rows (7) and (8) vary the experience horizon of respondents, by either including 10 years prior to birth, or by starting 10 years after birth. Row (9) adds risk aversion as additional regressor, row (10) excludes immigrants from the estimation. Row (11) reports results from a placebo experiment. Rows (12) and (13) contain split sample estimates, once for countries with relatively mild stock market declines in 2008, and once for the severely hit countries.

Table 3.8: The effect of stock market downturns on risk aversion

		Coefficient	Std. error	t-statistic
Number of experienced crashes (β_1)		0.118	0.048	2.490
Number of experienced crashes squared (β_2)		-0.009	0.003	-2.609
Average marginal effect	Risk aversion=1 (low)	0.000	0.000	-0.907
	Risk aversion=2	-0.002	0.002	-1.190
	Risk aversion=3	-0.006	0.004	-1.409
	Risk aversion=4 (high)	0.009	0.007	1.317
Fitted prob at p90-p10	Risk aversion=1 (low)	-0.002	0.000	-10.865
	Risk aversion=2	-0.010	0.001	-11.462
	Risk aversion=3	-0.022	0.002	-11.816
	Risk aversion=4 (high)	0.034	0.003	11.657
Log income		0.204	0.093	2.186
Log income squared		-0.014	0.005	-2.774
Number of children		0.037	0.039	0.956
Number of children squared		-0.004	0.013	-0.280
Log liquid assets		0.122	0.015	8.073
Log liquid assets squared		-0.014	0.001	-11.265
Retired		0.081	0.042	1.917
College		-0.318	0.043	-7.338
High school		-0.196	0.039	-5.093
Age		0.005	0.008	0.620
Age squared		0.000	0.000	0.965
Married		0.036	0.033	1.099
Financial sector employee		-0.231	0.058	-3.993
Austria		-0.011	0.078	-0.141
Belgium		0.255	0.049	5.212
Spain		0.434	0.047	9.146
Greece		0.006	0.051	0.123
Italy		-0.766	0.069	-11.088
Luxembourg		0.491	0.062	7.959
Netherlands		0.300	0.070	4.262
Portugal		0.707	0.108	6.523
Pseudo R squared			0.11	

Notes - The table shows estimated coefficients of the ordered probit model according to equation (4), explaining households' self-reported risk aversion. For the effect of experienced crashes (β_1 and β_2), the table also reports average marginal effects for each category of the ordered probit, and the average of the fitted probability at the 90th percentile minus the average fitted probability at the 10th percentile of the distribution of experienced crashes, for each category of the ordered probit.

Table 3.9: The effect of experienced stock market downturns on stock market participation

	Coefficient	Std. error	t-statistic
Crash	-0.31	0.07	-4.41
Crash squared	0.02	0.01	3.71
Average Marginal Effect	-0.02	0.00	-4.30
Fitted prob at p10 - p90	0.08	0.00	70.08
Log Income	-0.16	0.28	-0.58
Log Income squared	0.01	0.01	1.09
Children	-0.01	0.04	-0.23
Children squared	-0.00	0.01	-0.06
Log Liquid assets	0.29	0.12	2.34
Log Liquid assets squared	0.01	0.01	1.33
Retired	-0.07	0.05	-1.32
College	0.38	0.05	8.03
High School	0.19	0.04	4.46
Age	0.04	0.01	4.51
Age squared	-0.00	0.00	-4.24
Married	-0.03	0.04	-0.77
Financial sector	0.65	0.08	8.13
Austria	-1.01	0.12	-8.14
Belgium	-0.05	0.07	-0.67
Spain	-0.00	0.06	-0.03
Finland	0.47	0.05	9.57
France	0.27	0.05	5.72
Greece	-0.41	0.09	-4.80
Italy	-0.32	0.09	-3.69
Luxembourg	-0.47	0.08	-5.71
Netherlands	-0.31	0.10	-2.94
Portugal	-0.14	0.14	-1.00
Pseudo R squared		0.31	

Notes - Notes:The table shows estimated coefficients of the probit model according to equation (4), explaining households' participation in stock markets. For the effect of experienced returns (β), the table also reports average marginal effects and the average of the fitted probability at the 90th percentile minus the average fitted probability at the 10th percentile of the distribution of experienced returns.

Table 3.10: The effect of experienced stock market downturns on the share of liquid assets invested in stocks

	Coefficient	Std. error	t-statistic
Crash	0.032	0.036	0.887
Crash squared	-0.001	0.003	-0.383
Average Marginal Effect	0.022	0.014	1.529
Fitted prob at p10 - p90	-0.036	0.004	-8.903
Log Income	-0.094	0.170	-0.553
Log Income squared	0.005	0.008	0.658
Children	-0.019	0.020	-0.948
Children squared	0.007	0.006	1.281
Log Liquid assets	-0.224	0.060	-3.711
Log Liquid assets squared	0.010	0.003	3.615
Retired	0.030	0.025	1.200
College	0.029	0.023	1.265
High School	0.039	0.022	1.790
Age	0.002	0.005	0.521
Age squared	-0.000	0.000	-0.259
Married	0.004	0.017	0.212
Financial sector	0.017	0.028	0.626
Austria	0.072	0.068	1.046
Belgium	0.065	0.027	2.426
Spain	0.227	0.029	7.885
Finland	0.248	0.022	11.480
France	0.179	0.021	8.380
Greece	0.219	0.051	4.299
Italy	0.094	0.046	2.066
Luxembourg	-0.007	0.043	-0.164
Netherlands	0.044	0.054	0.825
Portugal	0.074	0.080	0.922
Pseudo R squared		0.14	

Notes - The table shows estimated coefficients of the tobit model according to equation (4), explaining the share of stocks in liquid assets. For the effect of experienced returns (β), the table also reports the average of the fitted probability at the 90th percentile minus the average fitted probability at the 10th percentile of the distribution of experienced returns.

Table 3.11: The effect of experienced stock market crashes on stock market participation, extensions and robustness tests

	AME	Std. error	t-statistic	Pseudo R-squared
(1)Benchmark model	-0.019	0.004	-4.301	0.31
(2)With return	-0.011	0.004	-2.417	0.31
(3)Booms	-0.017	0.004	-3.980	0.31
(4)Cutoff 40%	-0.062	0.012	-5.119	0.31
(5)Pensions	-0.075	0.006	-11.613	0.24
(6)No weights	-0.003	0.002	-1.282	0.34
(7)Risk aversion	-0.014	0.005	-2.649	0.34
(8)No immigrants	-0.009	0.007	-1.361	0.36
(9)Placebo experiment	-0.000	0.004	-0.124	0.31

Notes - The table shows estimated average marginal effects of the experienced stock market crashes on participation in stock markets, based on the probit model according to equation (4). Row (1) repeats the benchmark results. Row (2) adds the experienced stock market returns. Row (3) adds stock market booms. Row (4) changes the definition of a downturn to cases where annual nominal stock returns were below -40%. Row (5) includes voluntary pension plans in the definition of stock holdings. Row (6) provides unweighted results. Row (7) adds risk aversion. Row (8) reports results for an estimation that excludes immigrants. Row (9) shows the results for a placebo experiment where the number of experienced crises has been assigned randomly across the distribution of households.

Appendix A

Appendix

A.1 Simple OLS without selection variables

Table A.1: Share of funds invested on risky assets

	Spain		US	
	Direct	Indirect	Direct	Indirect
Married	-0.012	-0.012	-0.017*	-0.034***
	(0.021)	(0.019)	(0.010)	(0.007)
Family size	-0.008	-0.013	0.008**	0.008***
	(0.009)	(0.008)	(0.003)	(0.003)
College	0.040***	0.042***	-0.028***	0.048***
	(0.017)	(0.015)	(0.008)	(0.006)
Age 31 to 40	-0.015	0.010	-0.082***	-0.001
	(0.074)	(0.069)	(0.019)	(0.015)
Age 41 to 50	-0.034	0.040	-0.080***	0.019
	(0.071)	(0.068)	(0.019)	(0.014)
Age 51 to 60	-0.007	0.047	-0.015	0.073***
	(0.071)	(0.068)	(0.017)	(0.014)
Age 61 to 70	0.027	0.091	0.001	0.129***
	(0.069)	(0.067)	(0.018)	(0.014)
Age >70	0.102	0.180***	0.114***	0.211***
	(0.071)	(0.068)	(0.018)	(0.015)
Income	2.7e-08	8.9e-08***	7.13e-10*	2.31e-09***
	(3.0e-08)	(3.0e-08)	(4.23e-10)	4.22e-10
Net wealth	5.4e-09***	5.4e-09***	4.26e-10***	3.61e-10***
	(1.3e-09)	(1.3e-09)	(4.52e-11)	(4.26e-11)
Seeking some risk	0.038**	0.060***	0.016	0.065***
	(0.018)	(0.018)	(0.012)	(0.009)
Seeking fair risk	0.136***	0.149***	0.034***	0.119***
	(0.033)	(0.033)	(0.012)	(0.009)
Seeking a lot of risk	0.144***	0.244***	0.063***	0.135***
	(0.055)	(0.052)	(0.016)	(0.013)
Constant	0.329***	0.379***	0.282***	0.249***
	(0.068)	(0.064)	(0.019)	(0.015)
Observations	1,513	1,829	1,388	2,374

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A.2 Industry of employment in Survey of Consumer Finances

Question X7402 on the SCF questionnaire reads as follows: 'What kind of business or industry do you work in?' This same question is also asked to the spouse/partner of the household head (question X7412). The answer to the question is coded following the Census 2006 4-digit industry code. However, due to privacy concerns, the FRB has collapsed all the industry codes into only six different ones for the publicly available data set. Individuals who work for the financial industry are coded together with those who work for Software Publishing, Data Processing, Employment and Business Support Services, Security Services and Report and Maintenance. Because of this, we cannot determine exactly if a household member works in the financial industry or not. For the purpose of constructing our sophisticated household variable we have decided to consider all the households working in the aforementioned industries. In order to get an idea of the distortion introduced in our sample because of this code merging, we look at the 2007 US Economic Census. There were a total of 17,610,220 employees combining all the sectors mentioned above, of those, 50% were employed in the financial industry. Almost 11% worked for Repair and Maintenance and Security Services. Since our sample of sophisticated households only includes those with a college degree we can assume there will not be many of those in our sample. Employment support services represents 30% of the total employment, so our sample could be contaminated by those. However, we are looking at households whose wealth is above the median of the whole population, and, fortunately for us, there is an important divergence on the salaries of both groups. The average annual salary for financial industry employees was $76,037, while for Employment

and Business Support Services it was $28,363. All in all, we can say that probably a great majority of our final sample of sophisticated households' sample is employed in the financial services industry.

A.3 Probit models

Table A.2: Participation on risky assets

	Spain		US	
	Direct	Indirect	Direct	Indirect
Married	0.234***	0.187***	0.382***	0.386***
	(0.052)	(0.049)	(0.010)	(0.025)
Family size	0.005	-0.018	-0.030***	-0.073***
	(0.021)	(0.008)	(0.09)	(0.009)
College	0.535***	0.501***	0.684***	0.754***
	(0.047)	(0.047)	(0.021)	(0.021)
Age 31 to 40	0.047	0.218	0.017	0.278***
	(0.138)	(0.135)	(0.045)	(0.041)
Age 41 to 50	0.173	0.342***	0.278***	0.605***
	(0.133)	(0.130)	(0.042)	(0.038)
Age 51 to 60	0.468***	0.504***	0.410***	0.769***
	(0.132)	(0.131)	(0.041)	(0.039)
Age 61 to 70	0.578***	0.708***	0.600***	0.958***
	(0.132)	(0.131)	(0.044)	(0.042)
Age >70	0.704***	0.817***	0.887***	1.098***
	(0.131)	(0.131)	(0.045)	(0.044)
Income	3.1e-06***	5.6e-06***	1.90e-08***	2.03e-07***
	(4.0e-07)	(5.4e-07)	(2.93e-09)	1.74e-08
Net wealth	2.3e-07***	2.7e-07***	1.36e-09***	8.16e-09***
	(2.5e-08)	(2.4e-08)	(2.54e-10)	(1.07e-09)
Seeking some risk	0.926***	0.922***	0.683***	0.890***
	(0.050)	(0.051)	(0.028)	(0.025)
Seeking fair risk	0.824***	0.793***	0.906***	0.116***
	(0.114)	(0.121)	(0.031)	(0.031)
Seeking a lot of risk	0.790***	0.650***	0.978***	0.925***
	(0.198)	(0.183)	(0.016)	(0.047)
Constant	-2.045***	-1.960***	0.282***	-2.076***
	(0.133)	(0.132)	(0.019)	(0.045)
Observations	5,962	5,962	4,418	4,418

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

References

Alan, S. (2012). Do disaster expectations explain household portfolios? *Quantitative Economics*, (3):1–28.

Alesina, A. and N.Fuchs-Schundeln (2007). Goodbye lenin (or not?): The effect of communism on people. *American Economic Review*, (97(4)):1507–1528.

Alesina, A. and P.Giuliano (2011). Preferences for redistribution. *Handbook of Social Economics*, pages 93–132.

Alessie, R., van Rooij, M., and Lusardi, A. (2011). Financial literacy, retirement preparation and pension expectations in the netherlands. *Center for Research on Pensions and Welfare Policies*, (110).

Ameriks, J. and Zeldes, S. (2004). How do household portfolio shares vary with age. *Working Paper, Columbia Business School*.

Attanasio, O. (1995). The intertemporal allocation of consumption: Theory and evidence. *Carnegie-Rochester Conference Series on Public Policy*, (42):39:89.

Barro, R. (2006). Rare disasters and asset markets in the twentieth century. *Quarterly Journal of Economics*, (121(3)):823–866.

Barro, R. (2009). Rare disasters, asset prices and welfare costs. *American Economic Review*, (99(1)):243–264.

Basak, S. and Cuoco, D. (1998). An equilibrium model with restricted stock market participation. *Review of Financial Studies*, (11):309:341.

Bassett, W., M.Chosak, Driscoll, J., and E.Zakrajsek (2012). Changes in bank lending standards and the macroeconomy. *FEDS*, (2012-24).

Bekaert, G., Ehrmann, M., Fratzscher, M., and Mehl, A. (2012). Global crisis and equity market contagion. *NBER Working Paper*, (17121).

Bekaert, G. and Hoerova, M. (2013). The vix, the variance premium and stock market volatility. *NBER Working Paper*, (18995).

Bekaert, G., Hoerova, M., and Duca, M. L. (2013). Risk, uncertainty and monetary policy. *Journalof Monetary Economics*, (forthcoming).

Bertaut, C. (1998). Stockholding behaviour of us households: Evidence from the 1983-1989 survey of consumer finances. *Review of Economic and Statistics*, (80):263–275.

Bertaut, C. and Haliassos, M. (1997). Precautionary portfolio behavior from a life-cycle perspective. *Journal of Economic Dynamics and Control*, (21):1511:1542.

Bertaut, C. and Starr-McCluer, M. (2000). Household portfolios in the united states. *Federal Reserve Board discussion series*, (26).

Blanchflower, D. (2007). Is unemployment more costly than inflation. *NBER Working Paper*, (13505).

Bogan, V. (2008). Stock market participation and the internet. *Journal of Financial and Quantitative Analysis*, (43(1)):191–212.

Bover, O. (2008). The spanish survey of household finances (eff): Description and methods of the 2005 wave. *Banco de Espa na Occasional Paper*, (0308).

Bucks, B. K., Kennickell, A. B., Mach, T. L., and Moore, K. B. (2009). Changes in u.s. family finances from 2004 to 2007: Evidence from the survey of consumer finances. *Federal Reserve Bulletin*, (95):A1–A55.

Campbell, J. (2006). Household finance. *The Journal of Finance*, (61(4)):1553–1604.

Campbell, J. and Cochrane, J. (1999). By force of habit: A consumption-based explanation of aggregate stock market behaviour. *Journal of Political Economy*, (107(2)):205–251.

Carroll, C. D. (1997). Buffer-stock saving and the life-cycle/permanent income hypothesis. *Journal of Economics*, (112):1:55.

Choi, J., Laibson, D., Madrian, B., and A.Metrick (2009). Reinforcement learning and savings behaviour. *Journal of Finance*, (64):2515–2534.

Christelis, D., Georgarakos, D., and Haliassos, M. (2012). Differences in portfolios across countries: Economic environment vs household characteristics. *Review of Economics and Statistics*, pages 539–559.

Cocco, J., Gomes, F., and Maenhout, P. (1999). What level of fixed costs can reconcile consumption and stock returns? *Journal of Political Economy*, (107):969:997.

Cocco, J., Gomes, F., and Maenhout, P. (2005). Consumption and portfolio choice over the life-cycle. *Review of Financial Studies*, (18):491:533.

Constantinides, G. (1990). Habit formation: A resolution of the equity premium puzzle. *Journal of Political Economy*, (98(3)):519–543.

Davis, S. and Willen, P. (2000). Using financial assets to hedge labor income risks: Estimating the benefits. *working paper, University of Chicago*.

Davis, S. J., Kluber, F., and Willen, P. (2006). Borrowing costs and the demand for equity over the life-cycle. *The Review of Economics and Statistics*, (88(2)):348–362.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. (2011a). Individual risk attitudes: Measurements, determinants and behavioral consequences. *Journal of the European Economic Association*, (9(3)):522–550.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. (2011b). Individual risk attitudes: Measurements, determinants and behavioral consequences. *Journal of the European Economic Association*, (9(3)):522–550.

Ehrmann, M., Fratzscher, M., Gurkaynak, R., and Swanson, E. (2011). Convergence and anchoring of yield curves in the euro area. *Review of Economic and Statistics*, (93):350–364.

Ehrmann, M. and Tzamourani, P. (2012). Memories of high inflation. *European Journal of Political Economy*, (28(2)):174–191.

Faiella, M. (2010). The use of survey weights in regression analysis. *Banca d'Italia Working Paper*, (739).

Finance, H. and Network, C. (2013a). The eurosystem household finance and consumption network-methodological report for the first wave. *ECB Statistics Paper*, (1).

Finance, H. and Network, C. (2013b). The eurosystem household finance and consumption network-results from the first wave. *ECB Statistics Paper*, (2).

Gakidis, H. (1999). Earnings uncertainty and life-cycle portfolio choice. *working paper, MIT*.

Giuliano, P. and Spilimbergo, A. (2009). Growing up in a recession: Beliefs and the macroeconomy. *NBER Working Paper*, (15321).

Gourinchas, P.-O. and Parker, J. A. (2002). Consumption over the life cycle. *Econometrica*, (70):47:89.

Green, W. H. (1997). *Econometric Analysis*. Macmillan, New York.

Guiso, L., Haliasos, M., and Japelli, T. (2002). *Household Portfolios*. MIT press, Cambridge, Massachussetts.

Guiso, L., Haliassos, M., and Jappelli, T. (2003). Household stockholding in europe: Where do we stand and where do we go? *Economic Policy*, pages 123–170.

Guiso, L. and Jappelli, T. (2000). Household portfolios in italy. *Center for Economic Policy Research*, (2549).

Guiso, L. and Paiella, M. (2008). Risk aversion, wealth and background risk. *Journal of the European Economic Association*, (6):1109–1150.

Guiso, L., Sapienza, P., and Zingales, L. (2004). The role of social capital in financial development. *American Economic Review*, (94(3)):526–556.

Guiso, L., Sapienza, P., and Zingales, L. (2012). Time varying risk aversion. *Working Paper*.

Haliassos, M. and Bertaut, C. (1995). Why do so few hold stocks? *Economic Journal*, pages 1110–1129.

Hong, H., Kubik, J. D., and Stein, J. C. (2004). Social interaction and stock-market participation. *Journal of Finance*, (v59):137–163.

Hubbard, G., Skinner, J., and Zeldes, S. (1995). Precautionary saving and social insurance. *Journal of Political Economy*, (103):360:399.

Jappelli, T. (2010). Economic literacy: An international comparison. *The Economic Journal*, (120):429–451.

Judd, K. (1998). *Computational Economics*. FILL, FILL.

Kaustia, M. and Knupfer, S. (2008). Do investors overweight personal experience? evidence from ipo subscriptions. *Journal of Finance*, (63(6)):2679–2702.

King, M. and Leape, J. (1987). Asset accumulation, information and the life-cycle. *NBER Working Paper*, (2392).

King, M. and Leape, J. (1998). Wealth and portfolio composition: Theory and evidence. *Journal of Public Economics*, (69):155–193.

Kocherlakota, N. (1996). The equity premium: It's still a puzzle. *Journal of Economic Literature*, (34):42–71.

Lombardelli, C. and Saleheen, J. (2003). Public expectations of uk inflation. *Bank of england Quarterly Bulletin*, (43):281–290.

Magee, L., Robb, A., and Burbidge, J. (1998). On the use of sampling weights when estimating regression models with survey data. *Journal of Econometrics*, (84):251–271.

Malmendier, U. and Nagel, S. (2009). Learning from inflation experiences. *Mimeo, UC Berkeley and Stanford University.*

Malmendier, U. and Nagel, S. (2011). Depression babies. *Quarterly Journal of Economics*, (126(1)):373–416.

Markowitz, H. (1952). Portfolio selection. *Journal of Finance*, (7):77–91.

Mehra, R. and Prescott, E. (1985). The equity premium: A puzzle. *Journal of Monetary Economics*, (15):145–161.

Merton, R. C. (1969). Lifetime portfolio selection under uncertainty: The continuous-time case. *Review of Economic and Statistics*, (51):247–257.

Necker, S. and Ziegelmeyer, M. (2013). Risk taking after the financial crisis. *Mimeo, University of Freiburg.*

Polkovnichenko, V. (2000). Limited stock market participation and the equity premium. *Working paper, University of Minnesota.*

R.Alessie, S.Hochguertel, and van Soest, A. (2000). Household portfolios in the netherlands. *Tilburg: CentER for Economic Researc, Tilburg University*, (Discussion Paper 55).

Rietz, T. (1988). The equity risk premium. a solution. *Journal of Monetary Economics*, (22):117–131.

Samuelson, P. A. (1969). Lifetime portfolio selection by dynamic stochastic programming. *Review of Economic and Statistics*, (51):239–246.

Solon, G., Haider, S., and Woolridge, J. (2013). What are we weighting for? *NBER Working Paper No.18859*.

Tobin, J. (1958). Liquidity preference as behaviour towards risk. *Review of Economics and Statistics*, (25):68–85.

UNECE (2011). Canberra group handbook on household income statistics. *United Nations*.

van Rooij, M., Lusardi, A., and Alessie, R. (2011). Financial literacy and stock market participation. *Journal of Financial Economics*, (101(2)):449–472.

Vissing-Jorgensen, A. (2000). Towards an explanation of household portfolio choice heterogeneity: Non-financial income and participation cost structures. *University of Chicago Mimeo*.

Vissing-Jorgensen, A. (2002). Towards an explanation of household portfolio choice heterogeneity: Non financial income and participation cost structures. *Working paper, Northwestern University*.

Vissing-Jorgensen, A. (2003). Perspectives on behavioral finance: Does irrationality disappear with wealth? evidence from expectations and actions. *NBER Macroeconomics Annual*.

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