

Household Financial Risk Tolerance in Europe

Nora Laurinaityte*

July, 2018

Abstract

This is a study of household financial risk tolerance across the Eurozone countries and over time. Using the HFCS data, household subjective financial risk tolerance, stock ownership, and mutual fund ownership are all found to be increasing with household income, wealth, education, and homeownership. Younger households are more willing to take financial risks while at the same time being less likely to hold any investments into the stock markets. Using matching estimation, the differences in risk tolerance between Southern and Northern European households remain statistically significant and are highly persistent over time, suggesting that institutions are behind the level differences. In a strictly balanced German PHF, the changes in household's willingness to take financial risk over time correlate positively with changes in household income and negatively to changes in financial literacy. Changes in home-ownership status have a negative relation to changes in stock ownership, in line with the "crowding-out" hypothesis.

JEL Codes: D14, E21, G11

Keywords: risk tolerance, household finance, HFCS data, panel data, Eurozone

* Research Center SAFE and Goethe University Frankfurt. Email: laurinaityte@safe.uni-frankfurt.de.

This paper uses data from the Eurosystem Household Finance and Consumption Survey and data from the Deutsche Bundesbank Panel on Household Finances. The results published and the related observations and analysis may not correspond to results or analysis of the data producers. I thank Stefan Bender, Horst Entorf, Nicola Fuchs-Schündeln, Christian Hirsch, Tobias Schmidt, Florian Urbschat (discussant), Nerijus Cerniauskas (discussant), Denisa Sologon (discussant), participants of the First Italian Workshop of Econometrics and Empirical Economics (IWEEE): Panel Data Models and Applications, the 11th RGS Doctoral Conference in Economics, the Inaugural Baltic Economic Conference, the 6th Luxembourg Workshop on Household Finance and Consumption, and the seminar participants of the Joint SAFE-Bundesbank Data Center Seminar and Goethe University Finance Brown Bag Seminar for comments.

1. Introduction

As economic landscape becomes increasingly complex, study of how individuals and households make their investment decisions gains importance. Over recent years a large literature on the role of financial literacy for the household decision making has emerged (see the literature review provided in Lusardi and Mitchell (2014)). Financial risk tolerance, however, has attracted little attention, even though as Campbell (2006) suggested a better understanding of financial risk tolerance helps explain why certain households accumulate wealth over time while others do not, and contributes to improved definitions of financial literacy and financial education program design.

In this study I explore the differences in willingness to take financial risk, stock ownership, and mutual fund ownership across 12 Eurozone countries and over time using survey data. I find that traditional determinants of risk tolerance cannot fully explain neither the differences in levels across the 12 Eurozone countries studied, nor the significant variation over time, as the country fixed-effects and the time fixed effects are all statistically significant in the cross-sectional regressions. When I split the sample into South Europe (Italy, Greece, Cyprus, Portugal, Spain, Slovenia) and North Europe (Austria, Belgium, Germany, Luxembourg, Netherlands, Slovakia) and create a propensity score matched set of households based on the traditional determinants of risk tolerance, I find that the differences in levels of financial risk tolerance between North and South remain statistically significant, suggesting that institutions and culture are likely to play a significant role in explaining the level differences.

Christelis et al (2013) suggest that differences in stock ownership rates among Eurozone countries is primarily linked to different economic environments. To explore the impact of macroeconomic conditions, I exploit the European Sovereign Debt Crisis, which starts around the time the first wave of HFCS was collected, and ends around the time the second HFCS

wave was collected. I perform a difference-in-differences estimation on the propensity score matched sets based on the traditional determinants of risk tolerance of Southern vs. Northern European households in each HFCS wave following Abadie (2005). Majority of the difference-in-differences estimates are not statistically significant. Therefore it appears that in terms of over-time variation of risk tolerance, institutional changes are not the driving force. In fact, the institutional differences appear to be highly persistent over time. Rather, macroeconomic conditions appear important in explaining the dynamics of risk tolerance over time through changes in traditional determinants of risk tolerance, namely household income, wealth, and employment status.

Eurosystem Household Finance and Consumption Survey (HFCS) is predominantly collected as a repeated cross-section, with only a few countries containing a panel element. Furthermore, traditional questions on financial literacy is not part of HFCS core questionnaire. To investigate the importance of unobservable time-invariant household characteristics and financial literacy for financial risk tolerance, I therefore turn to a subsample of a panel of German households. I find that changes in household subjective risk tolerance correlate negatively with changes in financial literacy, suggesting that understanding the benefits of diversification reduces the general household appetite for financial risk. I also find evidence of a significant negative correlation between changes in homeownership status and changes in stock ownership over time when unobservable time-invariant household characteristics are taken into account.

Risk tolerance is the willingness of an individual to engage in a behavior where there is some uncertainty in the attainability of a certain goal accompanied with a possibility of a loss (Kogan and Wallach (1964), Okun (1976)). Hunter states that risk tolerance is “the amount of risk that an individual is willing to accept in the pursuit of some goal” (2002, p. 3). Irwin (1993) defines financial risk tolerance as willingness to engage in a financial behavior in which the outcomes are uncertain. Grable and Joo (2004) narrow financial risk tolerance to the

maximum amount of uncertainty someone is willing to accept when making a financial decision.

Risk tolerance can be assessed in many different ways. Grable (2016) list six different methods that have been used in previous research to measure risk tolerance, ranging from experimental evidence to subjective self-assessment based on risk scales. Financial risk tolerance is often assessed using self-reported household/individual willingness to take financial risk (Xiao (1996), Sung and Hanna (1996), Grable and Lytton (1998), Faig and Shum (2006), Grable et al (2009), Sahm (2012), Chiang and Xiao (2017)), as it is one of the only direct measures of risk-tolerance attitudes asked in national surveys of consumers.

The downside associated with such a subjective measure of financial risk tolerance is that it may not be a “good proxy for people’s true risk aversion” (Chen and Finke (1996), p. 94). Hanna and Lindamood (2004) discover using the responses to the risk tolerance question in the Federal Reserve Board’s Survey of Consumer Finances (SCF) that a large percent of respondents claim to have no risk tolerance, even though such pattern conflicts with actual risk-taking behaviors observed in everyday financial situations. Similarly, using the HFCS data I find that a significant fraction of households that report owning stocks claim to be not willing to take any financial risks at all. In the German panel, where the question about respondent’s individual risk aversion is available, I find that about a third of households not willing to take any risk on the household level have a very happy to take risk household head.

Grable and Lytton (2001) notes that a response to a single survey question does not fully represent the spectrum of financial risk tolerance. Malmendier and Nagel (2011) claim that the survey measure of household risk tolerance represents the combined effect of Arrow-Pratt risk aversion and beliefs. Therefore some researchers (Riley and Chow (1992), Malmendier and Nagel (2011), Cardak et al (2015)) instead measure financial risk tolerance using more objective measures such as a ratio of risky assets to wealth, direct stock ownership, or mutual fund ownership as proxies. In this study I explore both self-reported assessments and objective proxies as measures of financial risk tolerance. As none of the

measures employed is a pure measure of risk aversion, I abstain from using this term throughout.

Risk tolerance is an important factor that affects actual investment behavior (Snelbecker et al (1990), Campbell (2006), Lusardi (2000), Grable et al (2009), Dohmen et al (2011)). Finke and Huston (2003) state that there exists a relationship between financial risk tolerance and net worth. Similarly, Calvet and Sodini (2014) find that the portfolio share invested in risky assets is an increasing and concave function of financial wealth. Faig and Shum (2006) find that households that report lower willingness to take risk in response to a survey question have a lower allocation to risky assets. Shaw (1996) shows that the survey-based measure of financial risk tolerance helps explain differences in the willingness to make risky human capital investments and in wage growth. Because a person's tolerance for risk has such a significant impact on the way individuals make decisions, it is important to understand the factors that influence risk tolerance (Campbell (2006)). There are a number of demographic, socioeconomic, psychosocial, and other factors generally thought to be associated with financial risk tolerance (Guiso et al (1996), Xiao (1996), Sung and Hanna (1996), Wang and Hanna (1997), Bertaut (1998), Grable and Lytton (1998), Finke and Huston (2003), Yao et al (2005), Wang and Hanna (2007), Sahm (2012)). The majority of these factors have been discovered and investigated using the survey information almost exclusively from the US.

Empirical evidence on risk taking attitudes in Europe is quite scarce. Ampudia and Ehrmann (2014) look into the determinants of the willingness to take financial risks using the first wave (2009-2011) of the HFCS. In this study using the information from the two waves (2009-2011 and 2013-2015) of the HFCS I document the patterns of risk tolerance measures (self-assessment, direct and overall stock ownership, and mutual fund ownership) across European countries and over time. I also investigate the relationship between various demographic and socioeconomic factors and financial risk tolerance, and whether any of the known factors can explain the observed differences and changes across the two survey waves in risk tolerance among European countries.

A growing body of evidence now suggests that risk attitudes do indeed vary over time (Hoffman et al (2013), Yao and Curl (2011)) and with changing market conditions. Chiang and Xiao (2017) find using the panel element of the SCF data that in the US during the Global Financial Crisis households were in general less risk tolerant. The HFCS data covers a very interesting period of the European Sovereign Debt Crisis, which started at the end of 2009, just as the Global Financial Crisis was coming to an end. The European Sovereign Debt Crisis resulted in turmoil in government debt sector, with bond yield spreads widening, liquidity drying up, and excess volatility in the financial markets. Fear or mistrust of the financial system may add to an investor's unwillingness to accept risk, as discovered by Finke and Huston (2003). This study aims to establish how differences in household financial risk tolerance between Southern and Northern European households was affected by the crisis period in Europe.

Due to the cross-sectional nature of HFCS, causal relationships between various factors and financial risk tolerance cannot be identified. To investigate the degree to which the time-invariant household characteristics are important, I employ the balanced panel from the Deutsche Bundesbank Panel on Household Finances (PHF), which is part of the HFCS. Panel data are rare in household finance, and no work using the panel data has been done on the determinants of financial risk tolerance in Germany, to the best of my knowledge.

This paper is organized as follows. Section 2 discusses the data, introduces the methodology used, and presents descriptive statistics. The empirical results are presented and discussed in Section 3. Section 4 concludes and discusses the implications of the findings.

2. Data and Methodology

2.1 Data

Empirical work using international survey data is uncommon in household finance. This is mostly because international surveys with harmonized questionnaires are a relatively new phenomenon. In this study I use the HFCS data available from the European Central Bank (ECB). Particularly, I rely on the data from two waves of the survey – 2009-2011 and 2013-2015.

This survey is well suited for my analysis as it contains detailed information on household socio-demographic characteristics, income and in particular household wealth in a harmonized fashion from 20 European countries. Financial risk tolerance question was asked in both survey waves only in 13 Eurozone countries. Malta, however, had to be omitted from this study as it did not contain sufficient information on other variables employed. The study therefore restricts its analysis to the following 12 countries: Austria, Belgium, Cyprus, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Slovenia, Slovakia, and Spain. When households with negative total household income (60 households in total) and missing observations in the non-imputed variables are dropped, this translates into a final sample of over 35,000 households in each of the survey waves.

In addition to the household's willingness to take financial risks, this data set contains information on household ownership of real assets (properties, self-employed businesses, vehicles and valuables) and financial assets (savings account, stocks, bonds and other securities) as well as liabilities (mortgages, consumer loans, private loans, overdue bills, etc.). To deal with missing values the wealth and income variables of the HFCS are multiply imputed following Rubin (1987). Except for individual gross income and pension assets all the

information is collected at the household level and answered by a so-called “Financially Knowledgeable Person” (FKP) on behalf of the entire household.¹

Due to the repeated cross-section nature of the HFCS, the focus of the analysis using this data is on finding and documenting correlations between various household characteristics and household financial risk tolerance using various risk tolerance measures, rather than on establishing causality. From an econometric point of view, the drivers of financial risk tolerance can only be identified in a panel setting due to the problem of unobserved heterogeneity. Therefore I extend my analysis using a panel component of the HFCS dataset. This sample is known as the German Panel on Household Finances (PHF) (two waves of the survey – 2010 and 2014)². In this set-up one can control for unobservable time invariant characteristics using the fixed effects, which helps in reducing the bias of estimates that can arise when estimating correlations in the cross-section. However, as household wealth is one of the explanatory variables for financial risk tolerance (as documented in Sung and Hanna (1996)), due to concerns about reverse causality, establishing drivers of financial risk tolerance is not possible even in the panel setting.

As PHF is part of the HFCS, all of the PHF panel households appear in the HFCS. However, in addition to a possibility to construct a strictly balanced panel, PHF contains some additional questions, for example questions on financial literacy and on FKPs’ own risk tolerance that are also of interest to this study. In the PHF the panel component is 2138 households. However, in 67 of these households the FKP appears to change between the two waves, as the gender of the respondent to the survey changes from survey wave 1 to survey wave 2.

¹ Further information about HFCS is available on https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html.

² Further information about PHF is available on https://www.bundesbank.de/Navigation/EN/Bundesbank/Research/Panel_on_household_finances/panel_on_household_finances.html. The PHF data is registered with the German Registration Agency "da|ra" and has been assigned the following DOIs (Digital Object Identifiers): "10.12757/PHF.01.01.01.stata" for SUF Wave 1 Version 1.0, "10.12757/Bbk.PHF.02.01.01" for SUF Wave 2 Version 1.0

Therefore the panel sample in this study is restricted to the 2071 households where the respondent to the survey did not change.

The variables of interest in the HFCS are the household's willingness to take financial risk, household's direct stock market participation, household's indirect stock market participation measured via ownership of mutual funds, and household's overall stock market participation. The factors explored are FKP's gender, age, education, household income, household wealth, household size, and household's home ownership status.

In the survey questionnaire there is a question about the household's investment attitudes:

- *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? (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; 4-Not willing to take any financial risk; don't know; refuse to answer)*

This question was answered by the FKP on behalf of the household. The answers to this question are employed both in a binary fashion, where the household is considered as not willing to take financial risk if the response to this question was *4-Not willing to take any financial risk* (willingness to take risk dummy is assigned a value of 0), and willing to take financial risk otherwise (dummy assigned a value of 1); and as a scale variable, where 1 denotes households that are not willing to take any financial risk, 2 is assigned when the response was *"Take average financial risks expecting to earn average returns"*, 3 denotes willingness to take above-average risks, and 4 is assigned when the response was *"Take substantial financial risks"*.

Household's direct stock ownership is measured using an answer to the following survey question:

- *Do you/does anyone in your household own stock shares in any publicly traded companies? (1-Yes; 2-No; don't know; refuse to answer)*

Household is considered a direct participant in the stock market if the response to this question is 1-Yes, and not directly participating in the stock market otherwise.

Indirect stock market participation is measured using the FKPs response to the following question in the survey:

- *Do you/does anyone in your household have any investments in mutual funds, money market mutual funds or hedge funds? (If necessary say: these are types of investments that pool money from many investors and invests this money in stocks, bonds, and/or other securities) (1-Yes; 2-No; don't know; refuse to answer)*

Household is considered as indirectly participating in the financial market if the response to this question is 1-Yes. It is possible that stock market participation is overstated when using this indirect measure, as a household owning bond-only mutual funds would appear as indirectly holding stocks following my variable creation. However, as there is no further information on the composition of mutual funds household own, data does not allow discovery and elimination of such bond-only mutual fund owners from the indirect participation indicator.

Household is considered a participant in stock market if it either participates in the stock market directly, or holds mutual funds, or both.

In the PHF an additional variable of interest – FKP's own willingness to take risk – is investigated, and additional factor – financial literacy – is explored. The individual risk tolerance variable comes from the following survey question:

- *How do you view yourself: Are you in general a risk-taking person or do you try to avoid risks? Give your answer on a scale from "0" and "10", with "0" being "highly risk averse" and "10" being "very happy to take risks" (sentence used in wave 1). Please*

use the numbers from 0 to 10: 0 means that you are "not at all ready to take risks" and 10 means that you are "very willing to take risks" (sentence used in wave 2). (0: Highly Risk Averse/Not at all willing to take risks; 1; 2; 3; 4; 5; 6; 7; 8; 9; 10: Very happy/willing to take risks; don't know; refuse to answer)

This question is answered on a granular 11-point scale and should provide sufficient variation for identification purposes. When used in a binary fashion, a respondent is considered to be risk averse if the answer to this question is in the range between 0 and 4 (dummy value 0), and risk tolerant if the answer is 5 or above (dummy value of 1). Also, as this question is about FKP's personal self-assessment of risk tolerance rather than a request to evaluate risk attitudes of the household overall, it is preferred when aiming to identify causal link between the financial literacy (of the FKP, as he/she is the only one from the household answering the literacy questions) and individual risk tolerance. It is also a much better proxy for risk aversion than the risk attitudes question for the entire household.

Financial literacy is measured using the three standard financial literacy questions (compound interest, inflation, diversification)³, and is used in a binary fashion, where a value of 1 is assigned to a household where FKP answered all the three financial literacy questions correctly, and 0 otherwise.

2.2 Methodology

I first document how the household financial risk tolerance varies across European countries and over the two survey waves using both the subjective risk tolerance measure and the objective proxies to the risk tolerance – the direct stock market participation, the mutual fund ownership, and the stock market participation in general. Then I run pooled OLS regression on the cross-sectional data from the two waves aiming to identify significant

³ See Appendix A for detailed survey questions used to measure financial literacy.

covariates of the observed differences. In general the regression model has the following form:

$$y_{ic} = \alpha_c + \delta_t + \beta x_{ic} + \varepsilon_{ic}$$

where y_{ic} denotes the measure of financial risk tolerance of household i from country c , the variable indicating whether the household is subjectively willing to take financial risk, owns stocks, or owns mutual funds. α_c are the country dummies. δ_t is the survey wave dummy. x_{ic} is a vector of the various factors that are investigated as influencing household financial risk tolerance (FKP gender, FKP age, FKP education, FKP employment status, household income, household homeownership status, household wealth, and household size).

I then split my sample into South European countries (Italy, Greece, Cyprus, Portugal, Spain, Slovenia) and North European countries (Austria, Belgium, Germany, Luxembourg, Netherlands, Slovakia). In each of the two HFCS waves I create a propensity score matched sets of Northern and Southern households where the propensity score depends on the same factors employed in the pooled OLS. I use the single nearest neighbor matching (Rubin (1973)) and employ a caliper of 0.2 standard deviations, as recommended by Austin (2011) to minimize the bias arising from bad matching (Lunt (2014)).

I proceed by using the logistic treatment model (Southern European households being the “treated” households) to calculate average treatment effect of the treated (ATET) with robust Abadie–Imbens standard errors in each of the HFCS waves. To obtain the difference-in-differences estimates I calculate the difference in ATETs between the two survey waves. I continue using Abadie–Imbens standard errors for statistical inference of the difference-in-differences estimates.

The difference between matched-on-observables Southern and Northern European households in their financial risk tolerance stems from some unobservable factors that enter the household preferences, but have very different values in the Southern Europe vs. the North. As these differences appear to be highly persistent over time, I call them differences

in institutions and culture. Further exploration in what exactly constitutes these notions of institutions and culture are left for future studies.

Moving away from cross-country differences in risk tolerance, I turn to the panel setting in the German PHF and run fixed effects panel regressions using a strictly balanced panel using household risk tolerance measures and FKP individual risk index as variables of interest. Identification in the panel setting requires (at least some) variation in the regressors of interest over time. As the two survey waves of the PHF are only 4 years apart, there is very little variation in FKP's education, homeownership status, financial literacy, household size, and household wealth. This clearly makes the identification in a panel setting somewhat problematic. When time invariant household unobserved heterogeneity is accounted for, from all traditional determinants of household financial risk tolerance, only household income correlates significantly positively with subjective willingness to take risk and indirect stock market participation. Interestingly, changes in homeownership status correlate negatively with stock market participation, and changes in financial literacy correlate negatively with household subjective risk tolerance.

Furthermore, there are several important caveats concerning the data and the empirical strategy:

- 1) The surveys employed in the empirical study by design oversample the wealthy households (ECB (2008)). Thus, to implement inference on the whole population, it is recommended to use probability weights to account for oversampling (see Kennickell (2007) and Gelman and Hill (2007)). Whenever the HFCS data is used, the survey weights provided by the ECB are employed with the exception of when working with propensity score matched samples. In the PHF panel longitudinal weights provided by the Deutsche Bundesbank are used.
- 2) One has to take into account the uncertainty arising from the multiple imputation (5 imputates) of some of the variables used, like holdings of financial assets, wealth, and

income. Therefore multiple imputations (mi) package offered by STATA is used in all regressions and when performing matching.⁴

- 3) I perform an inverse-hyperbolic-sine transformation of household net wealth and total household income to deal with extreme outliers (note that for total household income also a logarithmic transformation would work (see Layard et al (2008)) which is not the case for wealth due to a non-negligible fraction of household with negative net worth). The inverse-hyperbolic-sine transformation can deal with zeros and negative values and looks as follows:

$$ihs(X) = \ln(X + \sqrt{X^2 + 1})$$

- 4) Since FKP's own risk assessment is a categorical variable ranging from 0 to 10, the cross-sectional regressions where the dependent variable is the risk tolerance index, I use ordered probit model in addition to OLS.
- 5) Bootstrap standard errors are employed in the international survey data regressions. Robust standard errors are used for cross-sectional regressions using the PHF data. In panel regressions the standard errors are clustered at household level.

2.3 Descriptive Statistics

Table 1 presents the summary statistics of the HFCS data used. The sample contains just over 35,000 households in Wave 1, and over 41,000 households in Wave 2. Panel A shows the number of households from each of the 12 Eurozone countries studied in each survey wave. Panel B presents summary statistics to the variables traditionally considered important for financial risk tolerance. Age is top-coded at 85 in the HFCS, and the FKP has to be at least 16

⁴ The HFCS data provided by the ECB and the PHF data provided by the Deutsche Bundesbank are multiply imputed using the method of Rubin (1987).

years of age to be eligible to respond to the survey questions on behalf of the household. FKPs appear to be slightly older on average in the second survey wave, probably because of a large panel element in Germany, where the FKPs are by construction 4 years older in the second wave compared to the first. Household income and wealth are both smaller on average in wave 2 compared to wave 1.

Figures 1-3 illustrate further how willingness to take financial risk varies across the 12 European countries studied and over the two waves of the HFCS. Panel A of Figure 1 shows the fraction of households choosing any one of the four possible answers to the financial risk tolerance question in the HFCS questionnaire in the survey wave 1. Overwhelming majority of households in all of the 12 European countries studied respond that they are not willing to take any risks at all in their investments (response *4-Not willing to take any financial risk*). In some countries virtually no households choose response *1-Take substantial financial risks expecting to earn substantial returns*. To create a more balanced financial risk tolerance measure I therefore create a binary variable, where the household is considered as not willing to take financial risk if the response to this question was 4 (risk tolerance dummy value 0), and willing to take financial risk otherwise (risk tolerance dummy value 1).

Figure 1 Panel B depicts how this risk tolerance dummy variable looks across European countries and over the two survey waves. The fraction of households that are subjectively willing to take any financial risk is very heterogeneous among the European countries. In Portugal, for example, only 7% of households respond as willing to take any kind of financial risk in their investments, while in Italy almost 50% of the households declare themselves as willing to take at least average risk in their investments (Wave 1).

Table 1: HFCS Summary Statistics

Panel A: Household Risk Tolerance

# Households		AT	BE	CY	DE	ES	GR	IT	LU	NL	PT	SI	SK
	Wave 1	2380	2327	1237	3565	6196	2971	7951	950	1268	4404	342	2057
	Wave 2	2997	2238	1289	4460	6098	3003	8156	1601	1244	6207	2553	2135
Willing to Take Risk	Wave 1	861	675	482	1404	1275	720	4061	293	382	378	76	816
	Wave 2	1269	614	232	1699	1179	544	3333	496	385	590	722	422
Directly Own Stock	Wave 1	128	439	472	636	1386	73	427	125	169	214	51	19
	Wave 2	151	298	288	836	1666	23	342	195	125	451	234	43
Own Mutual Funds	Wave 1	228	559	21	768	711	34	561	228	286	126	45	64
	Wave 2	294	552	26	937	769	16	492	312	206	232	173	53
Own Stock	Wave 1	300	769	485	1044	1669	99	849	290	349	304	87	80
	Wave 2	383	679	306	1340	1922	37	723	401	268	598	370	87

Table 1: HFCS Summary Statistics (continued)

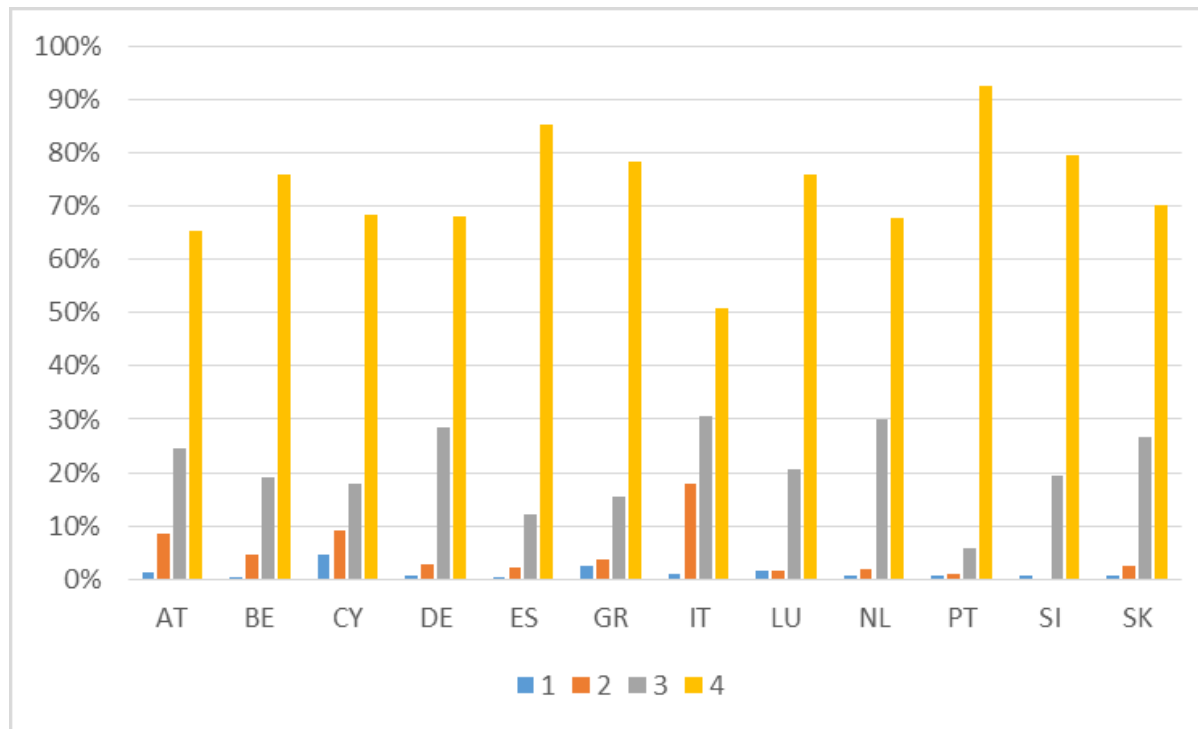
Panel B: Household Characteristics

		Mean	S.D.	Min	Max
Household Size	Wave 1	2,347424	1,259737	1	16
	Wave 2	2,308003	1,258485	1	11
Home Ownership	Wave 1	0,6127708	0,4871179	0	1
	Wave 2	0,6134664	0,4869562	0	1
FKP Employed	Wave 1	0,5208862	0,4995647	0	1
	Wave 2	0,5338051	0,4988569	0	1
FKP male	Wave 1	0,5254818	0,4993514	0	1
	Wave 2	0,5408632	0,4983284	0	1
FKP age	Wave 1	52,80064	16,81478	16	85
	Wave 2	53,92784	16,8282	16	85
FKP education primary only	Wave 1	0,1617115	0,3681868	0	1
	Wave 2	0,1578181	0,3645711	0	1
FKP has university degree	Wave 1	0,2354193	0,4242616	0	1
	Wave 2	0,2504028	0,4332458	0	1
ihh(Household Income)	Wave 1	10,72156	1,369205	0	15,38581
	Wave 2	10,70808	1,548425	0	16,73003
ihh(Household Wealth)	Wave 1	10,48525	5,133165	-13,64234	19,51415
	Wave 2	10,18373	5,48051	-14,75297	19,33426

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

Figure 1: Risk Tolerance in Europe

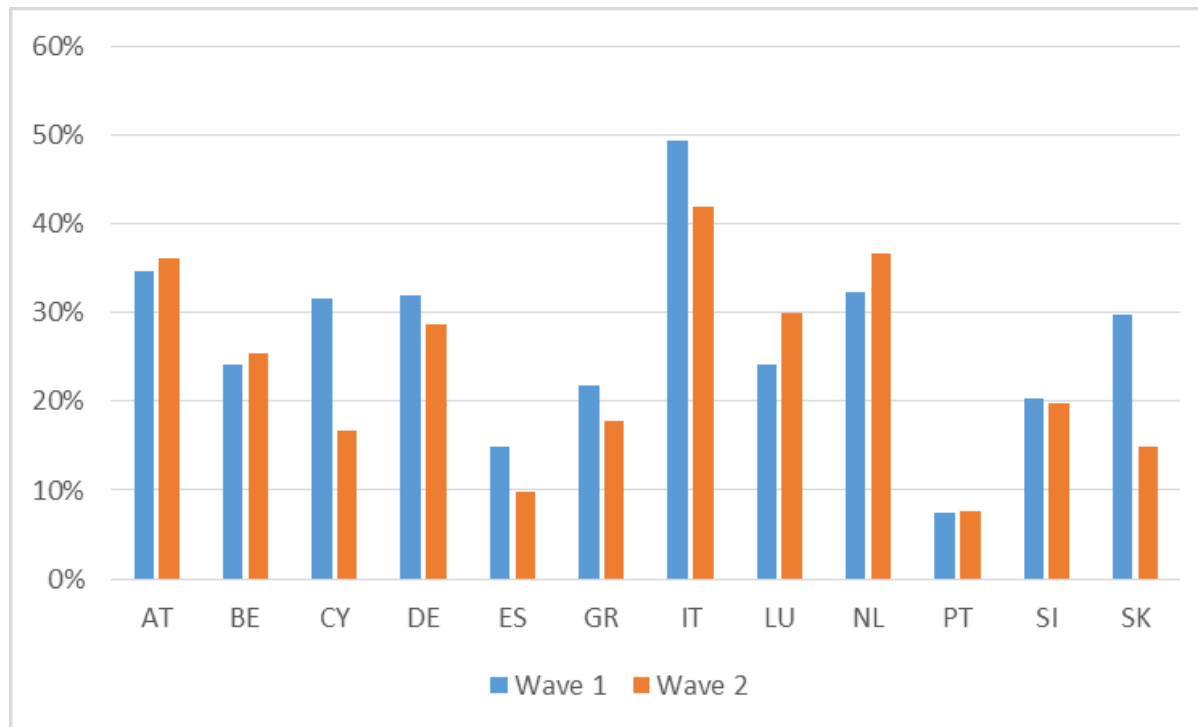
A: Responses to Financial Risk Tolerance Question



Source: HCFS Wave 1 data, own calculations.

Figure 1: Risk Tolerance in Europe (continued)

B: Fraction of Respondents Willing to Take Any Financial Risk



Source: HCFS data, own calculations.

In most of the European countries considered, the fraction of households willing to take financial risk decreased in the time period between the two surveys. This is not a surprising observation, as time period between the survey waves covers the European Sovereign Debt Crisis, and as Finke and Huston (2003) report, increased financial market volatility, fear and/or mistrust of the financial system increases investor's unwillingness to accept risk. Chiang and Xiao (2017) document that during the Global Financial Crisis the US households also held a less risk taking attitude.

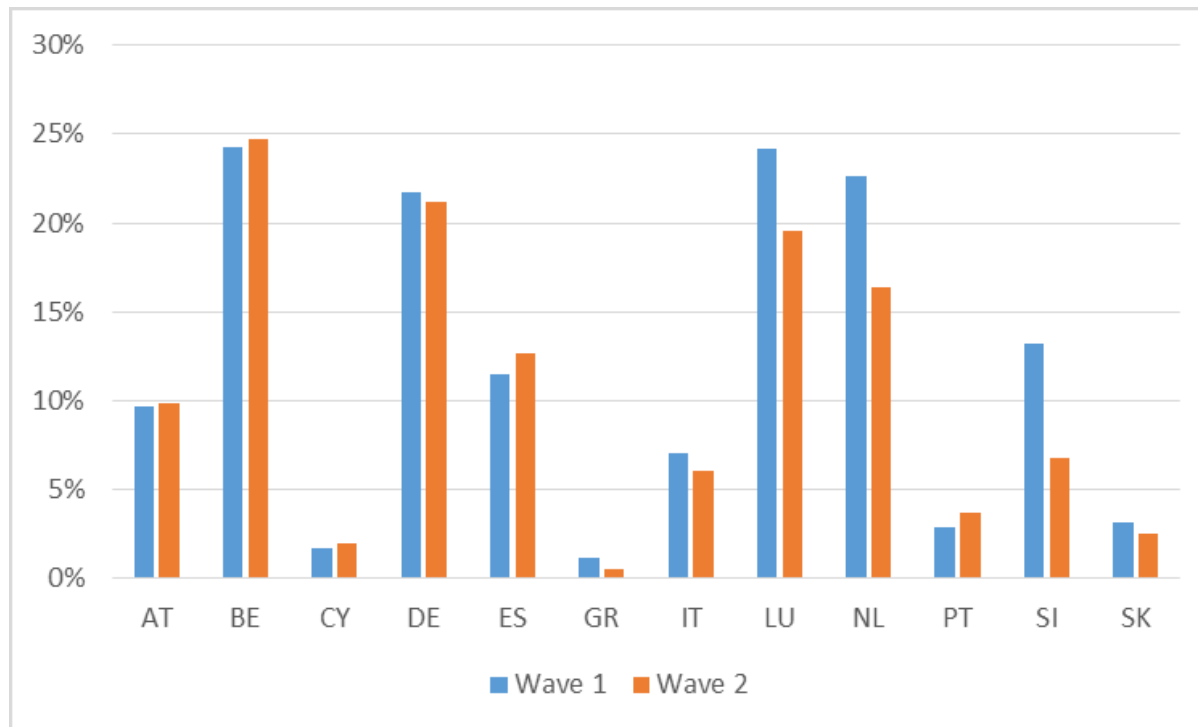
The most significant drop in the subjective risk tolerance is observed in Cyprus, where the fraction of population willing to take any financial risk in their investments halves from 2010 to 2013. This is not a surprising observation, as Cyprus experienced a financial crisis in 2012-2013, that resulted in a major international bailout on March 25, 2013⁵.

Interestingly, the fraction of households willing to take risk slightly increased in Austria, Belgium, Luxembourg, and the Netherlands. In these countries the fraction of households willing to take financial risk is higher in 2013 than in was in 2010.

As well as willingness to take risk, proxies of objective risk tolerance - mutual fund and direct stock ownership rates - vary a lot among European countries and over time, as depicted in Figures 2 and 3. Both direct stock ownership and mutual ownership rates are very low (below 5%) in Greece, Portugal, and Slovakia. The change over the survey years in mutual fund ownership rates is insignificant in the majority of countries. Direct stock ownership rates drop significantly in Cyprus and Slovenia (29% to 8% and 11% to 4% respectively). Interestingly, in Cyprus households report direct holdings of stocks, but majority claim not to own any mutual funds. In Spain and Portugal also sock ownership rates are higher than the mutual fund ownership rates. The reverse is true for the other countries of this study.

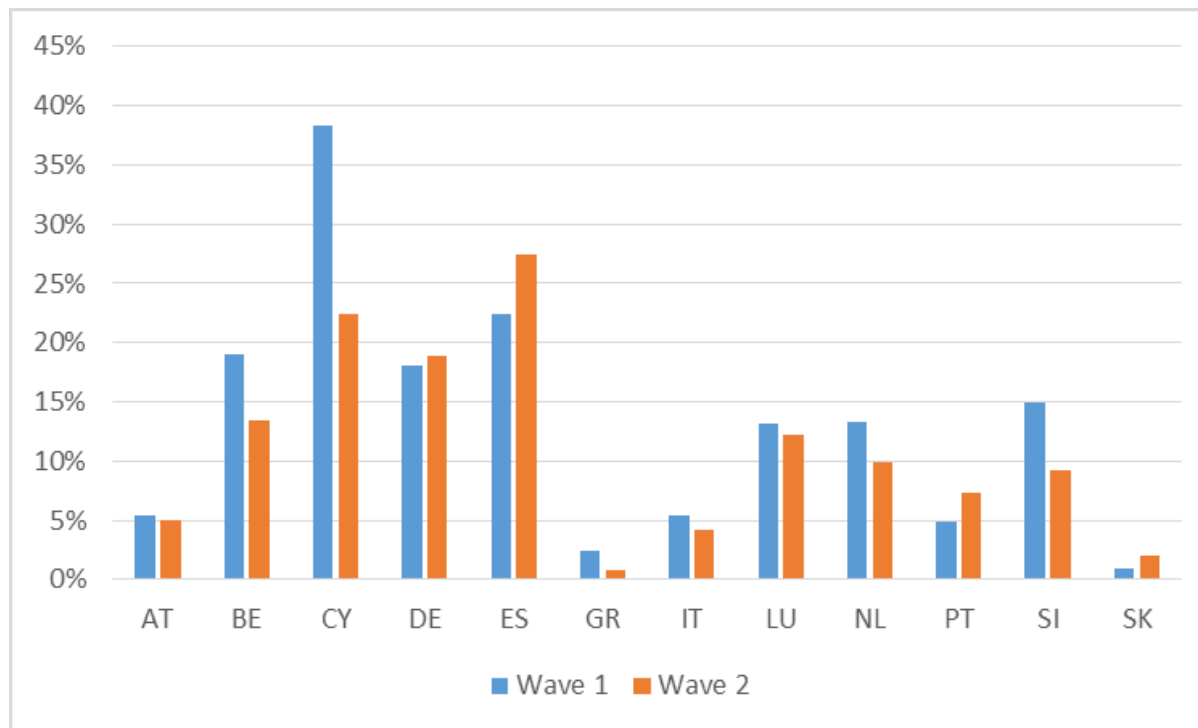
⁵ <https://www.ecb.europa.eu/press/pr/date/2013/html/pr130325.en.html>

Figure 2: Mutual Fund Ownership



Source: HFCS data, own calculations.

Figure 3: Direct Stock Ownership Rates



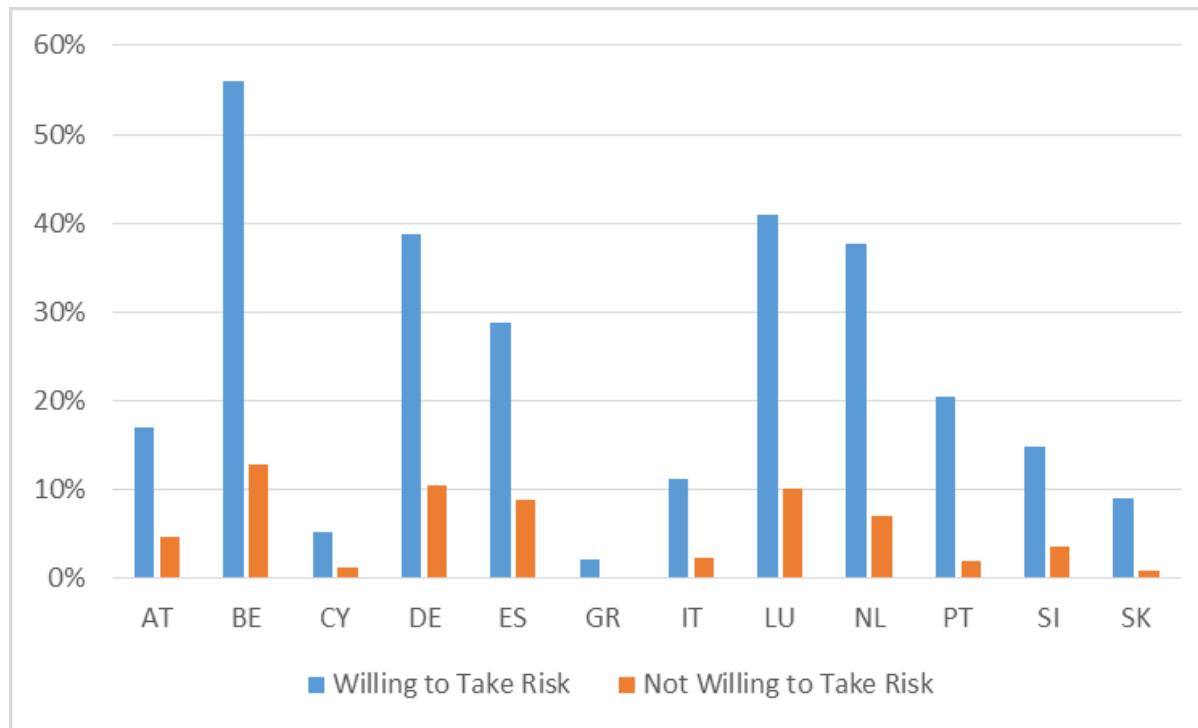
Source: HFCS data, own calculations.

As Figure 4 show, both mutual fund and direct stock ownership rates are much higher among those households that are willing to take financial risk vs. those that are not willing to take any risk with their investments. Interestingly, among those households that are willing to take risk, less than half of them hold stocks or mutual funds. Similarly, even among the households that claim to take no financial risk whatsoever, some households are found to own mutual funds and stocks. Therefore, even though in theory the three measures of financial risk tolerance used here should align, they do not align perfectly.

Table 2 summarizes the two subjective risk tolerance measures used in the PHF panel. As Panel A illustrates, the binary measure of household risk tolerance varies very little across the two panel waves. This is not surprising, given the Sahm (2012) finding that household willingness to take risk is highly persistent, and the fact that there are only two survey waves available. FKP individual willingness to take risk seem to vary much more across the two panel waves. As shown in Panel B, the binary measure of FKP willingness to take risk, that takes value “low” if the answer fell below 5 on the risk tolerance scale, and “high” otherwise, changes significantly over time. In wave 1 only 46% of the FKPs responded as not willing to take risks, while in wave 2 this fraction increases to 61%. As the respondent to this question was the same individual at two distinct points in time, the interest of this study lies in finding what caused such a change in willingness to take financial risk.

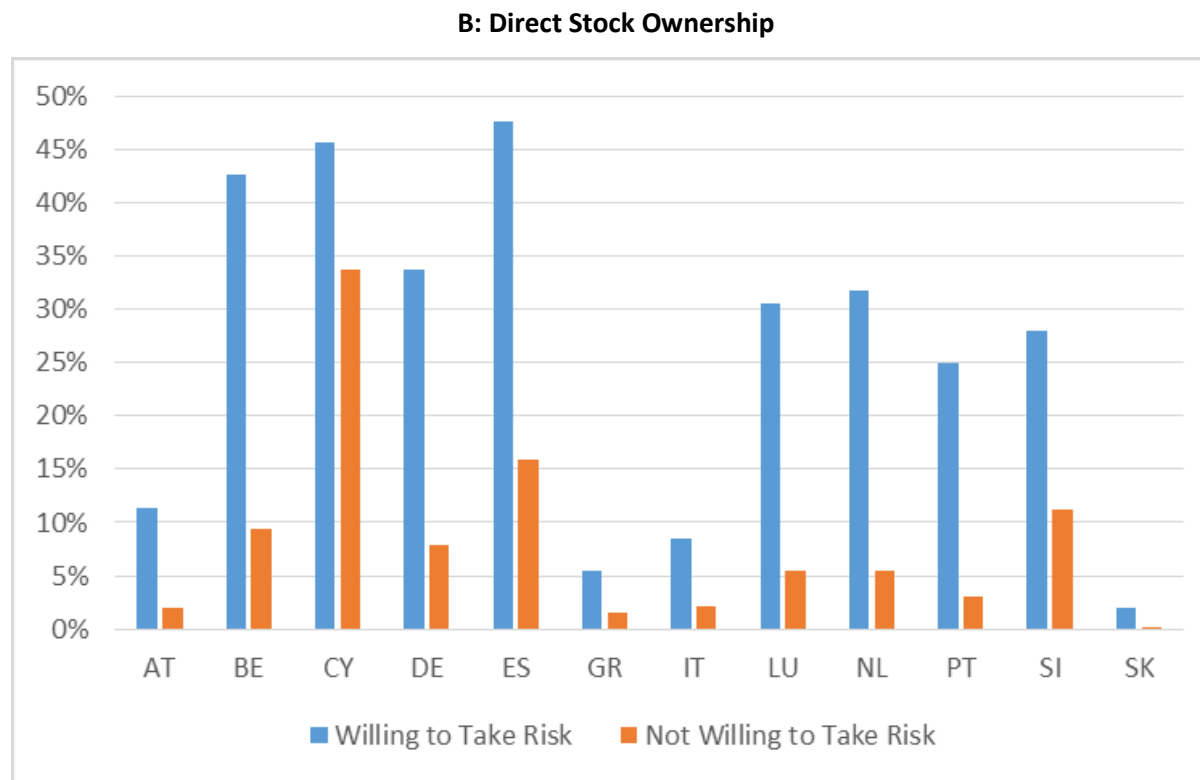
Figure 4: Mutual Fund and Stock Ownership and Subjective Risk Tolerance

A: Mutual Fund Ownership



Source: HCFS Wave 2 data, own calculations.

Figure 4: Mutual Fund and Stock Ownership and Subjective Risk Tolerance (continued)



Source: HCFS Wave 1 data, own calculations.

Table 2: Household Risk Tolerance and FKP Individual Willingness to Take Risk

Panel A: Household Risk Tolerance

Household Risk Tolerance	Wave 1	Wave 2
Not Willing To Take Any Risk	64%	69%
Willing To Take at least Average Risk	36%	31%

Panel B: Willingness to Take Risk of the FKP

FKP Willingness to Take Risk	Wave 1	Wave 2
Low	46%	61%
High	54%	39%

Panel C: Household Risk Tolerance and FKP Individual Risk Tolerance

Household Risk Tolerance	FKP Willingness to Take Risk			
	Wave 1		Wave 2	
	Low	High	Low	High
Not Willing To Take Any Risk	69%	31%	71%	29%
Willing To Take at least Average Risk	46%	54%	39%	61%

Source: Deutsche Bundesbank Panel on Household Finances, own calculations.

Panel C of Table 2 puts household willingness to take risk together with the household's FKPs own risk tolerance. Even though the two risk tolerance measures appear to be correlated, this correlation is not perfect. In Wave 2 for example in over a third of the households that are willing to take at least average risk, the FKP him/herself is not willing to take risk. Similarly, about a third of the households with the FKP responding as tolerant to risk are not willing to take any risk at all. Current survey design prevents the researcher from further investigating the reasons for such differences between FKP own risk appetite and household willingness to take risk. Question framing, within-household heterogeneity in risk tolerance, and household-specific decision-making dynamics are all likely to be important factors in explaining the observed non-perfect relation.

4. Results

4.1 International Cross-Section

The cross-sectional pooled OLS results using the HFCS data is presented in Table 3. Column 1 show the regression results where the explanatory variable is the binary subjective household willingness to take risk. In Column 2 the variable of interest is subjective household risk tolerance index, which allows accounting for more variation in the data. Column 3 depicts the regression of binary direct stock ownership as the variable of interest. In Column 4 household ownership of mutual funds is on the left-hand side of the regression. The regression in column 5 looks into participating in the stock market in general (both directly and indirectly).

From all of the explored potential covariates of household risk tolerance, gender of the FKP, household size, homeownership, education, household income, and household wealth are found to correlate significantly with all three risk tolerance measures. Most of the country dummies are also significant when Germany is chosen as a reference country, suggesting that institutions and culture indeed play a role in explaining observed level differences in the willingness to take risk, stock ownership and mutual fund ownership rates among Eurozone countries.

Table 3: Determinants of Household Risk Tolerance in International Cross-Section

VARIABLES	(1) Subjective Willingness to Take Risk	(2) Subjective Risk Index	(3) Direct Stock Ownership	(4) Mutual Fund Ownership	(5) Stock Market Participation
Household Size	-0.0134*** (0.00445)	-0.0221*** (0.00594)	-0.00499** (0.00220)	-0.00669*** (0.00233)	-0.00893*** (0.00279)
Homeowner	0.0349*** (0.0123)	0.0441*** (0.0156)	0.0244*** (0.00678)	0.0264*** (0.00788)	0.0408*** (0.00907)
FKP Employed	0.0359*** (0.0125)	0.0503*** (0.0158)	0.000835 (0.00561)	0.00190 (0.00682)	0.000842 (0.00791)
FKP Male	0.1000*** (0.00956)	0.130*** (0.0123)	0.0414*** (0.00511)	0.0290*** (0.00555)	0.0509*** (0.00665)
FKP under 36	0.0554*** (0.0175)	0.0484** (0.0223)	-0.0179** (0.00819)	-0.0312*** (0.00917)	-0.0328*** (0.0107)
FKP aged 51-65	-0.0398*** (0.0134)	-0.0559*** (0.0179)	0.00476 (0.00749)	-0.0131 (0.00859)	-0.00220 (0.00976)
FKP aged over 65	-0.127*** (0.0166)	-0.161*** (0.0230)	0.00287 (0.00838)	-0.0336*** (0.00991)	-0.0165 (0.0114)
FKP Primary Education	-0.0451*** (0.0102)	-0.0713*** (0.0139)	-0.0296*** (0.00556)	-0.00657 (0.00567)	-0.0382*** (0.00712)
FKP University Degree	0.0997*** (0.0133)	0.106*** (0.0176)	0.0839*** (0.00862)	0.0758*** (0.00895)	0.117*** (0.0106)
Ihs(Household Income)	0.0155*** (0.00377)	0.0137*** (0.00474)	0.0149*** (0.00134)	0.0155*** (0.00138)	0.0233*** (0.00180)
Ihs(Household Wealth)	0.00444*** (0.00125)	0.00477*** (0.00160)	0.00446*** (0.000396)	0.00518*** (0.000620)	0.00748*** (0.000679)

Austria	0.0783*** (0.0167)	0.141*** (0.0228)	-0.0350*** (0.00822)	-0.0356*** (0.00973)	-0.0490*** (0.0114)
Belgium	-0.0818*** (0.0215)	-0.0739*** (0.0270)	0.0323** (0.0153)	0.0290* (0.0163)	0.0460** (0.0186)
Cyprus	-0.0545** (0.0231)	0.0433 (0.0380)	0.105*** (0.0190)	-0.112*** (0.00909)	0.0372* (0.0197)
Spain	-0.180*** (0.0139)	-0.186*** (0.0173)	0.000273 (0.00921)	-0.0814*** (0.00942)	-0.0504*** (0.0114)
Greece	-0.0729*** (0.0146)	-0.0238 (0.0195)	-0.0483*** (0.00724)	-0.0981*** (0.00785)	-0.112*** (0.00935)
Italy	0.181*** (0.0132)	0.311*** (0.0176)	-0.0450*** (0.00703)	-0.0632*** (0.00803)	-0.0780*** (0.00932)
Luxembourg	-0.0783*** (0.0271)	-0.0629* (0.0356)	-0.0128 (0.0185)	-0.0251 (0.0195)	-0.0118 (0.0230)
Netherlands	0.00422 (0.0300)	-0.00758 (0.0342)	-0.00316 (0.0192)	0.0479** (0.0228)	0.0452* (0.0259)
Portugal	-0.207*** (0.0151)	-0.211*** (0.0196)	-0.0181* (0.00948)	-0.0824*** (0.00941)	-0.0691*** (0.0116)
Slovenia	-0.0746*** (0.0287)	-0.0960*** (0.0337)	0.0161 (0.0184)	-0.0199 (0.0202)	0.0142 (0.0246)
Slovakia	-0.0653*** (0.0179)	-0.0668*** (0.0221)	-0.0763*** (0.00728)	-0.0966*** (0.00846)	-0.136*** (0.00996)
Wave 2 Dummy	-0.0454*** (0.00940)	-0.0696*** (0.0121)	-0.00333 (0.00533)	-0.0104* (0.00572)	-0.00572 (0.00681)
Constant	0.0687* (0.0411)	0.139** (0.0540)	-0.153*** (0.0144)	-0.107*** (0.0151)	-0.199*** (0.0195)

Source: HFCS data, own calculations. Age 36-50, Female, Secondary Education, Germany as reference. OLS regressions. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Finding that risk tolerance is positively correlated with household income, household wealth, and education is very much in-line with the previous findings using the survey data from the US. Xiao (1996) using data from the 1989 Survey of Consumer Finances (SCF) found that stock ownership was positively associated with income, and negatively associated with lower education. Wang and Hanna (1997) found that respondents who are more educated, and more wealthy have a greater likelihood of holding risky assets. Sung and Hanna (1996) found that being more educated and wealthy are also associated with a greater likelihood of subjective risk tolerance. Grable and Lytton (1998) find that higher levels of education is the strongest predictor of willingness to take financial risk.

Homeownership rates have been shown to be related to the stock market participation rates in Europe by Christelis et al (2013). Therefore it is not surprising that homeownership is an important covariate for financial risk tolerance. Household size is significant in the cross-sectional regressions, in-line to what was documented for the US by Xiao (1996). The link between risk tolerance and the number of household members appears to be present in Europe as well as in the US.

FKP's that are older than 65 years of age appear to be significantly less likely to respond that their household is willing to take financial risks compared to households where the FKP is aged 36 to 50. Young FKPs (less than 36 years of age), however, appear less likely to own stocks and mutual funds compared to slightly older FKPs.

Christelis et al (2013) suggest that differences in stock ownership rates among Eurozone countries is primarily linked to different economic environments. To see whether there are indeed differences in financial risk tolerance depending on economic environment, I split the HFCS sample into South Europe (Italy, Greece, Cyprus, Portugal, Spain, Slovenia) and North Europe (Austria, Belgium, Germany, Luxembourg, Netherlands, Slovakia) and create a propensity score matched set of households based on the traditional determinants of risk tolerance used in the OLS regression before. In requesting that each household in the survey wave has a reasonably similar counterpart household in another European region based on

a set of characteristics, I lose a significant fraction of my sample. Only about 17,000 of households remain part of the matched set in each of the HFCS waves.

Table 4 Panel A shows the differences in risk tolerance between Southern and Northern European households in the two HFCS waves and the differences in risk tolerance between matched on observables Southern and Northern European households in the two HFCS waves. Matching is performed using logistic treatment model of propensity scores that are calculated using all of the covariates of risk tolerance from the cross-sectional regressions. The maximum distance for which two observations are potential neighbors is set to 0.2 standard deviations to minimize the bias arising from bad matching (Lunt (2014)). I use the single nearest neighbor matching (Rubin (1973)).

Table 4 Panel B presents the summary statistics of the covariates employed in propensity score calculation among the matched Northern and Southern households.

Table 4: Differences in Risk Tolerance between Northern and Southern Europe

Panel A: Differences in Risk Tolerance

Measures of Risk Tolerance		Wave 1		Wave 2	
		South-North Difference	S.E.	South-North Difference	S.E.
Subjective Willingness to Take Risk	Full Sample	-0,051945 ***	0,002116	-0,090284 ***	0,001802
	Matched Sample	0,024152 *	0,012341	0,030116 **	0,011007
Subjective Risk Index	Full Sample	0,004537	0,003014	-0,081420 ***	0,002432
	Matched Sample	0,089091 ***	0,016220	0,062250 ***	0,015716
Direct Stock Ownership	Full Sample	-0,009934 ***	0,001447	-0,001358	0,001275
	Matched Sample	-0,000840	0,008778	0,009464	0,008604
Mutual Fund Ownership	Full Sample	-0,107874 ***	0,001348	-0,086322 ***	0,001190
	Matched Sample	-0,062337 ***	0,009744	-0,034820 ***	0,005927
Stock Market Participation	Full Sample	-0,079813 ***	0,001716	-0,062006 ***	0,001518
	Matched Sample	-0,040528 ***	0,011199	-0,012626	0,009558

Source: HFCS data, own calculations. The South-North difference is either the simple difference in the means or the ATET of the matched households in South European countries (Italy, Greece, Cyprus, Portugal, Spain, Slovenia) and North European countries (Austria, Belgium, Germany, Luxembourg, Netherlands, Slovakia) (Southern European households being the “treated” households) calculated using logistic treatment method with propensity-score matching estimator. Standard errors reported are robust standard errors (for differences in the means) and Abadie-Imbens standard errors (for differences in the ATET). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

**Table 4: Differences in Risk Tolerance between Northern and Southern Europe
(continued)**

Panel B: Covariate Summary Statistics in Matched North-South Samples

		Wave 1		Wave 2	
		Mean	Std. Dev.	Mean	Std. Dev.
Household Size	Southern	2,501593	1,269254	2,456316	1,276484
	Northern	2,140621	1,166111	2,107348	1,177028
Homeownership	Southern	0,709990	0,453770	0,739716	0,438793
	Northern	0,598431	0,490225	0,567774	0,495393
FKP Employed	Southern	0,438930	0,496260	0,405124	0,490920
	Northern	0,511074	0,499887	0,458023	0,498243
FKP male	Southern	0,558158	0,496609	0,561325	0,496229
	Northern	0,540644	0,498355	0,563829	0,495917
FKP aged under 36	Southern	0,120028	0,324996	0,083819	0,277118
	Northern	0,206447	0,404763	0,137428	0,344304
FKP aged 45-65	Southern	0,280122	0,449061	0,299160	0,457893
	Northern	0,275946	0,446998	0,315478	0,464713
FKP aged over 65	Southern	0,326509	0,468939	0,372164	0,483385
	Northern	0,264853	0,441263	0,332214	0,471014
FKP primary education only	Southern	0,355362	0,478626	0,316345	0,465053
	Northern	0,031000	0,173321	0,028108	0,165285
FKP has university degree	Southern	0,179386	0,383678	0,202949	0,402198
	Northern	0,279734	0,448877	0,321026	0,466878
ihs(Household income)	Southern	10,531160	1,507171	10,491330	1,766702
	Northern	10,656450	1,473880	10,825480	1,428427
ihs(Household wealth)	Southern	11,385760	4,089076	11,275080	4,553165
	Northern	10,516730	4,970940	10,179290	5,582729

Source: HFCS data, own calculations.

Interestingly, in the full sample, southern households appear to be subjectively less willing to take risk than the northern households in both survey waves. However, the comparable to the Northern European household in covariates, a Southern European household sees itself as more willing to take financial risk in both survey waves. The South-North differences in direct stock ownership rates, mutual fund ownership rates, and overall stock market participation roughly halves when moving from a simple comparison to a comparison between households that are similar on observables. However, most of the differences in levels of financial risk tolerance between North and South remain statistically significant in the matched sample with the exception being direct stock ownership, suggesting that institutions and culture are likely to play a significant role in explaining the level differences in subjective willingness to take risk, mutual fund ownership rates, and stock market participation rates. Interestingly, the likelihood of participating in the stock market is significantly lower for Southern household in HFCS Wave 1, but not in Wave 2 in the matched sample, while in the general sample this difference is of comparable size and highly statistically significant in the two survey waves. This suggest that if the macroeconomic conditions would have remained constant, the gap between South and North Europe in terms of stock market participation would have effectively closed, likely due to convergence in institutions. However, as one major change that took place between the survey waves that affected the Southern Europe differently from the Northern Europe was the European Sovereign debt crisis, it appears that macroeconomic conditions are important in explaining the dynamics of risk tolerance over time. From the magnitude of the effects, the findings suggest that macroeconomic conditions matter at least as much if not more as the changes in institutions.

To further explore the time variation in the measures of financial risk tolerance over time not related to changes in observable characteristics of a household, I perform a difference-in-differences estimation on the propensity score matched sets based on the traditional

determinants of risk tolerance of Southern vs. Northern European households in each HFCS wave following Abadie (2005). Results are presented in Table 5.

The only difference-in-differences estimate that is marginally statistically significant (at 10% level) is the change in mutual fund ownership rates between South and North between the two survey waves. As the difference itself is negative, the positive difference-in-differences suggests that the Southern European household is closer to a comparable Northern European household in its likelihood to participate in mutual funds in HFCS Wave 2 compared to survey Wave 1. What remains unclear is what role understanding of the benefits of diversification play in explaining this change in mutual fund ownership probability. As HFCS itself does not contain financial literacy, and thus understanding diversification questions, in its core questionnaire, I turn to a sub-sample of the HFCS, the German Panel on Household Finances.

Table 5: Difference-in-Differences Estimation Results

	Subjective Willingness to Take Risk	Subjective Risk Index	Direct Stock Ownership	Mutual Fund Ownership	Stock Market Participation
Diff-in-Diff Estimate	0,005964	-0,026841	0,010304	0,027517 *	0,027902

Source: HFCS data, own calculations. The difference-in-differences estimate is the difference in the ATETs of the matched households in South European countries (Italy, Greece, Cyprus, Portugal, Spain, Slovenia) and North European countries (Austria, Belgium, Germany, Luxembourg, Netherlands, Slovakia) (Southern European households being the “treated” households) calculated using logistic treatment method with propensity-score matching estimator between HFCS Wave 2 and Wave 1. Standard errors reported are robust Abadie-Imbens standard errors. *** p<0.01, ** p<0.05, * p<0.1

4.2 Balanced German Panel

Due to a repeated cross-section of HFCS, establishing a causal relationship between financial risk tolerance and any of the factors that were found to correlate significantly in Table 3, is not possible. Estimation based on cross-sectional data yields biased results due to the presence of unobserved heterogeneity. Namely, important controls that are likely to affect financial risk tolerance and employment status, income, and wealth, for example, such as ability of the FKP to process information and trust, are unobserved and thus not controlled for in the cross-sectional regression. Therefore I move to the PHF data, where a balanced panel that allows for fixed effect regressions can be constructed, enabling me to account for time-invariant unobserved household heterogeneity.

Using the PHF data, I employ first the household subjective willingness to take risk, then the stock and mutual fund ownership as variables of interest. I run OLS regressions for each of the panel waves separately, then with pooled data, and finally a fixed effect panel regression with household and survey wave fixed effects. I also employ FKP individual risk appetite index as a variable of interest. In this latter case I run both OLS and ordered Probit regressions for each of the panel waves, before turning to the specification with the fixed effects.

Table 6 presents the results of regressions using the household risk tolerance dummy as the variable of interest in the PHF. Columns 1, 2, and 3 show OLS regressions using Survey waves 1, 2, and pooled data respectively. Panel Fixed Effects regression results are shown in Column 4.

In the cross-sectional regressions, household size correlates negatively with the household financial risk tolerance. Households with older FKPs perceive themselves as less willing to take financial risk than the households with FKPs aged 36-50. FKPs education correlates positively with household financial risk tolerance. Similarly, risk tolerance is positively correlated with household income. All these findings are very much in-line with the previous

literature on household financial risk tolerance and with the regression results from HFCS reported in Section 3.1.

In the panel regression, when fixed effects are included, however, only the household income remains significant. From all the factors explored, when the time-invariant household characteristics are accounted for, only the changes in household income and FKPs financial literacy can explain why the household changes its willingness to take financial risk over the two panel waves. This, however, does not mean that the other factors have no effect on household financial risk tolerance in general. As has been already noted in Section 2.2, the identification in the panel regression comes from the variation of the regressors over time. As the two panel waves are close together, and there are only two waves available at the time of writing, the finding that household size, education, and wealth have no significant effect on subjective household willingness to take risk is likely driven by low variation in these three variables.

Financial literacy dummy, which indicates how well the FKP answers the three standard financial literacy questions, though insignificant in the cross-section, is significant in the panel. Surprisingly, the coefficient on financial literacy score carries a negative sign, suggesting that when the FKP becomes more financially literate, the household's willingness to take financial risk falls. This finding, however, should be seen with caution, as financial literacy levels in the PHF are really high, with over 60% of FKPs answering all three financial literacy questions correctly in both panel waves. On the other hand, as most variation in the financial literacy comes from the FKPs ability to answer the question about the benefits of diversification correctly, it is probable that once the person understands these benefits, the willingness to take risk in absolute terms falls.

Table 6: Determinants of Household Subjective Risk Tolerance in the PHF Panel

	(1)	(2)	(3)	(4)
	OLS Wave 1	OLS Wave 2	OLS Pooled	Panel FE
VARIABLES	Household Subjective Willingness to Take Risk			
Financial Literacy Dummy	0.00425 (0.0491)	0.0942** (0.0447)	0.0491 (0.0331)	-0.111** (0.0476)
Household Size	-0.0696** (0.0271)	-0.0593*** (0.0219)	-0.0637*** (0.0169)	-0.0209 (0.0508)
Home Owner	0.0916* (0.0514)	-0.0162 (0.0461)	0.0317 (0.0345)	-0.162 (0.160)
FKP Employed	0.00934 (0.0655)	-0.0607 (0.0596)	-0.0273 (0.0449)	-0.130 (0.0812)
FKP under 36	-0.0159 (0.0821)	-0.0108 (0.0762)	-0.0122 (0.0560)	
FKP aged 51-65	-0.163** (0.0683)	-0.164*** (0.0623)	-0.163*** (0.0459)	
FKP aged over 65	-0.274*** (0.0833)	-0.269*** (0.0742)	-0.275*** (0.0560)	
FKP Primary Education	0.00701 (0.172)	-0.121** (0.0568)	-0.0556 (0.0939)	
FKP University Degree	0.0917* (0.0502)	0.0834* (0.0445)	0.0904*** (0.0335)	
lhs(Household Income)	0.0692*** (0.0205)	0.0762*** (0.0256)	0.0695*** (0.0161)	0.0674** (0.0340)
lhs(Household Wealth)	-0.00307 (0.00443)	0.00598 (0.00383)	0.00242 (0.00289)	-0.00888 (0.00567)
FKP age				-0.0127 (0.0297)
FKP age squared				0.000151 (0.000285)
Constant	-0.212 (0.219)	-0.388 (0.259)	-0.272 (0.166)	0.0475 (0.764)

Source: PHF data, own calculations. In Columns (1)-(3), age 36-50, secondary education (Abitur) as a reference, robust standard errors in parentheses. In Column (4), standard errors are clustered at household level.

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

Table 7: Determinants of Stock Ownership in the PHF Panel

	(1)	(2)	(3)	(4)
	OLS Wave 1	OLS Wave 2	OLS Pooled	Panel FE
VARIABLES	Stock Ownership			
Financial Literacy Dummy	0.0252 (0.0267)	0.0392* (0.0214)	0.0315* (0.0169)	-0.0137 (0.0142)
Household Size	-0.0208 (0.0138)	-0.0211* (0.0109)	-0.0213** (0.00855)	0.00782 (0.0236)
Home Owner	0.0320 (0.0317)	0.0294 (0.0319)	0.0309 (0.0224)	-0.321** (0.136)
FKP Employed	0.0341 (0.0261)	-0.0198 (0.0228)	0.00707 (0.0171)	0.0802 (0.0528)
FKP under 36	-0.0313 (0.0317)	-0.00686 (0.0391)	-0.0186 (0.0249)	
FKP aged 51-65	-0.00334 (0.0399)	-0.0339 (0.0305)	-0.0205 (0.0243)	
FKP aged over 65	-0.0241 (0.0366)	0.00517 (0.0353)	-0.00790 (0.0251)	
FKP Primary Education	0.00792 (0.0241)	0.0298 (0.0256)	0.0215 (0.0177)	
FKP University Degree	0.0898*** (0.0328)	0.0783*** (0.0300)	0.0845*** (0.0221)	
lhs(Household Income)	0.0475*** (0.0181)	0.0669*** (0.0189)	0.0550*** (0.0135)	0.00978 (0.0105)
lhs(Household Wealth)	0.00482*** (0.00114)	0.00482*** (0.00119)	0.00479*** (0.000820)	-5.97e-05 (0.000827)
FKP age				-0.00862 (0.00791)
FKP age squared				0.000100 (8.04e-05)
Constant	-0.477*** (0.179)	-0.683*** (0.191)	-0.555*** (0.133)	0.211 (0.201)

Source: PHF data, own calculations. In Columns (1)-(3), age 36-50, secondary education (Abitur) as a reference, robust standard errors in parentheses. In Column (4), standard errors are clustered at household level.

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

Table 7 presents the estimation results for the effect various factors have on the stock ownership. Education, income and wealth are all found to be positively correlated with stock ownership in the cross-sectional regressions. None of these covariates are significant in the panel regression with the fixed effects. Interestingly, homeownership status is significantly negatively correlated with the stock ownership once the unobserved household heterogeneity is taken into account, thus supporting the “crowding out” effect of housing suggested in for ex. Hu (2005), Zhou et al (2017). Again, the fact that education, income and wealth have no significant effect on stock ownership is likely driven by low variation in these variables across the two survey waves.

Table 8 depicts the regression results for the determinants of mutual fund ownership. In the cross-sectional regressions, household income, wealth, and FKPs financial literacy are all found to be positively correlated with mutual fund ownership dummy. Household size correlates negatively and statistically significantly. When one turns to the panel setting with fixed effects, only household income appears to matter, albeit the coefficient is only marginally significant.

Table 8: Determinants of Mutual Fund Ownership in the PHF Panel

VARIABLES	(1) OLS Wave 1	(2) OLS Wave2	(3) OLS Pooled	(4) Panel FE
	Mutual Fund Ownership			
Financial Literacy Dummy	0.108*** (0.0261)	0.0629** (0.0290)	0.0836*** (0.0197)	0.0289 (0.0237)
Household Size	-0.0342** (0.0174)	-0.0274** (0.0126)	-0.0319*** (0.0102)	0.0278 (0.0224)
Home Owner	0.0306 (0.0366)	0.0476 (0.0360)	0.0393 (0.0256)	-0.0713 (0.0599)
FKP Employed	0.00454 (0.0352)	-0.0424 (0.0359)	-0.0230 (0.0250)	0.0332 (0.0476)
FKP under 36	-0.0252 (0.0483)	-0.0264 (0.0448)	-0.0274 (0.0327)	
FKP aged 51-65	-0.0726* (0.0440)	-0.0676* (0.0399)	-0.0735** (0.0298)	
FKP aged over 65	-0.0728 (0.0498)	-0.0899* (0.0490)	-0.0838** (0.0348)	
FKP Primary Education	0.155 (0.119)	0.188 (0.128)	0.171** (0.0863)	
FKP University Degree	0.0401 (0.0351)	0.104*** (0.0345)	0.0725*** (0.0248)	
lhs(Household Income)	0.0652*** (0.0224)	0.0392* (0.0206)	0.0535*** (0.0141)	0.0297* (0.0178)
lhs(Household Wealth)	0.00897*** (0.00207)	0.00831*** (0.00171)	0.00862*** (0.00130)	-3.93e-05 (0.00108)
FKP age				-0.00243 (0.0133)
FKP age squared				4.23e-05 (0.000131)
Constant	-0.634*** (0.221)	-0.341* (0.205)	-0.497*** (0.139)	-0.261 (0.326)

Source: PHF data, own calculations. In Columns (1)-(3), age 36-50, secondary education (Abitur) as a reference, robust standard errors in parentheses. In Column (4), standard errors are clustered at household level.

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

Table 9: Determinants of Individual Risk Tolerance in the PHF Panel

	(1) OLS Wave 1	(2) Ordered Probit Wave 1	(3) OLS Wave 2	(4) Ordered Probit Wave 2	(5) OLS Pooled	(6) Ordered Probit Pooled	(7) Panel FE
VARIABLES	Risk Index						
Financial Literacy Dummy	0.250 (0.228)	0.129 (0.110)	-0.00730 (0.228)	0.00112 (0.107)	0.0992 (0.161)	0.0536 (0.0760)	-0.148 (0.235)
Household Size	-0.227* (0.129)	-0.117* (0.0624)	-0.157 (0.0957)	-0.0713 (0.0436)	-0.171** (0.0762)	-0.0778** (0.0352)	0.332 (0.247)
Home Owner	0.241 (0.226)	0.127 (0.109)	-0.209 (0.228)	-0.104 (0.107)	-0.0246 (0.163)	-0.0103 (0.0769)	-0.108 (0.566)
FKP is a female	-0.666*** (0.205)	-0.329*** (0.0993)	-0.807*** (0.214)	-0.374*** (0.100)	-0.734*** (0.149)	-0.346*** (0.0700)	
FKP Employed	0.592* (0.318)	0.305** (0.154)	0.615** (0.291)	0.279** (0.135)	0.605*** (0.217)	0.285*** (0.102)	-0.0503 (0.363)
FKP under 36	0.202 (0.324)	0.108 (0.151)	0.240 (0.350)	0.141 (0.160)	0.205 (0.240)	0.112 (0.110)	
FKP aged 51-65	-0.359 (0.298)	-0.172 (0.141)	-0.168 (0.277)	-0.0770 (0.126)	-0.245 (0.204)	-0.112 (0.0938)	
FKP aged over 65	-0.474 (0.391)	-0.203 (0.190)	-0.407 (0.359)	-0.184 (0.166)	-0.443* (0.268)	-0.197 (0.127)	
FKP Primary Education	0.269 (0.815)	0.107 (0.427)	-1.237 (0.863)	-0.776 (0.583)	-0.506 (0.647)	-0.322 (0.366)	

FKP University Degree	0.957*** (0.230)	0.443*** (0.105)	0.286 (0.229)	0.143 (0.105)	0.588*** (0.164)	0.277*** (0.0744)	
lhs(Household Income)	0.227** (0.104)	0.109** (0.0511)	0.346*** (0.129)	0.174** (0.0683)	0.282*** (0.0835)	0.135*** (0.0422)	0.113 (0.113)
lhs(Household Wealth)	-0.0313 (0.0201)	-0.0138 (0.00969)	-0.00434 (0.0190)	-0.00269 (0.00889)	-0.0151 (0.0140)	-0.00682 (0.00653)	0.00889 (0.0287)
FKP age							0.0697 (0.145)
FKP age squared							-0.000860 (0.00135)
Constant cut1		-0.159 (0.536)		0.525 (0.692)		0.139 (0.430)	
Constant cut2		0.206 (0.529)		0.788 (0.693)		0.445 (0.429)	
Constant cut3		0.732 (0.526)		1.217* (0.695)		0.913** (0.429)	
Constant cut4		1.191** (0.528)		1.686** (0.696)		1.373*** (0.430)	
Constant cut5		1.485*** (0.529)		1.933*** (0.695)		1.638*** (0.430)	
Constant cut6		2.059*** (0.534)		2.628*** (0.696)		2.276*** (0.431)	
Constant cut7		2.400*** (0.540)		2.932*** (0.698)		2.597*** (0.434)	
Constant cut8		2.871*** (0.548)		3.375*** (0.705)		3.053*** (0.439)	
Constant cut9		3.350*** (0.547)		4.184*** (0.750)		3.700*** (0.452)	
Constant cut10		3.644*** (0.543)		4.533*** (0.872)		4.019*** (0.479)	

Constant	1.273 (1.073)	0.314 (1.314)	0.840 (0.851)	0.755 (3.846)
----------	------------------	------------------	------------------	------------------

Source: PHF data, own calculations. In Columns (1)-(6), age 36-50, secondary education (Abitur) as a reference, robust standard errors in parentheses. In Column (7), standard errors are clustered at household level. *** p<0.01, ** p<0.05, * p<0.1

Table 9 presents the results from regressions using self-assessed risk tolerance index of the FKP as a variable of interest. Since FKP's own risk assessment is a categorical variable ranging from 0 to 10, in addition to the cross-sectional OLS regressions reposted in Columns 1, 3, and 5 for Wave 1, Wave 2, and Pooled data respectively, I also use ordered probit model, with output presented in Columns 2, 4, and 6. Fixed effects panel regression results are shown in Column 7.

FKPs gender, employment status, education, and household income all relate significantly to the FKP's individual risk appetite in the cross-section. All the coefficients carry expected signs, suggesting that higher education level, being employed, and having larger income all associate positively with FKP's subjective willingness to engage in risky taking. Male FKPs are more willing to take risks than female, and the more members the household contains, the less likely the FKP of that household is to declare him/herself as having a high appetite for risk.

In the panel fixed effects regression, however, none of the above mentioned covariates seem to matter. As identification in the panel setting come from the changes in the regressors over the two panel waves, the finding that household size, education, and income have no significant effect on the individual risk appetite is likely driven by low variation in these variables over the two panel waves. A larger panel dimension is needed for better understanding of the drivers of financial risk tolerance. Still, even with this limited data it is evident that household income is one of - if not - the key drivers of changes in willingness to take risk over time.

5. Conclusion

In this paper I investigate how the financial risk tolerance differs across 12 Eurozone countries, between Northern and Southern European households, and across German households over time. Specifically, I look at the links among risk taking attitude of households, stock and mutual fund ownership, and household sociodemographic characteristics.

On the one hand, the data is well suited for this analysis in the sense that it provides a very rich and granular set of information on demographics as well as on the households' wealth and income situation. Crucially, the question of subjective household willingness to take risk

in their investments is included in both waves of the survey and is in line with the standard praxis of measuring financial risk tolerance in the US. This would suggest that the results could be interpreted in comparison to the existent evidence.

However, there are some issues that make the whole analysis somewhat tricky. One is of econometric nature and concerns the fact that international data set is only available as a repeated cross-section. As unobservable household characteristics cannot be controlled for in this setting, establishing how important a driver of risk tolerance is one's cultural background and nationality without any bias is therefore not possible. Second, there is very little variation in variables of interest over time, as there are only two survey waves available. Third, as observed with the PHF data, there are substantial differences between FKP's own risk appetite and willingness to take risk of a household in its entirety. Unfortunately, the question regarding FKP's own risk tolerance was not included in the HFCS questionnaire. Similarly, the three classic financial literacy questions were also left out of the Core Eurozone Survey.

The main results are as follows. There are substantial differences in both the levels and the changes over time in household willingness to take financial risk, mutual fund and stock ownership across 12 Eurozone countries studied. These differences in levels cannot be fully explained with the classic factors presumed to be driving financial risk tolerance. Homeownership, education, income and wealth are all positively correlated with financial risk tolerance. However, even when all these factors are controlled for in a cross-sectional regression, country dummies that capture institutional and cultural background, remain highly significant for most of the 12 countries studied.

Furthermore, in a matched sample of Southern and Northern European households, the differences in levels of various financial risk tolerance measures remain statistically significant in both HFCS waves, suggesting that culture and institutions are significant factors in explaining the observed level differences in mutual fund ownership and stock market participation. In terms of the dynamics of risk tolerance over time, institutional convergence seems not to play a major role. Rather, macroeconomic conditions that change the distribution in the traditional covariates of risk tolerance in the population are what drives the changes in overall risk tolerance over time.

In the strictly balanced panel using the German PHF data, in a panel regression with fixed effects, it appears that household income and financial literacy are the only significant

correlates with subjective household willingness to take risk. Home ownership is the only significant correlate with stock market participation, suggesting that an investment into housing crowds out investments into the stock market. The non-significance of other factors like household size, education, and homeownership likely stem from very low variation in these variables across the panel waves. Furthermore, as the panel contains only German households, the factors that are significantly affecting willingness to take financial risk for these households may not have the same effect in other countries due to differences in cultural background.

All in all, the conducted analysis shows that by using household survey and especially household panel data new findings that contribute to the literature of financial risk tolerance can be obtained. With panel data over long periods and containing households of various cultures and living in different institutional set-ups it may be possible to quantify the importance of these aspects to the household investment choices and the impact crises and recessions have on financial risk tolerance, and provide further recommendations regarding improvements in financial literacy and provision of investment advice.

References

- Abadie, A.: 2005, Semiparametric Difference-in-Differences Estimators, *Review of Economic Studies*, 72, 1-19.
- Ampudia, M., Ehrmann, M.: 2014, Macroeconomic Experiences and Risk Taking of Euro Area Households, ECB Working Paper Series, No. 1652, March 2014.
- Austin, P.C.: 2011, Optimal Caliper Widths for Propensity-Score Matching when Estimating Differences in Means and Differences in Proportions in Observational Studies, *Pharmaceutical Statistics*, 10(2), 150-161.
- Bertaut, C.C.: 1998, Stockholding Behavior of US Households: Evidence from the 1983-1989 Survey of Consumer Finances, *Review of Economics and Statistics*, 80, 263-275.
- Campbell, J.Y.: 2006, Household Finance, *Journal of Finance*, 61(4), 1553-1604.
- Calvet, L.E., Sodini, P.: 2013, Twin Picks: Disentangling the Determinants of Risk-Taking in Household Portfolios, *Journal of Finance*, 62(2), 867-906.
- Cardak, B., McAllister, R., Sandy, S.: 2015, Do Lifetime Investment Experiences Affect Financial Risk Taking Behavior? Evidence from Australia. Paper presented at the 90th Annual Conference of the Western Economic Association International, Hawaii.
- Chaing, T-F., Xiao, J.J.: 2017, Household Characteristics and the Change of Financial Risk Tolerance During the Financial Crisis in the United States, *International Journal of Consumer Studies*, 41, 484-493.
- Chen, P., Finke, M.S.: 1996, Negative net worth and the life cycle hypothesis, *Financial Counseling and Planning*, 7(1), 87-96.
- Christelis, D., Georgarakos, D., Haliassos, M.: 2013, Differences in Portfolios across Countries: Economic Environment versus Household Characteristics, *Review of Economics and Statistics*, 95(1), 220-236.
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., Wagner, G.G.: 2011, Individual Risk Attitudes: Measurement, Determinants, and Behavioral Consequences, *Journal of the European Economic Association*, 9(3), 522-550.

ECB: 2008, Oversampling the wealthy: eye for an eye, euro for a euro, Household Finance and Consumption Network publication, available at <https://info.publicintelligence.net/Oversampling.pdf>.

Finke, M. S., Huston, S. J.: 2003, The brighter side of financial risk: Financial risk tolerance and wealth. *Journal of Family and Economic Issues*, 24(3), 233–256.

Gelman, A., Hill, J.: 2007, *Data Analysis using Regression and Multilevel/Hierarchical Models*, Cambridge University Press.

Grable, J.E.: 2016, Financial Risk Tolerance, in J.J. Xiao (eds.) *Handbook of Consumer Finance Research*, Springer.

Grable, J.E., Joo, S-H.: 2004: Environmental and Biopsychosocial Factors Associated with Financial Risk Tolerance, *Journal of Financial Counseling and Planning*, 15(1), 73-82.

Grable, J.E., Lytton, R.H.: 1998, Investor risk tolerance: Testing the efficacy of demographics as differentiating and classifying factors. *Financial Counseling and Planning*, 9, 61-73.

Grable, J.E., Park, J-Y., Joo, S-H.: 2009, Explaining Financial Management Behavior for Koreans Living in the United States, *Journal of Consumer Affairs*, Volume 43, Issue 1, 80-107.

Guiso, L., Jappelli, T., Terlizzese, D.: 1996, Income Risk, Borrowing Constraints, and Portfolio Choice, *American Economic Review*, 86, 158-172.

Hanna, S.D., Lindamood, S.: 2004, An Improved Measure of Risk Aversion, *Financial Counseling and Planning*, 15(2), 27-38.

Hoffman, A.O.I., Post, T., Pennings, J.M.E.: 2013, Individual Investor Perceptions and Behavior During the Financial Crisis, *Journal of Banking and Finance*, 37(1), 60-74.

Hu, X.: 2005, Portfolio choices for homeowners, *Journal of Urban Economics*, 58 (1), 114-136.

Hunter, D.R.: 2002, Risk Perception and Risk Tolerance in Aircraft Pilots, *FEDERAL AVIATION ADMINISTRATION WASHINGTON DC OFFICE OF AVIATION MEDICINE*, <http://www.dtic.mil/docs/citations/ADA407997>.

Irwin, C.E.: 1993, Adolescence and Risk Taking: How are they Related? In N.J. Bell & R.W. Bell (Eds.), *Adolescent Risk Taking*, Newbury Park, Ca: Sage.

Kennickell, A.B.: 2007, The Role of Over-sampling of the Wealthy in the Survey of Consumer Finances, The Federal Reserve, available from <https://www.federalreserve.gov/econresdata/scf/files/isi2007.pdf>.

Kogan, N., Wallach, M.A.: 1964, Risk Taking: A Study in Cognition and Personality, New York: Holt, Rinehart & Winston.

Layard, R., Nickell, S., Mayraz, G.: 2008, The marginal utility of income, *Journal of Public Economics*, 92, 1846-1857.

Lunt, M.: 2014, Selecting an Appropriate Caliper Can Be Essential for Achieving Good Balance With Propensity Score Matching, *American Journal of Epidemiology*, 179(2), 226-235.

Lusardi, A.: 2000, Saving for Retirement: the Importance of Planning, TIAA-CREF Institute, Issue n. 66.

Lusardi, A., Mitchell, O.S.: 2014, The Economic Importance of Financial Literacy: Theory and Evidence, *Journal of Economic Literature*, 52(1), 5-44.

Malmendier, U., Nagel, S.: 2011, Depression Babies: Do Macroeconomic Experiences Affect Risk Taking? *Quarterly Journal of Economics* 126(1), 373-416.

Okun, M.A.: 1976, Adult age and Cautiousness in Decision, *Human Development*, 19(4), 220-233.

Riley, W. B., Chow, K.V.: 1992, Asset Allocation and Individual Risk Aversion, *Financial Analysts Journal*, 48(6), 32-37.

Rubin, D.B: 1973, Matching to Remove Bias in Observational Studies, *Biometrics*, 29(1), 159-183.

Rubin, D.E: 1987, Multiple imputation for nonresponse in surveys. New York: Wiley.

Sahm, C.R.: 2012, How Much Does Risk Tolerance Change? *Quarterly Journal of Finance*, 2(4).

Shaw, K.: 1996, An Empirical Analysis of Risk Aversion and Income Growth, *Journal of Labor Economics*, 14, 626-653.

Shum, P., Faig, M.: 2006, What Explains Household Stock Holdings? *Journal of Banking and Finance*, 30, 2579-2597.

Snelbecker, G.E., Roszkowski, M.J., Cutler, N.E.: 1990, Investor's Risk Tolerance and Return Aspirations, and Financial Advisors' Interpretations: A Conceptual Model and Exploratory Data, *Journal of Behavioral Economics*, 19(4), 377-393.

Sung, J., & Hanna S.:1996, Factors related to risk tolerance, *Financial Counseling and Planning*, 7, 11-20.

Wang, C. & Hanna, S. D.: 2007, The risk tolerance and stock ownership of business owning households, *Financial Counseling and Planning*, 18(2), 3-18.

Wang, H. & Hanna, S.: 1997, Does risk tolerance decrease with age? *Financial Counseling and Planning*, 8 (2), 27-31.

Yao, R., Curl, A. L.: 2011, Do Market Returns Influence Risk Tolerance? Evidence from Panel Data, *Journal of Family Economic Issues*, 32(3), 532-544.

Yao, R., Gutter, M.S., Hanna, S.D.: 2005, The financial risk tolerance of Blacks, Hispanics and whites. *Financial Counseling and Planning*, 16 (1), 51-62.

Xiao, J. J. :1996, Effects of family income and life cycle stages on household financial asset ownership, *Financial Counseling and Planning*, 7, 21-30.

Zhou, Q., He, Q., Yuan, Y.: 2017, Does Residential Housing Crowd Out or Promote Households' Stock Investment? Evidence from China, *Emerging Markets Finance and Trade*, 53 (8), 1869-1893.

Appendix A

PHF Questions Regarding Financial Literacy

In the part of the study where PHF sample is used, financial literacy is measured using the three standard financial literacy questions (compound interest, inflation, diversification), and is used in a binary fashion, where a value of 1 is assigned to a household where FKP answered all the three financial literacy questions correctly, and 0 otherwise.

The survey questions employed are as follows:

Compound interest effect:

- *Let us assume you have a balance of € 100 in your savings account. This balance bears interest at an annual rate of 2%, and you leave it there for 5 years. What do you think: How high is your balance after 5 years? (**Higher than €102**; Exactly €102; Lower than €102; Don't know; Refuse to answer)*

Inflation:

- *Let us assume that the interest paid on your savings account is 1% per year and the inflation rate is 2% per year. What do you think: After a year, will you be able to buy just as much, more or less than today with the balance in your savings account? (Inflation) (More; Just as much; **Less than today**; Don't know; Refuse to answer)*

Diversification:

- *Do you agree with the following statement: "The investment in the stock of a single company is less risky than investing in a fund with stock in similar companies"? (Diversification) (I agree; **I do not agree**; Don't know; Refuse to answer)*