Effects of the financial crisis on household financial risky assets holdings: Empirical evidence from Europe

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ABSTRACT

The aim of this paper is to analyze the dynamic nature of holding financial risky assets by households before and after the 2008 financial crisis. We use data from Wave 2 (2006–2007) and Wave 4 (2010–2011) of the Survey of Health, Ageing and Retirement in Europe (SHARE), which cover the time periods before and after the 2008 financial crisis, respectively. Empirical evidence shows that households with higher net wealth, higher educational level, higher probability of receiving inheritance, better self-perceived health status, and more social activities tend to own risky assets in both waves. However, household size has significantly negative effect only in Wave 4. Overall, households are less inclined to hold risky assets after the financial crisis. The dynamic results reveal that households with increased net wealth between these two periods have stronger (weaker) association with holding of financial risky assets. Households with older respondent (aged over 65) are less likely to change their financial decisions regarding the owning of risky assets. However, highly-educated households exhibit two different financial behaviors, either increased or decreased probability of owning risky assets. We also find varying effects among countries.

1. Introduction

Investment behavior in household portfolio decisions is a very important issue especially in the face of financial shocks. Traditional financial theory assumes that people are completely rational, have unbiased expectations of future events, and make decisions based on maximum expected utility. Individual or group psychological and behavioral factors are completely ignored. However, based on the concepts of behavioral finance, behavior is driven by personal characteristics, personality, and psychology. Individuals may have the same or different perception of the interactions reflected in the financial market. Thus, it is interesting to examine whether household portfolio decisions regarding the holding of risky assets differ before and after the 2008 financial crisis.

The field of behavioral finance has its beginnings in the 1990s (Shiller, 2003). According to previous empirical studies on behavioral finance, decision making in terms of risk is affected by individuals' characteristics, risk preferences, and psychology

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(Kahneman & Tversky, 1979; Thaler, 1985, 1999; Thaler and Johnson, 1990). Kahneman and Tversky (1979) propose the prospect theory which states that investors are risk averse when there is sure gain, implying that people overweigh outcomes that are considered certain. However, investors demonstrate risk seeking preference for choices involving sure loss. Based on studies by Thaler (1985; 1999), mental accounting involves how outcomes are perceived and experienced, how decisions are made and subsequently evaluated; how the assignment of activities to specific accounts is made; and how the accounts are evaluated and choices connected. In addition, Thaler and Johnson (1990) find that if investors have prior gains from investment their willingness to accept financial risks increases, which is the so-called house money effect. However, there are two types of investment behavior when there are prior losses. One is to accept the higher risky component choice to overcome the prior losses, or the so-called break-even effect. The other is to decrease the risky investment choice, or the so-called snake-bite effect.

One branch of the literature focuses on the associations among holding of risky assets and demographic characteristics or monetary factors (income and net wealth) during a certain time period (Betermier et al., 2012; Brunetti et al., 2010; Cardak et al., 2009; Christiansen et al., 2010; Shum et al., 2006). More recent factors include cognitive abilities (Christelis et al., 2010) and self-perceived health status (Atella et al., 2012) in specific European countries. Some examples are studies on stock market expectations in the Netherlands (Hurd et al., 2011), self-declared risk aversion in Germany (Barasinska et al., 2012), risk aversion and mutual fund classes in Greece (Syriopoulos et al., 2002), and net wealth allocation in Spain (Mayordomo et al., 2014).

Another branch of research focuses on the relationship between the financial crisis and investment behaviors based on macro-level data from the US (Hoffmann et al., 2013; Mustafa et al., 2015), Southeast Asia (Thao et al., 2012), and Taiwan (Yu et al., 2010).[1] However, in the existing literature, micro-level data (individual or household) is rarely used (Guiso & Paiella, 2008). Based on household data, Guiso and Paiella (2008) examine how the changes in background risk affect the individual's absolute risk tolerance and the decision to hold risky assets.[2] The financial crisis can be regarded as a perceived increase in the background risk of households.[3] No studies examine how investment behaviors of owning risky assets change after the financial crisis in Europe, especially in terms of household data. Therefore, based on the study of Guiso and Paiella (2008), we expect that there exists a relationship between financial crisis and household financial risky asset holdings.

Given that the willingness to bear financial risk may change, due to the impact of the financial crisis of 2008, the aim of this paper is to analyze the dynamic nature of holding of financial risky assets by households during this event, based on panel data from the Survey of Health, Ageing and Retirement in Europe (SHARE). In this study, financial risky assets include stocks, shares, mutual funds mostly in stocks, and individual retirement accounts mostly in stocks, based on a study by Atella at al. (2012). We follow the same households in Wave 2 (2006–2007) and Wave 4 (2010–2011), as the survey periods of these two waves are before and after the financial crisis of 2008, respectively. This allows us to examine whether financial investment behavior changes during the financial crisis.

The main contributions of this study are summarized below. First, we analyze dynamic setting of owning financial risky assets before and after the 2008 financial crisis, with comparisons with prior research serving as the static framework, for the holding of financial risky assets (Atella et al., 2012; Christiansen et al., 2010) or investment portfolio (Barasinska et al., 2012). Second, we follow the dynamic setting of Liebenberg et al. (2012) and Heo et al. (2013), which focuses on the changes in life insurance holdings only, instead of financial risky assets. Finally, we analyze 12 European countries in SHARE database, which is an improvement over previous studies that focus on only one country. The SHARE database is generic and all questions are standardized across countries, allowing consistent international comparisons. We consider household data in SHARE, such as household demographic and monetary variables and country-level data, which may be indicators of the impact of the financial crisis.

Our empirical results indicate that households with higher net wealth, higher educational level, higher probability of receiving inheritance, better self-perceived health status, and more social activities tend to own risky assets both before (in Wave 2) and after (in Wave 4) the financial crisis. However, there is a significantly negative effect for household size only in Wave 4, which indicates the effect of financial crisis. In addition, households in countries with higher value of domestic credit for private sector (% of GDP) or lower unemployment rate (%) have higher probability of holding risky assets in both waves. However, we find that GDP per capita growth (%) has positive, while central government debt (% of GDP) has negative, associations with owning of risky assets only in Wave 4.

From the pooled data, we find a negative marginal effect in Wave 4 which implies that, ceteris paribus, households have less of an intention to hold risky assets after the financial crisis.[4] In addition, the results of interaction terms between some household variables and W4 dummy reveal that the increase in the probability of holding risky assets after the financial crisis is less pronounced for the households with higher net wealth, higher educational level, better self-perceived health status or more social activities. In addition, there are varying results for the impact of the financial crisis among 12 European countries by the interaction terms between each country dummy and W4 dummy. Our evidence shows that, after the financial crisis, the decreases in holding of risky assets are more pronounced among households in Germany, Sweden, Spain, and Denmark. In contrast, such decreases are less pronounced in three countries (the Netherlands, Switzerland and the Czech Republic).

By following the same households in Wave 2 and Wave 4, we examine how household decisions to hold risky assets change from

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[1] Some studies discuss the impact of the financial crisis on investor health in Spain (Gili et al., 2012) and Greece (Kentikelenis et al., 2011). These emphasize the effects of health instead of household investment behavior.

[2] Georgarakos and Pasini (2009) use data from the 1995 wave of the Survey of Household Income and Wealth, which is run by the Bank of Italy.

[3] We thank the referee who provided this comment.

[4] We thank the referee who provided this comment.

before to after the financial crisis based on detailed data from the SHARE database. We define four types of holding risky portfolio behaviors.[5] The first type is holding of risky assets in both waves, denoted RR. The second type is without holding of risky assets in both waves, denoted NN. We combine NN and RR into the "no change" group. The third type is holding of risky assets in Wave 2, but not in Wave 4, which we define as decrease in holdings of risky assets after the financial crisis and denote RN. The last type is an increase in holdings of risky assets after 2008, denoted NR and referring to the holding of risky assets in Wave 4 but not in Wave 2.

Based on the dynamic results of whole sample, households with increases (decreases) in net wealth after the financial crisis are more likely to be of NR (RN) type. Households with elderly respondent (aged over 65) are more likely to maintain portfolio composition. However, highly-educated households exhibit two types of financial behavior, either RN or NR, implying that they have different financial expectations based on the experience of the financial crisis. Households with changing social activities are more likely to show changing financial decisions and are either NR or RN.

In addition, GDP per capita growth change and unemployment rate change are positively related to RN and negatively related to no change group (NN & RR). In contrast, domestic credit changes and government debt change increase the probability of no change group (NN & RR) and decrease the probability of RN. Domestic credit changes are negatively related to NR.

Finally, our study provides new insights. Our empirical evidence implies that most investors have decreased risk tolerance following the 2008 financial crisis, affecting their incentive to purchase risky assets. In addition, we find that households in countries with higher value of domestic credit for private sector (% of GDP), lower unemployment rate (%) or higher GDP per capita growth (%) are positively associated with owning of risky assets in Wave 4. Thus, our empirical evidence may offer some policy implications for European governments. In general, governments implement quantitative easing to stimulate the economy in the short run when facing financial crisis. In the long run, governments might provide subsidies to higher productivity industries to improve the productivity of the overall economy and increase GDP per capita and decrease the unemployment rate. Higher economic growth drives the stable development of the financial market and builds confidence among investors in the stock market, especially in the wake of a financial crisis.[6]

This paper is organized as follows. The relevant literature is reviewed and hypotheses are developed in Section 2. We introduce the database, variables and descriptive statistics in Section 3. Section 4 includes an explanation of our methodological approach. Section 5 presents the empirical results. The conclusion is provided in Section 6.

2. Literature review and hypotheses development

2.1. Risky financial assets holding and portfolio choices

The issues regarding the decision to hold financial risky assets or the composition of financial portfolios are explored not only by focusing on economic and demographic factors, such as income, net wealth, gender and marital status (Betermier et al., 2012; Brunetti et al., 2010; Cardak et al., 2009; Christiansen et al., 2010; Shum et al., 2006), but also cognitive abilities (Christelis et al., 2010), stock market expectations (Hurd et al., 2011), health status (Atella et al., 2012), risk attitude (Barasinska et al., 2012; Syriopoulos et al., 2002) and housing restrictions (Mayordomo et al., 2014).

Based on Wave 1 of SHARE database (2004–2005), Christelis et al. (2010) examine the relationship between household stock-holdings and cognitive abilities and show that cognitive impairment negatively and significantly affects holdings of risky assets, especially in terms of mutual funds and retirement accounts. For the effects of demographic factors, households with higher education, higher income and wealth, good self-perceived health status, and that are socially active are strongly associated with the probability of becoming stockholders.

Using the same database as Christelis et al. (2010), Atella et al. (2012) focus on the correlation between health status and risky asset holdings across 10 European countries, some of which have a national health service (NHS) and some of which do not. The authors demonstrate the negative effects of current self-perceived health status and future health risks on holdings of risky assets in countries without NHS. They also find that both income and net wealth have positive correlations with risky asset holdings only in countries without NHS.

In the Netherlands, Hurd et al. (2011) investigate the relationship between Dutch household stock ownership and stock market expectations, including gains and losses, during the period 2004–2006. They conclude that households with higher rates of return tend to own more risky assets. In contrast, if households perceive higher risk in rates of return, they are less likely to invest in stocks.

Barasinska et al. (2012) arrange various types of financial assets into three levels of riskiness in Germany. Different combinations of financial assets are classified based on diversity of assets in portfolios. When household self-declared risk aversion increases, the types of assets in portfolios decrease. A reasonable explanation for under-diversified portfolios, consisting of safe assets only, is that safe and liquid assets are a "buffer" against low income periods. Hence, risk-averse people tend to reduce their holdings of relatively risky or risky assets to protect their net wealth.

By using price shifts as a signal of shifting risk aversion among Greek investors, Syriopoulos et al. (2002) examine how risk aversion attitude affects the demand for mutual funds, including equity, bond, balanced and money market funds. Their empirical results show that increased household expenditure has a positive impact on asset allocation to the fund classes, specifically equity and money market funds. In addition, equity fund is the most price-sensitive asset class. In contrast, money market funds have lower price elasticity.

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[5] In our paper, we only observe whether households hold financial risky assets in Wave 2 and Wave 4. We do not examine the value of these financial risky assets.

[6] Mankiw and Zeldes (1991) find that the aggregate consumptions of stockholders and nonstockholders differ. Stockholder consumption is more volatile and stronger with excess equity returns from the stock market. These differences help explain the equity premium.

Table 1

List of variables.

Dependent Variables		Description
	Holding risky assets	Dummy variable that represents the household's probability of holding risky assets. Its value is 1 for holding of any type of risky asset and 0 otherwise. Risky assets include stocks or shares or mutual funds mostly in stocks or individual retirement accounts mostly in stocks (as063_ = 1; or as019_ = 1; or as023_ = 1), based on Atella at al. (2012). Source: SHARE database.
	Δ Holding Risky Assets	Change in holding of risky assets by a household. It is a category variable that equals 0, 1 and 2 for no change, decrease and increase, respectively. The first type is holding of risky assets in both waves, denoted RR. The second type is not holding risky assets in either wave, denoted NN. We combine NN and RR into the "no change" group. The third type is holding risky assets in Wave 2 but not in Wave 4, which we define as households that decrease holdings of risky assets after the financial crisis and denote RN. The last type is increasing holdings of risky assets after 2008, denoted NR, holding risky assets in Wave 4 but not in Wave 2. Source: SHARE database.
Independent variables		
Household data	Income	Total household income version B (thinc2) obtained from the one-shot question on total household yearly income. Source: SHARE database.
	ln_income	Natural log of household income. Source: SHARE database.
	Δ Income	Difference in total household income between Wave 2 and Wave 4 for each respondent, equal to total household income of Wave 4 minus total household income of Wave 2. It equals 1 if the change is positive and 0 if the change is negative. Source: SHARE database.
	Net wealth	The sum of the financial and real assets of the household (including the value of owned property) net of financial liabilities (hnetw). Source: SHARE database.
	ln_net wealth	Natural log of household net wealth. Source: SHARE database.
	Δ Net wealth	Difference in household net worth between Wave 2 and Wave 4 for each respondent, equal to household net worth in Wave 4 minus household net worth in Wave 2. Its value is 1 if positive and 0 otherwise. Source: SHARE database.
	Pension	Annual old age & early retirement pensions (ypen1). Source: SHARE database.
	ln_pension	Natural log of household pension. Source: SHARE database.
	Δ Pension	Difference in annual old age & early retirement pensions between Wave 2 and Wave 4 for each respondent, equal to annual old age & early retirement pensions in Wave 4 minus annual old age & early retirement pensions in Wave 2. It equals 1 if the above subtraction is greater than 0 and 0 if the subtraction is less than 0. Source: SHARE database.
	Prob. of inheritance	Over the next 10 years, the probability that the respondent will receive any inheritance, including property and other valuables (0–100 percent). Source: SHARE database.
	Δ Prob. of inheritance	Difference in the probability of receiving inheritance, including property and other valuables, for each respondent between Wave 2 and Wave 4. Its value is 1 if the change in probability of receiving inheritance is positive and 0 otherwise. Source: SHARE database.
	Age ≥65	It is a dummy variable that takes the value of 1 if age of respondent in the year when the interview took place (age) is higher than 65, and 0 otherwise. Source: SHARE database.
	Marital status	Based on the question: "What is your marital status?" Answers: 1. Married and living together with spouse; 2. Registered partnership; 3. Married, and living separated from spouse; 4. Never married; 5. Divorced; 6. Widowed. We define married individuals by combining the first three choices into married status (mstat). In our study, it is a category variable with values of 1–4 (1 = never married; 2 = married; 3 = divorced and 4 = widowed). Source: SHARE database.
	Δ Marital status	Change in respondent's marital status; in which 0 represents no change, 1 change from never married to married, 2 change from married to divorced and 3 change from married to widowed. Source: SHARE database.

Independent Variables		Description
Household data (cont')	Household size	The total number of members of the household calculated by the sum of children and parents. For the households in which marital status is married, plus 2; in other cases (never married/divorced/widowed), plus 1 for each child (nchild). Source: SHARE database.
	Δ Household size	Change in household size after the financial crisis of 2008. Source: SHARE database.
	Education	Based on Atella et al. (2012), education is defined as the completed years of education of respondent (yedu). Source: SHARE database.
	Self-perceived health (*Good*⁺)	Dummy variable that is of value 1 if respondent's self-perceived health is at least good, and 0 otherwise (sphus). Source: SHARE database.
	Δ Self-perceived health (*Good*⁺)	Change in self-perceived health. No change, decrease and increase through the financial crisis are represented by the values 0, 1 and 2, respectively. Source: SHARE database.
	Social activities	Dummy variable of value 1 if respondent has attended sport, social or other kinds of clubs in the last month of Wave 2 and in the last year of Wave 4, and 0 otherwise (ac002d5 and ac035d5). Source: SHARE database.
	Δ Social activities	Change in social activities. No change, decrease and increase through the financial crisis are represented by the values 0, 1 and 2, respectively. Source: SHARE database.
	Country dummy	Category variable representing the country of respondent. Source: SHARE database.
Country-level data	GDP per capita growth (%)	Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 US dollars. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. We take the average values in both periods 2006–2007 and 2010–2011 to be consistent with other variables in our sample. Source: World Bank database.
	GDP per capita growth change	The absolute value of difference in GDP per capita growth in each country before and after the financial crisis of 2008. Source: World Bank database.
	Domestic credit (% GDP)	Domestic credit to private sector refers to annual financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, trade credits and other

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Table 1 (*continued*)

Independent Variables		Description
		accounts receivable, that establish a claim for repayment. We take the average values in both periods 2006–2007 and 2010–2011 to be consistent with other variables in our sample. Source: World Bank database.
	Domestic credit change	The absolute value of difference in domestic credit for private sector in each country before and after the financial crisis of 2008. Source: World Bank database.
	Unemployment rate (% labor force)	Unemployment rate is defined as the annual share of the labor force that is without work but available for and seeking employment. We take the average values in both periods 2006–2007 and 2010–2011 to be consistent with other variables in our sample. Source: World Bank database.
	Unemployment rate change	The absolute value of difference in unemployment rate in each country before and after the financial crisis of 2008. Source: World Bank database.
	Government debt (% GDP)	The total annual central government debt of each country, calculated by percentage of GDP in the same year. We take the average values in both periods 2006–2007 and 2010–2011 to be consistent with other variables in our sample. Source: OECD database.
	Government debt change	The absolute value of difference in central government debt in each country before and after the financial crisis of 2008. Source: OECD database.

Mayordomo et al. (2014) analyze the differences in composition between theoretically optimal and actual portfolios in Spain. In an optimal portfolio, instead of only two assets (liquid and illiquid), households make investment decisions based on four types of assets, including stocks, deposits, mortgage, and housing. The empirical evidence shows that the household actual portfolio includes less in stocks and deposits while the optimal and actual average investments in mortgage are similar. The authors indicate that such households are headed by a person who is financially sophisticated, older and retired. They also find greater participation in risky assets classes among wealthy households.

Based on the review of the above literature, our hypothesis is as follows:

Hypothesis 1.   Households with higher educational level, higher income and net wealth, better self-perceived health status, and that are more socially active are more likely to own financial risky assets.

2.2. Financial crisis

Many studies directly analyze investor behavior during the financial crisis (Hofmann et al., 2013; Mustafa et al., 2015; Yu et al., 2010). Based on attention-grabbing factors, Yu et al. (2010) investigate different categories of investors with dissimilar trading patterns and conclude that there is a decrease in the buying of riskier assets during a financial crisis when compared with other periods. Mustafa et al. (2015) analyze the flight-to-quality behavior during the period of sharply negative stock market returns, with approximately 200% volatility, in 2008. They report that investors become more risk averse, shifting from stocks to corporate bonds, during a global financial crisis.

Table 2
Summary statistics of household data.

Item	(1) Wave 2 (2006–2007) N₂ = 9618 (100%)				p-value	(2) Wave 4 (2010–2011) N₄ = 9618 (100%)				p-value
	Holding risky assets (RA) N₂ = 2236 (23.25%)		No risky assets N₂ = 7382 (76.75%)			Holding risky assets (RA) N₄ = 1965 (20.43%)		No risky assets N₄ = 7653 (79.57%)		
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)	
Income	45.33	(64.47)	40.52	(64.57)	0.002*	37.76	(49.71)	31.64	(49.38)	0.000*
Net wealth	413.91	(508.20)	200.60	(283.84)	0.000*	427.92	(522.96)	199.16	(313.24)	0.000*
Pension	6.50	(10.31)	7.13	(12.38)	0.028*	10.12	(21.27)	9.68	(17.54)	0.349*
Prob. of inheritance	24.36	(37.19)	12.95	(28.26)	0.000*	24.95	(37.48)	13.15	(28.49)	0.000*
Age ≥ 65	0.40	(0.49)	0.51	(0.50)	0.000*	0.59	(0.49)	0.66	(0.48)	0.000*
Marital status					0.000&					0.000&
Married	0.71	(0.45)	0.57	(0.49)		0.69	(0.46)	0.55	(0.50)	
Never married	0.07	(0.25)	0.08	(0.27)		0.07	(0.25)	0.07	(0.27)	
Divorced	0.09	(0.29)	0.11	(0.31)		0.10	(0.30)	0.11	(0.31)	
Widowed	0.13	(0.33)	0.24	(0.43)		0.14	(0.35)	0.27	(0.44)	
Household size	3.80	(1.41)	3.76	(1.61)	0.233*	3.77	(1.35)	3.74	(1.62)	0.533*
Education	13.09	(3.90)	10.21	(4.25)	0.000*	13.13	(3.90)	10.31	(4.28)	0.000*
Self-perceived health (*good*⁺)	0.81	(0.39)	0.64	(0.48)	0.000&	0.78	(0.42)	0.60	(0.49)	0.000&
Social activity	0.38	(0.49)	0.20	(0.40)	0.000&	0.47	(0.50)	0.26	(0.44)	0.000&

Note: In our sample, there are 15 countries in Wave 2 and 16 countries in Wave 4. We focus on the same respondents in both waves for each country. Thus, we delete 3 countries (Greece, Israel, and Ireland) in Wave 2 and 4 countries (Hungary, Portugal, Slovenia, and Estonia) in Wave 4. Monetary amounts are PPP-adjusted and in thousand Euros. *t-test; & Chi-square test.

Table 3

Descriptive statistics for changing variables of household data.

Variable	Mean (SD)	N₂₄ = 9618	%	Variable	Mean (SD)	N₂₄ = 9618	%
Change in holding of risky assets				Change in prob. of inheritance			
Decreased holding (RN)	–	867	9.01	No change	–	9599	99.80
No change (NN)	–	6786	70.6	Negative change	–	13	0.14
No change (RR)	–	1369	14.2	Positive change	–	6	0.06
Increased holding (NR)	–	596	6.20	Change in household size			
				No change	–	8671	90.15
Age ≥ 65 Wave 2	0.48 (0.50)	–	–	Negative change	–	614	6.38
Education (years) Wave 4	10.88 (4.35)	–	–	Positive change	–	333	3.46
				Change in marital status			
Change in income				No change	–	9284	96.53
No change	–	0	0	from Never Married to Married	–	49	0.51
Negative change	–	4897	50.91	from Married to Divorced	–	28	0.29
Positive change	–	4721	49.09	from Married to Widowed	–	257	2.67
Change in net wealth				Self-perceived health (*Good*⁺)			
No change	–	31	0.32	No change	–	7305	75.95
Negative change	–	4886	50.80	Increasing	–	943	9.80
Positive change	–	4701	48.88	Decreasing	–	1370	14.24
Change in pension				Social activities			
No change	–	2699	28.06	No change	–	7417	77.12
Negative change	–	2228	23.16	Increasing	–	1371	14.25
Positive change	–	4691	48.77	Decreasing	–	830	8.63

Note: In our sample, there are 15 countries in Wave 2 and 16 countries in Wave 4. We only focus on the same respondents in both waves for each country. Thus, we analyze 12 countries in our sample by deleting 3 countries (Greece, Israel, and Ireland) in Wave 2 and 4 countries (Hungary, Portugal, Slovenia, and Estonia) in Wave 4.

Guiso and Paiella (2008) examine the relationship between risk aversion and wealth and find that the index of absolute risk aversion is a decreasing function of the endowment. They also show that when risk cannot be avoided or there is no insurance against background risks, individuals are more risk averse and hold fewer or no risky assets. An increase in a single standard deviation of background risk lowers absolute risk tolerance by about 19%.

In contrast, Hoffmann et al. (2013) examine how investor perceptions, represented by risk tolerance, risk perceptions and return expectations, change. Such changes drive stock trading trends and risk-taking behavior in the period 2008–2009. They find that even return expectations and risk tolerance of investors go down while risk perception rises during the worst months of the crisis. Subsequently, investor perceptions completely recover at the end of 2009. Hence, investors continue to trade in risky assets during the financial crisis. Our second hypothesis regarding the effects of the financial crisis on the probability of holding risky assets is as follows:

Hypothesis 2. After the financial crisis, the correlations between household variables, including net wealth, educational level, self-perceived health status and social activities, and the probability of holding risky assets are weaker but still positive and significant.

2.3. Dynamic analysis

Two previous studies use dynamic framework to analyze life insurance demand.[7] Liebenberg et al. (2012) focus on the effects of life events, such as marital status change, having a child or becoming unemployed, on life insurance demand in the US from 1983 to 1989. Evidence shows that parenthood is associated with increased holding of term insurance, while becoming unemployed is associated with surrender of whole life insurance. Similarly, Heo et al. (2013) investigate the changes in life insurance consumption of US households based on four factors: net wealth, income, household size and marital status for the period 2004–2008. They conclude that households with an increase in net wealth are more likely to increase life insurance consumption. Nevertheless, these two dynamic analyses do not cover change in financial risky holdings or impact of financial shock.

In our dynamic setting model, we examine changes in financial risky holdings between Wave 2 (2006–2007) and Wave 4 (2010–2011), based on household survey data from the SHARE panel study. Following the findings of Heo et al. (2013) that a positive relationship exists only between household net wealth and life insurance consumption, we anticipate a significant association between household net wealth and stockholdings. Thus, our third hypothesis is as follows:

Hypothesis 3. Change in asset holdings is mainly related to change in net wealth.

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[7] Life insurance is defined as fairly-safe asset in Atella et. al (2012).

Table 4
Summary statistics of country-level data.

Country	(1) 2006–2007 period (Wave 2)					(2) 2010–2011 period (Wave 4)					(3) % changes [(Wave 4 – Wave 2)/Wave 2]				
	% HRA	GDP capita growth	Domestic credit	Unemployment rate	Government debt	% HRA	GDP capita growth	Domestic credit	Unemployment rate	Government debt	% HRA	GDP capita growth	Domestic credit	Unemployment rate	Government debt
Austria	7.5	3.17	93.68	5.43	59.1	7.5	2.08	97.29	4.69	65.8	0.00	−0.34	0.04	−0.14	0.11
Germany	21.17	3.61	99.16	10.71	40.4	16.82	4.92	86.28	6.39	44.4	-4.35	0.36	−0.13	−0.40	0.10
Sweden	61.74	3.37	107.55	7.36	39.3	54.98	3.49	125.40	8.17	33.8	-6.76	0.04	0.17	0.11	−0.14
Netherlands	21.76	3.41	114.51	4.31	38.4	18.10	1.04	115.44	4.71	51.8	-3.66	−0.70	0.01	0.09	0.35
Spain	4.86	2.15	161.62	8.80	31.5	3.53	−0.90	168.74	20.63	51.7	-1.33	−1.42	0.04	1.34	0.64
Italy	7.05	1.33	79.02	7.26	96.55	5.82	0.89	94.08	8.36	109	-1.23	−0.33	0.19	0.15	0.13
France	20.08	1.70	86.54	8.47	52.1	18.89	1.52	96.36	8.84	67.4	-1.19	−0.10	0.11	0.04	0.29
Denmark	49.72	2.02	176.77	4.37	30.25	42.59	1.17	190.14	7.52	39.6	-7.13	−0.42	0.08	0.72	0.31
Switzerland	28.91	3.26	155.49	4.22	24.2	28.12	1.25	158.94	4.61	20.2	-0.79	−0.62	0.02	0.09	−0.17
Belgium	26.40	2.26	66.88	8.34	86.45	21.44	1.10	55.73	7.71	96.8	-4.96	−0.51	−0.17	−0.08	0.12
Czech Republic	8.82	5.78	36.45	7.54	25.05	10.69	1.77	47.68	7.00	36.6	1.87	−0.69	0.31	−0.07	0.46
Poland	1.73	6.67	34.16	15.80	43.85	1.33	4.43	50.07	9.64	49.7	- 0.4	−0.34	0.47	−0.39	0.13

Note: (1) HRA (%) is Percentage of Holding Risky Assets in each country from SHARE database; (2) the source of GPD per capita growth (%), Domestic credit for private sector (% of GDP) and Unemployment rate (% of force labor) are from the World Bank database; (3) Central Government debt (% of GDP) data is from OECD database; (4) the order of the 12 countries follows the numerical order of SHARE database.

3. Data and variables

3.1. Data

In this study, we explore the changes in household behavior in terms of holding of risky assets through the financial crisis. Our analysis is based on households that participated in both Wave 2 (2006–2007) and Wave 4 (2010–2011) of SHARE, as these two waves represent the periods before and after this event, respectively. SHARE is a European database that provides detailed information on financial assets, investment behavior and demographics of respondents obtained during face-to-face interviews. In addition to the household data from SHARE, we use four country-level variables: GDP per capita growth, domestic credit and unemployment rate from the World Bank database and government debt from the OECD database.

Many previous papers use SHARE data to analyze household investment decisions or portfolio choices (Atella et al., 2012; Christelis et al., 2010). To improve the accuracy, missing values of variables are dropped. Most of the data is collected at the individual level, with analyses carried out based on information from household financial respondents. SHARE provides detailed information for one-person and multi-person households.

There are 13 countries included in Wave 2 and 16 countries included in Wave 4. Since our research focus is on how European households change their financial decisions, especially holding of risky assets, we only include those households with participation in both Wave 2 and Wave 4. In other words, we ignore households with participation only in Wave 2 or Wave 4. Our sample consists of 9618 household observations from 12 countries: Denmark, Sweden, Austria, Belgium, France, Germany, the Netherlands, Switzerland, Poland, the Czech Republic, Italy, and Spain.

3.2. Variables

We set up the dependent variable *binary for holding risky assets*, in which risky assets are defined as stocks or shares, mutual funds mostly in stocks, and individual retirement accounts mostly in stocks, following the research of Atella et al. (2012). For dynamic

Table 5
Summary statistics of household financial behavior types.

Item	(1) Wave 2 (2006–2007) N = 9618 (100%)								p-value
	NN n = 6786 (70.56%)		RR n = 1369 (14.23%)		RN n = 867 (9.01%)		NR n = 596 (6.20%)		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	
Income	40.08	(64.21)	46.54	(63.93)	43.42	(65.32)	45.52	(68.44)	0.0021*
Net wealth	189.69	(265.78)	455.16	(580.39)	348.77	(357.07)	324.87	(420.85)	0.0000*
Pension	7.10	(12.13)	6.23	(10.42)	6.91	(10.12)	7.43	(14.93)	0.0724*
Prob. of inheritance	12.12	(27.38)	26.09	(38.33)	21.61	(35.17)	22.41	(35.51)	0.0000*
Age $\geq$ 65	0.52	(0.50)	0.39	(0.49)	0.41	(0.49)	0.39	(0.49)	0.0000*
Marital status									0.000&
Married	0.57	(0.50)	0.75	(0.44)	0.67	(0.47)	0.63	(0.48)	
Never married	0.08	(0.27)	0.07	(0.25)	0.07	(0.26)	0.069	(0.25)	
Divorced	0.10	(0.31)	0.08	(0.28)	0.10	(0.30)	0.12	(0.33)	
Widowed	0.25	(0.43)	0.10	(0.31)	0.16	(0.37)	0.17	(0.38)	
Household size	3.77	(1.62)	3.83	(1.34)	3.76	(1.51)	3.69	(1.40)	0.2850*
Education	10.00	(4.22)	13.38	(3.89)	12.64	(3.88)	12.57	(3.85)	0.0000*
Self-perceived health (*good*[+])	0.63	(0.48)	0.82	(0.38)	0.79	(0.41)	0.77	(0.42)	0.000&
Social activity	0.19	(0.39)	0.38	(0.49)	0.37	(0.48)	0.31	(0.46)	0.000&

Item	(2) Wave 4 (2010–2011) N = 9618 (100%)								p-value
	NN n = 6786 (70.56%)		RR n = 1369 (14.23%)		RN n = 867 (9.01%)		NR n = 596 (6.20%)		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	
Income	30.80	(48.51)	38.31	(46.38)	38.22	(55.28)	36.50	(56.66)	0.0000*
Net wealth	185.01	(301.47)	459.36	(564.69)	309.85	(375.63)	355.69	(402.61)	0.0000*
Pension	9.46	(16.80)	9.40	(18.84)	11.43	(22.46)	11.76	(25.95)	0.0009*
Prob. of inheritance	12.07	(27.34)	26.05	(38.26)	21.61	(35.17)	22.41	(35.51)	0.0000*
Age $\geq$ 65	0.67	(0.47)	0.60	(0.49)	0.58	(0.49)	0.57	(0.50)	0.0000*
Marital status									0.000&
Married	0.54	(0.50)	0.72	(0.45)	0.65	(0.48)	0.61	(0.49)	
Never married	0.08	(0.27)	0.07	(0.25)	0.07	(0.26)	0.07	(0.25)	
Divorced	0.11	(0.31)	0.09	(0.28)	0.10	(0.30)	0.12	(0.33)	
Widowed	0.28	(0.45)	0.12	(0.33)	0.18	(0.38)	0.20	(0.40)	
Household size	3.74	(1.63)	3.81	(1.34)	3.74	(1.55)	3.67	(1.38)	0.3254*
Education	10.01	(4.23)	13.37	(3.90)	12.64	(3.89)	12.57	(3.85)	0.0000*
Self-perceived health (*good*[+])	0.58	(0.50)	0.80	(0.40)	0.75	(0.43)	0.73	(0.45)	0.000&
Social activity	0.23	(0.42)	0.50	(0.50)	0.43	(0.50)	0.41	(0.49)	0.000&

Note: (1) NN (RR) is without (with) risky assets in both waves; RN (NR) is with (without) risky assets in Wave 2 and without (with) risky assets in Wave 4; (2) Monetary amounts are PPP-adjusted and in thousand Euros. *t*-test; & Chi-square test.

Table 6
Correlation coefficients of variables.

Wave 2 (2006–2007)		A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2	L2	M2	N2	O2
Risky assets	**A2**	1.00														
Income	**B2**	0.14*	1.00													
Net wealth	**C2**	0.29*	0.25*	1.00												
Pension	**D2**	−0.07*	−0.09*	−0.05*	1.00											
Prob. of inheritance	**E2**	0.16*	0.14*	0.17*	−0.26*	1.00										
Age ≥65	**F2**	−0.09*	−0.16*	−0.11*	0.65*	−0.32*	1.00									
Marital status	**G2**	−0.12*	−0.19*	−0.23*	0.27*	−0.13*	0.24*	1.00								
Household size	**H2**	0.01	0.04*	0.05*	−0.04*	−0.01	0.03*	−0.16*	1.00							
Education	**I2**	0.28*	0.19*	0.22*	−0.13*	0.22*	−0.26*	−0.13*	−0.07*	1.00						
Self-perceived health	**J2**	0.16*	0.16*	0.20*	−0.07*	0.15*	−0.14*	−0.09*	−0.02*	0.23*	1.00					
Social activities	**K2**	0.17*	0.08*	0.13*	0.01	0.10*	−0.04*	−0.02	−0.00	0.18*	0.15*	1.00				
GDP per capita growth	**L2**	−0.10*	−0.23*	−0.28*	−0.08*	−0.11*	−0.05*	0.04*	0.04*	0.03*	−0.13*	−0.09*	1.00			
Domestic credit	**M2**	0.20*	0.13*	0.17*	−0.07*	0.11*	0.02	−0.04*	0.00	0.05*	0.15*	0.17*	−0.49*	1.00		
Unemployment rate	**N2**	−0.18*	−0.20*	−0.18*	−0.04*	−0.11*	−0.01	0.00	0.05*	−0.11*	−0.21*	−0.21*	0.51*	−0.61*	1.00	
Government debt	**O2**	−0.11*	0.08*	0.08*	0.11*	0.01	0.04*	−0.03*	−0.02	−0.14*	−0.03*	−0.10*	−0.46*	−0.43*	0.12*	1.00
Wave 4 (2010–2011)		**A4**	**B4**	**C4**	**D4**	**E4**	**F4**	**G4**	**H4**	**I4**	**J4**	**K4**	**L4**	**M4**	**N4**	**O4**
Risky assets	**A4**	1.00														
Income	**B4**	0.17*	1.00													
Net wealth	**C4**	0.28*	0.28*	1.00												
Pension	**D4**	−0.04*	−0.09*	−0.03*	1.00											
Prob. of inheritance	**E4**	0.15*	0.17*	0.18*	−0.22*	1.00										
Age ≥65	**F4**	−0.06*	−0.19*	−0.11*	0.61*	−0.31*	1.00									
Marital status	**G4**	−0.11*	−0.23*	−0.25*	0.21*	−0.13*	0.21*	1.00								
Household size	**H4**	0.01	0.09*	0.04*	−0.04*	−0.00	0.02	−0.16*	1.00							
Education	**I4**	0.26*	0.24*	0.25*	−0.08*	0.22*	−0.22*	−0.13*	−0.06*	1.00						
Self-perceived health	**J4**	0.15*	0.16*	0.20*	−0.05*	0.15*	−0.16*	−0.11*	−0.01	0.23*	1.00					
Social activities	**K4**	0.19*	0.13*	0.17*	0.01	0.12*	−0.06*	−0.06*	−0.01	0.21*	0.19*	1.00				
GDP per capita growth	**L4**	0.07*	−0.02*	−0.14*	−0.01	−0.02*	−0.01	0.00	0.01	0.15*	−0.05*	−0.02*	1.00			
Domestic credit	**M4**	0.19*	0.13*	0.10*	−0.12*	0.09*	0.02	−0.05*	0.02	0.01	0.11*	0.14*	−0.39*	1.00		
Unemployment rate	**N4**	−0.11*	−0.10*	0.05*	−0.09*	−0.06*	0.02	−0.02	0.04*	−0.26*	−0.12*	−0.15*	−0.37*	0.23*	1.00	
Government debt	**O4**	−0.17*	−0.06*	0.08*	0.11*	−0.01	0.01	−0.02*	−0.01	−0.16*	−0.06*	−0.09*	−0.32*	−0.43*	0.07*	1.00

analysis, we identify four categories of change behavior in holding of risky assets before and after the financial crisis: RR, NN, RN, and NR.

There are three main independent monetary variables in our model, *household income, net wealth* and *pension*. Monetary variables are adjusted by purchasing power parity (PPP) among countries (Atella et al., 2012; Christelis et al., 2010). In addition, the variable of *Probability of inheritance* involves all financial sources that households may treat as a hedge for their investment portfolios. Social and demographic characteristics of respondents are analyzed by setting up control variables for age, marital status, household size, education, self-perceived health and occupation. In addition, we consider four country-level variables: *GDP per capita growth, Domestic credit, Unemployment rate*, and *Government debt* to reflect the effects of financial crisis. These are treated as control variables. The definitions of all variables are shown in Table 1.

Table 7
Marginal effects of probit models and fixed effects models of holding risky assets.

Dep. Var: Binary for holding risky assets	(1) Cross-sectional data Probit models (N = 9618)		(2) Pooled data (Wave 2 + Wave 4) Fixed effects models (N = 19,236)					
	Wave 2	Wave 4	(1)	(2)	(3)	(4)	(5)	(6)
ln (income)	0.004	0.007	−0.005	−0.005	−0.005	−0.005	−0.005	−0.005
	(0.005)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
ln (net wealth)	0.067***	0.065***	0.019***	0.022***	0.019***	0.019***	0.019***	0.019***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ln (pension)	0.001	0.002	−0.006	−0.005	−0.005	−0.005	−0.005	−0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Prob. of inheritance	0.001***	0.001***	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.00)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age ≥ 65	0.008	0.014	0.006	0.007	0.006	0.007	0.007	0.007
	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Marital status (ref: Never married)								
Married	0.029*	0.025	−0.098	−0.095	−0.097	−0.092	−0.099	−0.096
	(0.017)	(0.016)	(0.119)	(0.119)	(0.119)	(0.119)	(0.119)	(0.118)
Divorced	−0.008	0.005	−0.105	−0.104	−0.105	−0.099	−0.107	−0.103
	(0.019)	(0.018)	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)
Widowed	−0.016	0.001	−0.065	−0.063	−0.064	−0.061	−0.069	−0.065
	(0.018)	(0.016)	(0.119)	(0.119)	(0.119)	(0.119)	(0.119)	(0.119)
Household size	−0.005	−0.006**	0.005	0.005	0.005	0.005	0.005	0.005
	(0.003)	(0.003)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Education (years)	0.016***	0.011***	−0.001	−0.001	−0.001	0.001	−0.000	−0.001
	(0.001)	(0.001)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Self-perceived health (*Good*+)	0.033***	0.030***	−0.003	−0.003	−0.004	−0.003	0.009	−0.003
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.008)
Social activities	0.059***	0.054***	0.015*	0.016*	0.015*	0.016*	0.016*	0.037***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)
GDP per capita growth	0.007	0.030***	−0.009***	−0.008**	−0.009***	−0.009***	−0.009***	−0.009***
	(0.007)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Domestic credit	0.001***	0.001***	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment rate	−0.012***	−0.008***	−0.002*	−0.002	−0.002**	−0.002**	−0.002	−0.002
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Government debt	−0.001	−0.001**	0.001*	0.001**	0.001*	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Wave 4 dummy	–	–	−0.052***	−0.021	−0.049***	−0.021	−0.035***	−0.038***
			(0.008)	(0.015)	(0.010)	(0.014)	(0.011)	(0.009)
Wave 4*ln (net wealth)	–	–	–	−0.006**	–	–	–	–
				(0.003)				
Wave 4*ln (pension)	–	–	–	–	−0.002	–	–	–
					(0.004)			
Wave 4*education	–	–	–	–	–	−0.003***	–	–
						(0.001)		
Wave 4*self-perceive health (*Good*+)	–	–	–	–	–	–	−0.022**	–
							(0.010)	
Wave 4*social activities	–	–	–	–	–	–	–	−0.040***
								(0.011)

Note: Monetary amounts are PPP-adjusted and in thousand euros. Standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. All empirical values are presented according to the structure Coef. (SE). We do not consider w4_dummy*ln(income) as the VIF value of this interaction term as it is greater than 10. We do not analyze the interaction term between Wave 4 and probability of receiving inheritance or household size for no change households as these two variables are 99.80% and 90.15%, respectively, after the financial crisis of 2008.

3.3. Summary statistics

Table 2 shows the summary statistics and mean *t*-test results for all variables of households for the whole sample. Among the 9618 households, the probability of holding risky assets decreases from 23.25% in Wave 2 (2006–2007) to 20.43% in Wave 4 (2010–2011). This suggests that households tend to reduce their holdings of risky assets after the financial crisis in 2008.

For the monetary variables (income, net wealth, and pension), the means of income and net wealth for the households with risky assets are greater than those for the households without risky assets in both waves, especially net wealth. The mean net wealth of the households with risky assets, 413.91 (427.92) thousand Euros, is twice as high as that of the households without risky assets, 200.60 (199.16) thousand Euros, in Wave 2 (Wave 4). In addition, among the households with risky assets, mean income decreases while net wealth increases from Wave 2 to Wave 4. This can be explained as more assets lead to acceptance of greater risks even after a dangerously volatile financial crisis.

Higher probability of receiving inheritance leads to higher probability of holding risky assets. Households that own stocks have 24.36% and 24.95% probabilities of receiving inheritance before and after the financial crisis, respectively, while households that do not own stocks have 12.95% and 13.15% probabilities of receiving inheritance, respectively.

Furthermore, households with risky assets tend to have respondent with over 13 years of education on average, while households without risky assets tend to have respondent with just over 10 years of education on average in both waves. This implies that households with higher level of education are more likely to invest in stocks.

Marital status may also affect the decision to hold risky assets. Married respondents tend to invest in risky assets, while widowed respondents do not. Among households holding risky assets, 71% have married respondent in Wave 2 and 69% have married respondent in Wave 4. This is compared to 57% and 55% for households without risky assets in Wave 2 and Wave 4, respectively. In contrast, households with risky assets are 13% and 14% more likely to have a widowed respondent before and after the financial crisis, respectively, while households without risky assets are 24% and 27% more likely to have a widowed respondent before and after the financial crisis, respectively.

Table 3 presents the descriptive statistics for household variables through the financial crisis. Most households show no change in the financial decision to hold risky assets, such as type NN (70.6%) and type RR (14.2%). However, the percentage of RN households (9.01%) is higher than that of NR households (6.2%). For the independent variables, there are two opposing trends. Monetary variables such as household income and net wealth show either significant decrease or increase (over 99% of the households in the sample) and most households receive a pension (over 71% of the households in the sample). Other variables that reflect household lifestyle or demographics, such as social activities, self-perceived health status, marital status, household size and probability of receiving inheritance, remain mostly unchanged (no change group makes up 75% to 99% of the sample).

In Table 4, the summary statistics of the percentages of holding of risky assets and four country-level variables of 12 European countries are shown to examine whether macroeconomic factors affect household decision to hold risky assets. Four country-level variables are related to the impact of the financial crisis, GDP per capita growth (%), domestic credit for private sector (% of GDP), unemployment rate (% of labor force) and central government debt (% of GDP). In columns (1), (2), and (3) of Table 4 are presented the data for Wave 2 and Wave 4 and the changes from Wave 2 to Wave 4.

Column (3) of Table 4 shows that after the financial crisis, the percentages of households holding risky assets decrease in all countries

Table 8
Interaction terms between Wave 4 dummy and country dummy (N = 19,236).

Dep. Var: Binary for holding risky assets	Austria (1)	Germany (2)	Sweden (3)	Netherlands (4)	Spain (5)	Italy (6)
Wave 4 dummy	−0.002 (0.006)	0.018*** (0.007)	−0.015** (0.006)	−0.004 (0.006)	−0.024*** (0.006)	−0.004 (0.006)
Country (dummy)	−0.105*** (0.019)	−0.056*** (0.016)	0.373*** (0.013)	−0.114*** (0.014)	−0.304*** (0.017)	−0.089*** (0.015)
Wave 4*Country (dummy)	0.034 (0.027)	−0.114*** (0.023)	−0.070*** (0.018)	0.035* (0.019)	−0.049* (0.029)	−0.016 (0.018)
Other controls	ln (income), ln (net wealth), ln (pension), Prob. of inheritance, Age ≥65, Marital status, Household size, Education (years), Self-perceived health (*Good*⁺), Social activities, GDP per capita growth, Domestic credit, Unemployment rate, Government debt.					

Dep. Var: Binary for holding risky assets	France (7)	Denmark (8)	Switzerland (9)	Belgium (10)	Czech Republic (11)	Poland (12)
Wave 4 dummy	0.000 (0.007)	0.004 (0.006)	−0.002 (0.006)	0.007 (0.006)	−0.006 (0.006)	0.008 (0.006)
Country (dummy)	0.000 (0.014)	0.118*** (0.015)	−0.119*** (0.016)	0.117*** (0.013)	−0.102*** (0.017)	−0.067*** (0.021)
Wave 4*Country (dummy)	−0.024 (0.018)	−0.047** (0.019)	0.044** (0.022)	−0.002 (0.017)	0.119*** (0.023)	−0.017 (0.022)
Other controls	ln (income), ln (net wealth), ln (pension), Prob. of inheritance, Age ≥65, Marital status, Household size, Education (years), Self-perceived health (*Good*⁺), Social activities, GDP per capita growth, Domestic credit, Unemployment rate, Government debt.					

Note: ***p < 0.01, **p < 0.05, * < 0.1. Our regression results are based on pooled data fixed effect models and consider interaction term between w4_dummy and country dummy for each country individually. All empirical values in this table are presented according to the structure Coef. (SE). Full results are available from the authors upon request.

except the Czech Republic (increase of around 1.87%) and Austria (no change). In terms of the negative impact of the financial crisis, countries with more marked decreases in the percentages of households holding risky assets are Denmark (-7.13%), Sweden (-6.76%), Belgium (-4.96%), Germany (-4.35%), and the Netherlands (-3.66%).

In addition, in terms of the changes in country-level data, column (3) of Table 4 shows that GDP per capita growth tends to decrease after the financial crisis in all countries except Germany and Sweden. However, the values of domestic credit for private sector (% of GDP) increase for all countries except Germany and Belgium. Unemployment rate increases in 7 of 12 countries. Finally, central government debt (% of GDP) increases in all countries except Sweden and Switzerland.

Shown in Table 5 are the household summary statistics of all variables for the 4 types of financial behavior: NN, RR, RN and NR. The largest proportion of households, 70.56%, belongs to NN type. The second largest proportion, 14.23%, belongs to RR type. RN and NR types make up 9.01% and 6.2% of our whole sample, respectively.

Among the 4 types, RR (NN) demonstrates the highest (lowest) values for income and net wealth in both Wave 2 and Wave 4. For the other two types, the trends in mean income and mean net wealth differ between the waves. In Wave 2, mean income of RN households (43.42 thousand Euros) is lower than that of NR households (45.52 thousand Euros). Mean net wealth is higher among RN households (348.77 thousand Euros) than among NR households (324.87 thousand Euros). However, opposing results are obtained for mean income and mean net wealth in Wave 4. This implies that households with higher mean net wealth but lower mean income in Wave 4 are more likely to belong to the NR type.

Level of education plays an important role in household investment decisions. RR households have the highest mean years of education (13.38). They also demonstrate the highest self-perceived health status (0.80–0.82) and social activity values (0.38–0.50). In contrast, NN households have the lowest mean years of education (around 10), self-perceived health status (0.58–0.63) and social activity values (0.19–0.23).

Table 6 shows the results of Pearson's correlation matrix. Based on variance inflation factors (VIF), we investigate if multi-collinearity exists among the variables. In this study, only dummy variable for age older than 65 is considered, instead of continuous variable for age. VIF values are less than 10, indicating no multi-collinearity among the variables.

4. Methodology

We first use probit regression model to examine the determinants of holding financial risky assets in Wave 2 (2006–2007) and Wave 4 (2010–2011) individually. In the empirical model in Eq. (1), we define a binary response variable, risky assets holding, as the indicator of whether a household holds financial risky assets, as follows:

$$\left(\text{Prob }\left(\text{Holding Risky Assets}_{i,t}=1\right)=\varphi(X_{i,t}\ \beta_X+\varepsilon_i)\right)=\Phi(X_{i,t}\ \beta_X+\varepsilon_i) \tag{1}$$

where Φ represents the standard normal cumulative distribution function, i denotes the household, $t=1$ if household information is from Wave 2 and $t=2$ if household information is from Wave 4. β is the vector of the parameter of all available explanatory variables and ε is an error term. All available explanatory variables are included in X.

In addition, to investigate the effects of the financial crisis, we analyze the pooled data of both waves and use the interaction terms between household variables, as well as each country dummy and W4 dummy, as follows:

Prob (holding risky assets$_i = 1$) $= \Phi(X_i\ \beta_X + \beta 1$ W4 * ln_income$_i$ + $\beta 2$ W4* ln_net wealth$_i$ + $\beta 3$ W4* ln_pension$_i$ + $\beta 4$ W4* education$_i$ + $\beta 5$ W4* self-perceived health$_i$ + $\beta 6$ W4*country dummy + ε_i) (2).

For the dynamic setting, we use multinomial logit regression to examine how the factors are associated with the changes in holding of risky assets (Δ Holding Risky Assets) from Wave 2 to Wave 4. There are four types of households categorized by changes in holding of risky assets, RN, NN, RR and NR. Based on a previous study (Barasinska et al., 2012), we first demonstrate how the independent variables affect the probability of each outcome. The model is as follows:

For our case, we have four categories, with J outcomes, where $J = 4$ (RN, NN, RR and NR). Thus, the probability of observing a particular change in the holding of risky assets Prob (ΔHolding risky Assets = j) is:

$$\text{Prob}(\text{Holding Risky Assets}_i=j)=\frac{\exp(X\beta_j)}{\sum_{n=RN}^{NR}\exp(X\beta_n)}$$

$$j=RN,NN,RR,\text{and}NR;n=RN,NN,RR,\text{and}NR;j\neq n \tag{3}$$

Next, we follow the study of Heo et al. (2013) to investigate the individual factors affecting the probability of RN or NR, compared to the probability of NN and RR, as shown in Eq. (4):

$$\frac{\text{Prob }(\text{Holding Risky Assets}_i=h)}{\text{Prob }(\text{Holding Risky Assets}_i=NN\&RR)}=\frac{\exp(X\beta_h)}{\exp(X\beta_{NN\&RR})}\text{h}=\text{RN or NR} \tag{4}$$

To specifically analyze the no change group, we choose either NN or RR as a reference group on sub-sample analysis.

Table 9

Multinomial logit results of full sample including RN, NR, NN and RR (N = 9618).

Variables	Multinomial Logit Model		Multinomial Logit Model		
	(1-1) RN vs (NN & RR)	(1–2) NR vs. (NN & RR)	(2–1) NN & RR	(2-2) RN	(2–3) NR
Intercept	−2.343*** (0.110)	−2.836*** (0.123)	–	–	–
Change in income (1 = positive)	0.055 (0.052)	0.022 (0.057)	−0.007 (0.007)	0.006 (0.005)	0.001 (0.005)
Change in net wealth (1 = positive)	−0.274*** (0.052)	0.212*** (0.057)	0.010 (0.007)	−0.031*** (0.005)	0.021*** (0.005)
Change in pension (1 = positive)	0.076 (0.053)	0.026 (0.059)	−0.010 (0.007)	0.008 (0.005)	0.002 (0.005)
Prob. of inheritance (Wave 4)	0.002** (0.001)	0.002** (0.001)	−0.000*** (0.000)	0.000* (0.000)	0.000** (0.000)
Age ≥ 65 (Wave 2)	−0.111* (0.057)	−0.117* (0.063)	0.018** (0.008)	−0.010* (0.006)	−0.009* (0.005)
Change in marital status (0 = no change)					
from Never Married to Married	0.485 (0.332)	0.017 (0.418)	−0.062 (0.059)	0.066 (0.052)	−0.004 (0.031)
from Married to Divorced	−0.164 (0.441)	−0.696 (0.620)	0.047 (0.043)	−0.010 (0.037)	−0.037* (0.020)
from Married to Widowed	−0.152 (0.217)	−0.105 (0.227)	0.021 (0.025)	−0.014 (0.019)	−0.006 (0.016)
Household size change (ref: no change)					
Decreasing	0.088 (0.139)	0.183 (0.146)	−0.024 (0.020)	0.008 (0.015)	0.016 (0.014)
Increasing	0.083 (0.143)	0.090 (0.155)	−0.013 (0.020)	0.008 (0.015)	0.005 (0.013)
Education (Wave 4)	0.070*** (0.006)	0.065*** (0.007)	−0.010*** (0.001)	0.006*** (0.001)	0.004*** (0.001)
Self-perceived health (Good⁺) change (ref: no change)					
Decreasing	−0.110 (0.078)	−0.082 (0.086)	0.014 (0.010)	−0.009 (0.007)	−0.005 (0.007)
Increasing	−0.024 (0.091)	−0.045 (0.101)	0.005 (0.012)	−0.002 (0.009)	−0.003 (0.008)
Change in social activities (ref: no change)					
Decreasing	0.358*** (0.083)	0.164* (0.097)	−0.047*** (0.013)	0.039*** (0.011)	0.008 (0.008)
Increasing	0.198*** (0.070)	0.256*** (0.075)	−0.037*** (0.010)	0.018** (0.008)	0.019*** (0.007)
GDP per capita growth change	0.288*** (0.091)	0.071 (0.101)	−0.032*** (0.012)	0.029*** (0.009)	0.003 (0.008)
Domestic credit change	−1.000*** (0.175)	−0.593*** (0.182)	0.135*** (0.022)	−0.099*** (0.018)	−0.036** (0.015)
Unemployment rate change	0.443*** (0.083)	0.161* (0.091)	−0.053*** (0.011)	0.046*** (0.009)	0.008 (0.007)
Government debt change	−0.582*** (0.153)	−0.275* (0.167)	0.071*** (0.020)	−0.057*** (0.015)	−0.014 (0.014)

Note: Monetary amounts are PPP-adjusted. Household income, net wealth and pension are in thousand euros. ***$p < 0.01$, **$p < 0.05$, * < 0.1. All empirical values in this table are presented according to the structure B (SE). We directly use the probability of receiving inheritance of household, but do not use change in probability of receiving inheritance, as the portion of this change in our full sample is too small (0.2%).

5. Empirical results

5.1. Static analysis

Table 7 shows the effects of variables of interest on the decision to hold risky assets for each wave (column (1)). The marginal effects of probit models show that household net wealth increases the probability of purchasing financial risky assets by 6.7% and 6.5% in Wave 2 and Wave 4, respectively. Our results are consistent with those of previous studies (Atella et al., 2012; Barasinska et al., 2012; and Mayordomo et al., 2013) which report a positive relationship between net wealth and owning of risky assets. The other two monetary variables (income and pension) have no significant impact on the probability of holding risky assets in either time period (Wave 2 or Wave 4). Households with higher probability of receiving inheritance, higher educational level, better self-perceived health status and more social activities are significantly and positively correlated with holding of risky assets. Overall, our results are consistent with Hypothesis 1 and the literature (Atella et al., 2012; Mayordomo et al., 2013). However, household size has significantly negative effect on holding of risky assets only in Wave 4. This might be a symptom of the crisis effect.

In addition, our empirical results show that households in countries with higher domestic credit for private sector (% of GDP) or lower unemployment rate (%) have higher probability of holding risky assets in both waves. GDP per capita growth (%) is positively associated and central government debt (% of GDP) is negatively associated with owning of risky assets only in Wave 4.

By pooling data, we report the results of household fixed effects models. In Table 7, the estimated results of column (2–1) show that households are less likely to own risky assets post-financial crisis (Wave 4) than pre-financial crisis (Wave 2). This implies that, ceteris paribus, households have less intention to hold risky assets after the financial crisis. However, we find that GDP per capita growth (%) has negative impact at the 1% significance level and central government debt (% of GDP) has positive impact at the 10% significance level on the holding of risky assets.

Table 10

Multinomial logit results of the 1st sub-sample including RN, NR and NN (N = 8249).

Variables	Multinomial Logit Model		Multinomial Logit Model		
	(1-1) RN vs NN	(1–2) NR vs. NN	(2–1) NN	(2-2) RN	(2–3) NR
Intercept	−2.353*** (0.115)	−2.856*** (0.127)	–	–	–
Change in income (1 = positive)	0.052 (0.055)	0.023 (0.060)	−0.007 (0.008)	0.006 (0.006)	0.001 (0.005)
Change in net wealth (1 = positive)	−0.288*** (0.055)	0.217*** (0.060)	0.010 (0.008)	−0.033*** (0.006)	0.023*** (0.005)
Change in pension (1 = positive)	0.087 (0.056)	0.036 (0.061)	−0.013 (0.008)	0.010* (0.006)	0.003 (0.005)
Prob. of inheritance (Wave 4)	0.003*** (0.001)	0.003*** (0.001)	−0.001*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Age ≥ 65 (Wave 2)	−0.125** (0.061)	−0.125* (0.066)	0.022** (0.008)	−0.011* (0.006)	−0.010* (0.006)
Change in marital status (0 = no change)					
from Never Married to Married	0.534 (0.352)	0.024 (0.439)	−0.074 (0.068)	0.079 (0.060)	−0.005 (0.035)
from Married to Divorced	−0.139 (0.477)	−0.716 (0.654)	0.047 (0.050)	−0.007 (0.043)	−0.040* (0.023)
from Married to Widowed	−0.072 (0.228)	−0.043 (0.237)	0.009 (0.030)	−0.008 (0.022)	−0.001 (0.020)
Household size change (ref: no change)					
Decreasing	0.006 (0.145)	0.115 (0.152)	−0.011 (0.021)	0.001 (0.015)	0.010 (0.015)
Increasing	0.062 (0.150)	0.079 (0.162)	−0.010 (0.022)	0.006 (0.016)	0.004 (0.015)
Education (Wave 4)	0.099*** (0.007)	0.093*** (0.008)	−0.016*** (0.001)	0.009*** (0.001)	0.007*** (0.001)
Self-perceived health (*Good*+) change (ref: no change)					
Decreasing	−0.162** (0.082)	−0.123 (0.089)	0.022** (0.011)	−0.013* (0.008)	−0.009 (0.007)
Increasing	−0.024 (0.096)	−0.045 (0.105)	0.006 (0.013)	−0.002 (0.010)	−0.003 (0.009)
Change in social activities (ref: no change)					
Decreasing	0.365*** (0.088)	0.160 (0.102)	−0.048*** (0.015)	0.040*** (0.012)	0.008 (0.009)
Increasing	0.309*** (0.075)	0.355*** (0.080)	−0.061*** (0.012)	0.031*** (0.009)	0.030*** (0.009)
GDP per capita growth change	0.516*** (0.096)	0.292*** (0.105)	−0.075*** (0.013)	0.055*** (0.010)	0.020** (0.009)
Domestic credit change	−0.824*** (0.181)	−0.439** (0.188)	0.117*** (0.025)	−0.089*** (0.020)	−0.028* (0.016)
Unemployment rate change	0.861*** (0.090)	0.550*** (0.097)	−0.128*** (0.013)	0.090*** (0.009)	0.038*** (0.008)
Government debt change	−1.249*** (0.164)	−0.871*** (0.178)	0.186*** (0.023)	−0.127*** (0.017)	−0.060*** (0.015)

Note: Monetary amounts are PPP-adjusted. Household income, net wealth and pension are in thousand euros. ***p < 0.01, **p < 0.05, * < 0.1. All empirical values in this table are presented according to the structure B (SE). We directly use the probability of receiving inheritance, but do not use change in probability of receiving inheritance, as the portion of this change in our full sample is too small (0.2%).

5.1.1. Analysis of interaction effects

We next focus on the interaction effects between the main variables of interest and a period variable W4 to examine the results of our pooled data analysis, as shown in columns (2–2) to (2–6) of Table 7. We find that the estimated coefficients of the interaction terms for *Wave 4*ln(net wealth)*, *Wave 4*education*, *Wave 4*self-perceived health*, and *Wave 4*social activities* negatively and significantly differ from 0 at both the 1% and 5% significance levels. This indicates that the increase in the probability of holding risky assets after the financial crisis is less pronounced for households with higher net wealth, higher educational level, better self-perceived health status, or with more participation in social activities. Overall, the results of Table 7 are consistent with Hypothesis 2.

We analyze the interaction effects between Wave 4 and each country dummy, as shown in Table 8. The effects of holding risky assets after the financial crisis differ for each country. Among the 12 European countries, there are only four countries with estimated co-efficients of interaction terms (*Wave 4*Country dummy*) that are significantly negative, Germany, Sweden, Spain, and Denmark. This implies that, after the financial crisis, households in these four countries have a lower probability of holding risky assets than households in other countries. In contrast, estimated coefficients of the interaction terms are significantly positive for three countries, the Netherlands, Switzerland, and the Czech Republic, although the estimated coefficients of *Country dummy* for these three countries are negative. By summation of the estimated coefficients of *Wave 4*Country dummy* and *Country dummy*, we conclude that, after the financial crisis, the decrease in the probability of households holding risky assets is relatively pronounced in the Netherlands and Switzerland when compared with other countries.[8]

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[8] The summation values of the estimated coefficients of *Wave 4*Country dummy* and *Country dummy* for the Netherlands and Switzerland negatively and significantly differ from 0. The summation value for the Czech Republic is positive.

Table 11

Multinomial logit results of the 2nd sub-sample including RN, NR and RR (N = 2832).

Variables	Multinomial Logit Model		Multinomial Logit Model		
	(1-1) RN vs RR	(1–2) NR vs. RR	(2–1) RR	(2-2) RN	(2-3) NR
Intercept	−0.014 (0.165)	−0.616*** (0.178)	–	–	–
Change in income (1 = positive)	0.070 (0.073)	0.035 (0.079)	−0.017 (0.020)	0.016 (0.018)	0.001 (0.016)
Change in net wealth (1 = positive)	−0.256*** (0.073)	0.329*** (0.079)	0.004 (0.020)	−0.100*** (0.018)	0.096*** (0.015)
Change in pension (1 = positive)	0.073 (0.075)	0.027 (0.081)	−0.017 (0.021)	0.018 (0.019)	−0.001 (0.016)
Prob. of inheritance (Wave 4)	−0.001 (0.001)	−0.001 (0.001)	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Age ≥ 65 (Wave 2)	0.034 (0.082)	0.000 (0.089)	−0.007 (0.022)	0.008 (0.020)	−0.001 (0.017)
Change in marital status (0 = no change)					
from Never Married to Married	0.359 (0.496)	−0.133 (0.569)	−0.055 (0.141)	0.115 (0.134)	−0.060 (0.088)
from Married to Divorced	−0.305 (0.589)	−0.751 (0.757)	0.136 (0.157)	−0.027 (0.139)	−0.110 (0.094)
from Married to Widowed	−0.333 (0.324)	−0.198 (0.339)	0.088 (0.087)	−0.067 (0.069)	−0.021 (0.060)
Household size change (ref: no change)					
Decreasing	0.463** (0.207)	0.544** (0.217)	−0.150*** (0.053)	0.065 (0.053)	0.085* (0.050)
Increasing	0.308 (0.214)	0.309 (0.228)	−0.091 (0.057)	0.054 (0.055)	0.036 (0.048)
Education (Wave 4)	−0.044*** (0.010)	−0.048*** (0.010)	0.014*** (0.003)	−0.008*** (0.002)	−0.007*** (0.002)
Self-perceived health (Good[+]) change (ref: no change)					
Decreasing	0.091 (0.115)	0.083 (0.124)	−0.030 (0.031)	0.016 (0.029)	0.014 (0.025)
Increasing	−0.055 (0.134)	−0.065 (0.145)	0.020 (0.037)	−0.011 (0.032)	−0.008 (0.028)
Change in social activities (ref: no change)					
Decreasing	0.319*** (0.117)	0.096 (0.131)	−0.071** (0.032)	0.082*** (0.031)	−0.011 (0.025)
Increasing	−0.104 (0.092)	−0.023 (0.098)	0.021 (0.025)	−0.024 (0.022)	0.003 (0.020)
GDP per capita growth change	−0.556*** (0.134)	−0.866*** (0.143)	0.216*** (0.037)	−0.077** (0.033)	−0.139*** (0.028)
Domestic credit change	0.184 (0.313)	0.950*** (0.325)	−0.158* (0.089)	−0.027 (0.075)	0.185*** (0.060)
Unemployment rate change	−1.027*** (0.130)	−1.354*** (0.138)	0.364*** (0.037)	−0.162*** (0.032)	−0.202*** (0.026)
Government debt change	1.675*** (0.208)	1.851*** (0.221)	−0.547*** (0.057)	0.297*** (0.052)	0.249*** (0.044)

Note: Monetary amounts are PPP-adjusted. Household income, net wealth and pension are in thousand euros. ***p < 0.01, **p < 0.05, * < 0.1. All empirical values in this table are presented according to the structure B (SE). We directly use the probability of receiving inheritance, but do not use change in probability of receiving inheritance, as the portion of this change in our full sample is too small (0.2%).

5.2. Dynamic analysis

5.2.1. Full sample

Table 9 presents the empirical results of multinomial logit regressions for the full sample. There are three categories of households including the no change group (NN and RR), RN type and NR type. Based on the model of Heo et al. (2013), we choose the no change group (NN and RR) as the reference group in our full sample analysis.

Column (1) of Table 9 demonstrates that, compared to the no change group, households with increased net wealth are less likely to have reduced probability of holding risky assets, type RN, as shown in column (1-1). In contrast, they tend to hold risky assets in their portfolios, type NR, as shown in column (1–2). These results are consistent with Hypothesis 3 and a study by Heo et al. (2013), which indicates that households treat net wealth as a tool to hedge their financial situations when deciding to invest in risky assets. We also find that more highly educated households have reduced or increased probability of holding risky assets than the no change group after the financial crisis. This implies that more highly educated households have different financial expectations following a financial crisis.

In column (2) of Table 9 column, we examine the marginal effect of an increase in an independent variable on the probability of each category including no change group in column (2-1), RN type in column (2–2), and NR type in column (2–3)[9]. Column (2) of Table 9 shows that increased net wealth increases the probability of NR by 2.1% and decreases the probability of RN by 3.1%. Households in which the respondent is older than 65 tend to belong to the no change group instead of the NR or RN type. In addition, one-unit increase in the number of years of education of the respondent increases the probability of RN by 0.6% and NR by 0.4% and decreases the probability of no change group by around 1%.

Compared to no change group, the empirical results demonstrate that households with less participation in social activities are more likely to be of RN type. Furthermore, when households increase their social activities, they are more likely to be of RN or NR type than of NN or RR type. This reinforces the conclusion that social activities positively affect the changes in household financial decisions. For the country-level variables, our empirical outcomes show that GDP per capita growth change and unemployment rate change are positively related to RN type and negatively related to no change group (NN & RR). Domestic credit changes and government debt change increase the probability of no change group (NN & RR) and decrease the probability of RN type. The variable of domestic credit changes is negatively related to NR type.

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[9] For the multinomial logit model in Table 9, the marginal effects of column (2) do not necessarily correspond in sign to the coefficients in column (1).

5.2.2. Sub-sample analysis

The next dynamic analysis is carried out on two subsamples. The first subsample includes NN, RN and NR and the second includes RR, RN and NR. NN is the reference group in column (1) of Table 10, in which we compare RN versus NN and NR versus NN. Column (2) of Table 10 displays the marginal effects of each independent variable on the probability of these three types (NN, RN or NR).

The significant factors in Table 10, associated with the changes in holding of risky assets, show similarities to those of the full sample model in Table 9, except for the changes in self-perceived health status and three country-level variables (GDP per capita growth change, unemployment rate change, and government debt change). Column (2) of Table 10 reveals that when household self-perceived health status worsens, the probability of NN type is relatively high. This finding is consistent with that of Atella et al. (2012) for households in countries without NHS. This implies that when Europeans perceive poorer health, they are more risk averse. We also find no association between these three variables and NR. However, GDP per capita growth change and unemployment rate change are positively related to NR and government debt change is negatively related to NR.

For the second sub-group analysis, shown in Table 11, we choose RR as the reference group. We compare RN versus RR and NR versus RR in column (1) and demonstrate marginal effects in column (2). The effect of the changes in net wealth is the same as in Tables 9 and 10. However, we obtain different results for the effects of other factors.

For example, probability of inheritance (Wave 4) and age have no significant effect on any type of household. Interestingly, the results of this sub-group analysis in column (2) reveal that higher educational level has stronger (weaker) association with RR (RN or NR) type, consistent with the findings of Mayordomo et al. (2013) and Atella et al. (2012). This implies that when we consider only three types of households, which own risky assets in at least one period, and exclude NN, more highly educated households are inclined to keep risky assets even during the financial crisis.

6. Conclusion

In this study, we investigate the holdings of financial risky assets before and after the 2008 financial crisis based on detailed information from the SHARE database and following the same households in Wave 2 (2006–2007) and Wave 4 (2010–2011). Our empirical results demonstrate that households with higher net wealth, higher educational level, higher probability of receiving inheritance, better self-perceived health status, and more social activities tend to own risky assets in both waves. However, household size has significantly negative effect only in Wave 4. This might signal a crisis effect. In addition, we find that households in countries with higher value of domestic credit for private sector (% of GDP), lower unemployment rate (%), or higher GDP per capita growth (%) are positively associated with owning of risky assets in Wave 4.

The results of interaction terms between Wave 4, and all independent variables reveal that the increase in the probability of holding risky assets after the financial crisis is less pronounced for the households with higher net wealth, higher educational level, better self-perceived health status, and more social activities. We also find varying results for the impact of the financial crisis among 12 European countries in terms of the decision to own risky assets. There are only four countries (Germany, Sweden, Spain, and Denmark) in which there is a lower probability of households holding risky assets after the financial crisis. In contrast, estimated coefficients of the interaction terms are significantly positive for three countries, the Netherlands, Switzerland, and the Czech Republic.

The most important findings are related to dynamic analysis. We set up four types of households in terms of the changes in holding of risky assets in Wave 2 and Wave 4, including NN, RR, NR and RN. The marginal effects of multinomial logit model show that increased net wealth increases the probability of NR by 2.1% and decreases the probability of RN by 3.1%. Households in which the head of the household is older than 65 tend to belong to the no change group instead of NR or RN. However, households with highly educated respondent are more likely to change their investment portfolios, and are either of NR or RN type.

Our study provides new insights. From our empirical evidence, although households tend to hold fewer risky assets after the financial crisis, there are varying results for the impact of the financial crisis among 12 European countries and country-level economic indicators. Our policy implication is that governments provide subsidies to support the higher productivity industries to improve the productivity of the overall economy, increase GDP per capita and decrease the unemployment rate. Higher economic growth drives the stable development of the financial market and builds the confidence of investors in the stock market, especially in the wake of a financial crisis. Therefore, future research might explore whether government policies differ related to the recovery of financial markets in each of these 12 European countries, which may affect investors' incentives to purchase risky assets.

Note: The significance level is at 5%. We only consider age ≥ 65 as dummy variable, not age, to obtain variance inflation factors (VIF) values less than 10, indicating no multi-collinearity among the variables. All household data comes from Wave 2 and Wave 4 of SHARE and country-level data is collected and calculated as average values for the time period 2006–2007 or 2010–2011 from World Bank database (GDP per capita growth, Domestic credit, and Unemployment rate) and OECD database (Government debt).

Author statement

We would like to submit our revised paper entitled "Effects of the Financial Crisis on Household Financial Risky Assets Holdings: Empirical Evidence from Europe." We have revised our manuscript based on the reviewers' valuable comments and suggestions. We also hired a professional English native-speaking editor to polish the writing of our paper. We hope this manuscript suitable for inclusion in an upcoming issue of your publication.

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References

Atella, V., Brunetti, M., & Maestas, N. (2012). Household portfolio choices, health status and health care systems: A cross-country analysis based on SHARE. *Journal of Banking & Finance, 36*, 1320–1335.

Barasinska, N., Schafer, D., & Stephan, A. (2012). Individual risk attitudes and the composition of financial portfolios: Evidence from German household portfolios. *The Quarterly Review of Economics and Finance, 52*, 1–14.

Betermier, S., Jansson, T., Parlour, C., & Walden, J. (2012). Hedging labor income risk. *Journal of Financial Economics, 105*, 622–639.

Brunetti, M., & Toricelli, C. (2010). Population age structure and household portfolio choices in Italy. *The European Journal of Finance, 16*(6), 481–502.

Cardak, B. A., & Wilkins, R. (2009). The determinants of household risky assets holdings: Australian evidence on background risk and other factors. *Journal of Banking & Finance, 33*, 850–860.

Christelis, D., Jappelli, T., & Padula, M. (2010). Cognitive abilities and portfolio choice. *European Economic Review, 54*, 18–38.

Christiansen, C., Joensen, J. S., & Rangvid, J. (2010). *The effects of marriage and divorce on financial investments: Learning to love or hate risk? CREATES research papers*. <ftp://ftp.samit.au.dk/creates/rp/10/rp10_57.pdf>.

Georgarakos, D., & Pasini, G. (2009). *Trust, sociability and stock market participation*. Frankfurt: Center for Financial Studies (CFS), Goethe University.

Gili, M., Roca, M., Basu, S., McKee, M., & Stuckler, D. (2012). The mental health risks of economic crisis in Spain: Evidence from primary care centres, 2006 and 2010. *The European Journal of Public Health, 23*(1), 103–108.

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

Heo, W., Grable, J. E., & Chatterjee, S. (2013). Life insurance consumption as a function of wealth change. *Financial Services Review, 22*, 389–404.

Hoffmann, A. O. I., Post, T., & Pennings, J. M. E. (2013). Individual investor perceptions and behavior during the financial crisis. *Journal of Banking & Finance, 37*, 60–74.

Hurd, M., Rooij, M. V., & Winter, J. (2011). Stock market expectations of Dutch households. *Journal of Applied Econometrics, 26*, 416–436.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263–291.

Kentikelenis, A., Karanikolos, M., Papanicolas, I., Basu, S., McKee, M., & Stuckler, D. (2011). Health effects of financial crisis: Omens of a Greek strategy. *The Lancet, 378*(9801), 1457–1458.

Liebenberg, A. P., Carson, J. M., & Dumm, R. E. (2012). A dynamic analysis of the demand for life insurance. *Journal of Risk & Insurance, 79*(3), 619–644.

Mankiw, N. G., & Zeldes, S. P. (1991). The consumption of stockholders and nonstockholders. *Journal of Financial Economics, 29*(1), 97–112.

Mayordomo, S., Rodriguez-Moreno, M., & Pena, J. I. (2014). Portfolio choice with indivisible and illiquid housing assets: The case of Spain. *Quantitative Finance, 14*(11), 2045–2064.

Mustafa, N. N. S., Samsudin, S., Shahadan, F., & Yi, A. K. J. (2015). Flight-to-quality between stock and bond markets: Pre and post Global financial crisis. *Procedia Economics and Finance, 31*, 846–855.

Shiller, R. J. (2003). From efficient markets theory to behavioral finance. *The Journal of Economic Perspectives, 17*(1), 83–104.

Shum, P., & Faig, M. (2006). What explains household stock holdings? *Journal of Banking & Finance, 30*, 2579–2597.

Syriopoulos, T. (2002). Risk aversion and portfolio allocation to mutual fund classes. *International Review of Economics & Finance, 11*, 427–447.

Thaler, R. H. (1985). Mental accounting and consumer choice. *Marketing Science, 4*, 199–214.

Thaler, R. H. (1999). Mental accounting matters. *Journal of Behavioral Decision Making, 12*(3), 183–206.

Thao, T. P., & Daly, K. (2012). The impacts of the global financial crisis on Southeast Asian equity markets integration. *International Journal of Trade, Economics and Finance, 3*(4), 299–304.

Yu, H. Y., & Hsieh, S. F. (2010). The effect of attention on buying behavior during a financial crisis: Evidence from the Taiwan stock exchange. *International Review of Financial Analysis, 19*, 270–280.