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Household portfolios and financial literacy: The flight to delegation*

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Abstract

In this paper we analyse the asset allocation of European households, focusing on developments during the period that followed the recent twin financial crises. We examine whether "search for yield" materialises outside financial institutions and whether the degree of financial literacy plays a role. We consider a wider set of alternatives to the safe assets by incorporating mutual funds to the standard set of stocks and bonds. We provide novel evidence which suggests that the "search for yield" during the post-crisis period of low interest rates took place not by raising the direct holdings of stocks and bonds, but rather indirectly through higher mutual funds' holdings, in line with a "flight to delegation". Importantly, this behaviour is strongly linked to the level of financial literacy, with the most literate households displaying significantly higher use of mutual funds.

JEL classification: E2; E44; G11; G51
Keywords: Asset allocation; Financial literacy; Delegation;

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1 Introduction

The period following the twin crises, namely the Global Financial Crisis (GFC) of 2007-8 and the European Sovereign Debt Crisis (ESDC) 0f 2010-12, was unique in terms of combining the investors' recent experience of huge economic and financial turmoil along with ultra-expansionary monetary policy. Specifically, rates of return on safe assets declined to historically low levels, with one of the key policy rates in the euro area even turning negative, while at the same time asset purchases in the context of Quantitative Easing (QE) programmes reached record highs.[1]

Hence, two major forces were interacting during the post-crisis period. On the one hand, low interest rates generate a tendency to "search for yield", that is, to adopt riskier investment strategies in the hope of achieving a higher return compared to what could be earned by investing in safer assets. This behaviour has been extensively analysed, with the evidence being strongly supportive of "search for yield", in the case of banks and other institutional investors (e.g. Jimenez et al., 2014; Di Maggio and Kacperczyk, 2017; and Chodorow-Reich, 2014). On the other hand, the recent negative exposure of investors to the twin crises is expected to make them more cautious. This argument is based on an extensive literature considering the impact of financial crises on investment behaviour (e.g. Malmendier, 2021; Malmendier and Nagel, 2011; Kuchler and Zafar, 2019). We further enrich these arguments by positing that the degree of financial literacy of households can also affect this trade-off, based upon one of the major findings of the financial literacy literature. In particular, the more financially literate investors are, the is the probability that they will expand their asset allocation beyond the safe assets (see e.g. van Rooij et al., 2011).

In this paper, we contribute to the existing literature in three key dimensions. First, we provide evidence on the asset allocation of European households during the post-crisis period, in order to examine whether "search for yield"materialises outside financial institutions, despite the possible opposite tendency for cautiousness. Second, we consider a wider set of alternatives to the safe asset, to pursue "search for yield", by incorporating mutual funds in the typical options of stocks and bonds. Third, we examine whether the degree of financial literacy matters for the asset allocation of European households, both overall, and more importantly for our analysis during the post-crisis period.

The longitudinal sample that we employ covers 52,541 heads of households from twelve European countries over the period 2004-2017. Specifically, we utilise eight waves from the Survey on Health, Ageing and Retirement (SHARE): 2004; 2005; 2006; 2007; 2011; 2013; 2015 and 2017. In addition to the data on the allocation of households' financial assets across safe assets, stocks, bonds and mutual funds, SHARE provides information on several important household characteristics. These include, among others, demographics, physical and mental health, the level of financial literacy and risk attitudes. In our empirical analysis, we start by modelling the share of safe assets in total assets, as well as the share of the three risky assets (stocks, bonds

[1] In an unprecedented development, the deposit facility rate of the European Central Bank (ECB) turned negative in June 2014, following its reduction to 0% in July 2012. Moreover, the ECB turned to QE by the end of 2014, which was intensified by the inclusion of government bonds on the set of purchased assets in early 2015.

and mutual funds) on a wide set of possible determinants, including the degree of financial literacy and several controls. The four asset shares are modelled as censored outcomes using a random effects Tobit model. We then try to address potential endogeneity, related to financial literacy, by adopting an instrumental variables approach (IV Tobit model). Finally, we include an indicator to reflect the post-crisis period as well as the interaction between this indicator and the degree of financial literacy.

Our key results are threefold. First, and in line with the previous literature, we confirm that financial literacy has an overall positive (negative) and statistically significant link with the the share of risky (safe) assets in households' portfolios. This link is robust to accounting for potential endogeneity in the IV estimates. Second, extending the previous literature, we show that the post-crisis period is associated with elevated holdings of safe assets and lower holdings of stocks and bonds. This reflects trends towards more cautious behaviour in the aftermath of significant economic and financial turmoil. Our results paint a more complex picture, though, since they reveal higher holdings of mutual fund holdings in the post-crisis period. Thus, we provide novel evidence which suggests that a"search for yield" during the post-crisis period of low interest rates took place not by raising the direct holdings of stocks and bonds, but rather indirectly through higher mutual funds' holdings. These findings suggest that the compromise reached in the trade-off between post-crisis cautiousness and the inventive to "search for yield" involved a "flight to delegation", that is, the utilisation of the perceived expertise of mutual funds managers. Third, we show that this behaviour is strongly linked to the level of financial literacy, with the most literate households displaying significantly higher use of mutual funds (compared to the least literate households) as a means to invest in riskier assets. On the other hand, the differences across levels of financial literacy in the post-crisis period are not significant for stocks, bonds and safe assets.

This paper brings together multiple branches of the finance literature. First branch comprises, studies that investigate the effects of financial literacy on asset allocation. The financial literacy literature is extensive and has provided a significant body of evidence for the importance of financial literacy in several domains of individual and household financial decision-making. Of particular relevance for this study is the link between financial literacy and savings and investment. Early studies, notably by Bernheim (1995), have shown that individuals vary significantly with regard to their saving behaviour and financial literacy has been found to be a strong predictor of savings. More recently, a series of studies, including Lusardi and Mitchell (2007) and Lusardi and Mitchell (2011), show that financially literate individuals in the U.S have a higher probability of preparing for retirement and, therefore, of accumulating wealth than non financially literate individuals. Focusing on investment, the existing literature has repeatedly found a positive association between financial literacy and stock market participation. For instance, van Rooij et al. (2011) find that highly financially literate individuals are significantly more likely to invest in stocks and are more likely to accumulate wealth.[2]

[2]Similar findings, linking financial literacy and/or cognitive abilities with participation in asset markets, have been reported in a plethora of studies (see e.g. Christelis et al., 2010; Yoong, 2011). More recently, financial literacy has also found to be associated with participation in derivative markets, see Hsiao and Tsai (2018).

Our paper extends the financial literacy literature by focusing on the post-crisis era, a period with unique characteristics that has not been adequately analysed in previous studies, and examining whether financial literacy matters for household asset allocation. Our key finding, that there a positive link between financial literacy and household investment in mutual funds, is intriguing. Christelis et al. (2010) use the first wave of SHARE and show that the propensity to invest in stocks is strongly associated with cognitive abilities, for both direct stock market participation and indirect participation through mutual funds and retirement accounts. Compared to that study, we use multiple waves of SHARE, covering the pre-crisis period, the twin crises as well as the post-crisis period. Moreover, we focus on financial literacy as opposed to general cognitive abilities. The "flight to delegation" during the post-crisis period is positively linked to the level of financial literacy, a finding which is broadly consistent with previous evidence by Hackethal et al. (2012) regarding who delegates portfolio decisions to financial advisors. Hackethal et al. (2012) argue that the delegation of portfolio decisions has potential advantages, such as reduced information acquisition costs, as well as possibly superior investment practices. On the other hand, commissions and fees have to be paid and agency problems may arise. They find that financial advisors tend to be matched with richer, older, more experienced, self-employed, female investors (rather than with poorer, younger, inexperienced and male ones), and that advised accounts offer, on average, lower net returns and inferior risk-return tradeoffs.[3] Our study considers a different type of delegation, involving the use of mutual funds, links it with financial literacy and does not consider the investment performance of household portfolios.[4]

Finally, our paper is related to the literature on "search for yield". Several previous studies have examined the behaviour of banks (Jimenez et al., 2014; Delis et al., 2017), mutual funds (Hau and Lai, 2016; Di Maggio and Kacperczyk, 2017), and pension funds (Chodorow-Reich, 2014). These studies typically provide evidence in support of greater propensity for undertaking riskier investments by financial institutions when interest rates are low. The literature on "search for yield", in the case of households, is less dense and primarily considers US data. The recent study by Alzuabi et al. (2020) examines the portfolio allocation of US households in response to unexpected changes in interest rates using data from the Panel Study of Income Dynamics. It shows that declining interest rates are associated with higher (lower) household portfolio allocation to high (low) risk assets in line with "search for yield" behaviour.[5] Luetticke (2021) also investigates the effects of unexpected changes in interest rates on household port-

[3]Hackethal et al. (2012, p.10) point out that "...advisors are similar to babysitters: babysitters are matched with well-to-do parents, they perform a service that parents themselves could do better, they charge for it, but observed child achievement is not boosted by babysitters but by positive characteristics of the family".

[4]Other research in the field has documented a positive association between financial literacy and investment performance. For example, Clark et al. (2017) explore whether more financially knowledgeable investors hold better performing retirement plans and find that financially literate individuals boosted their monthly expected excess returns by 2.3 basis points, through investments in risky assets. Focusing on portfolio returns, Bianchi (2018) matches administrative data on portfolio choices with financial literacy measures and shows that more financially literate households are significantly more likely to hold better performing portfolios.

[5]Lian et al. (2019) also conclude that US household investment decisions are characterised by "search for yield" when interest rates are low. However, their empirical analysis is conducted at the aggregate, rather than the household, level, using Flow of Funds data on household sector flows into stocks and interest-bearing safe assets.

folio choices. tThe study uses repeated cross-sectional data on household portfolios from the Survey of Consumer Finances. Unlike our study, Luetticke (2021) focuses on the choice between liquid and illiquid assets and the potential heterogeneity in portfolio responses to interest rate surprises across US households with different levels of wealth. Our study contributes to this literature in various dimensions. It focuses on European, rather than US households and identifies a "delegation" effect during the period of post-crisis period of ultra-low rates, which is linked to the level of financial literacy. In addition, it does not attempt to develop measures of unexpected interest rate changes and relies upon a simple dummy variable approach which has the benefit of interpretative and economic simplicity. This approach is also consistent with the idea that most households are not sophisticated enough to rely upon advanced econometric models in order to estimate interest rate surprises.

2 Data and empirical strategy

2.1 Data

We use data from SHARE for eight waves, which cover the following years: 2004; 2005; 2006; 2007; 2011; 2013; 2015 and 2017, as well as from the 2008 wave of SHARELIFE, which focuses on individuals' life histories. The data is longitudinal, which allows us to track individuals across a relatively long period of time incorporating different stages of the life and business cycles. In addition, SHARE covers a number of countries, where economic conditions and economic policy have been substantially different. To be specific, we focus on twelve countries: Austria; Germany; Netherlands; Spain; Italy; France; Greece; Belgium; Luxembourg; Portugal; Slovenia and Estonia.[6] We focus upon heads of household, where the survey covers respondents aged 50 years and over, providing information on a wide range of thematic blocks (or modules), such as demographic characteristics, education, physical and mental health, the level of financial literacy and cognitive ability, economic and financial activities and well-being as well as general life satisfaction.

The SHARE data provides combined information on the two main variables of our analysis, household financial assets and financial literacy. Furthermore, the SHARE provides comprehensive information on respondents' early life events, such as living and health conditions and ability based on school performance, where we use the latter in the analysis to tackle the potential problem of endogeneity of financial literacy (as discussed in detail in the next section). Our panel dataset comprises 52,541 heads of household (N) followed over time with total observations (NT) of 102,861, and individuals observed between a minimum of one (N=23,579) and six occasions (N=1,789).

We model the following financial outcomes, y_{it}: the share of financial assets held in: safe assets; bonds; stocks; and mutual funds. The specific survey questions are as follows: (1) for safe assets, i.e. bank accounts and savings (baccs), *'About how much do you* [*and/and/and/and*] [*your/your/your/your*] [*husband/wife/partner/partner*] *currently have in bank accounts, transaction*

[6] All countries belong to the Euro Area, hence they share a common monetary policy.

accounts, saving accounts or postal accounts?'; (2) for Government and corporate bonds, *'About how much do you currently* [*and/and/and/and*] [*your/your/your/your*] [*husband/wife/partner/partner*] *have in government or corporate bonds?'*; (3) for stocks and shares, *'About how much do you* [*and/and/and/and*] [*your/your/your/your*] [*husband/ wife/partner/partner*] *currently have in stocks or shares* (*listed or unlisted on stock market*)*?'*; and (4) for mutual funds, *'About how much do you* [*and/and/and/and*] [*your/your/your/your*] [*husband/ wife/partner/partner*] *currently have in mutual funds or managed investment accounts?'*. More formally, defining Y_{it} as the monetary amount held in the $k = 1, .., 4$ asset types then the proportion held in a particular asset is given by:

$$y_{it}^k = \left(\frac{Y_{it}^k}{\sum_{k=1}^4 Y_{it}^k} \right) \forall k = 1, .., 4 \tag{1}$$

Hence, each dependent variable is bounded between zero and unity. Figure 1 shows the distribution of each variable (excluding mass points), where there is a distinct continuum between zero and unity with evidence of spikes at 0.5 and 1 in all asset shares with the exception of safe assets. The proportion of respondents holding 100% of their wealth in safe assets is 78.8%, whilst in terms of those not holding bonds, stocks or mutual funds the relevant proportions are: 93.8%; 89.6% and 88.5%, respectively. Table 1 shows that, as expected, safe assets are the most prevalent type of asset held, at just under 87%, followed by mutual funds at 5.8%.

The measure of financial literacy, FL_i, is based on the responses to the following four questions: (1) *If the chance of getting a disease is 10 percent, how many people out of one thousand would be expected to get the disease? The possible answers are 100, 10, 90, 900, and another answer.* (2) *In a sale, a shop is selling all items at half price. Before the sale, a sofa costs 300 euro. How much will it cost in the sale? The possible answers are 150, 600, and another answer.* (3) *A second-hand car dealer is selling a car for 6000 euro. This is two-thirds of what it costs new. How much did the car cost new? The possible answers are 9000, 4000, 8000, 12,000, 18,000, and another answer.* (4) *Let us say you have 2000 euro in a saving account. The account earns 10 percent interest each year. How much would you have in the account at the end 2 years? The possible answers are 2420, 2020, 2040, 2100, 2200, 2400, and another answer.* Hence, the responses reveal the respondent's proficiency in numeracy. The possible answers are shown on a card and the interviewer is instructed not to read the questions out to the respondent.

If the respondent answers (1) correctly, they are then asked (3) and, if this question is also answered correctly, they are asked question (4). Answering (1) correctly results in a score of 3, answering (3) correctly but answering (4) incorrectly results in a score of 4, while answering (4) correctly results in a score of 5. On the other hand, if the individual answers (1) incorrectly, they are directed to question (2). If question (2) is correctly answered, a score of 2 is given, while if (2) is answered incorrectly, they receive a score of 1. These questions have been previously used in the household finance literature to capture financial literacy, e.g. Christelis et al. (2010), Jappelli and Padula (2013) and Lusardi and Mitchell (2014). The index is defined on a scale of 1 to 5, where higher values denote better financial literacy. We treat financial literacy as time invariant, captured at the first time the respondent answers this set of questions in the panel,

in order to avoid 'learning' effects and also because this set of questions is not included in every wave of the SHARE. The distribution of the financial literacy measure across each of the categories is as follows: 1 (least literate)=5.97%; 2=14.68%; 3=30.57%; 4=33.46% and 5 (most literate)=15.31%, and Table 1 reveals that, on average, the financial literacy score is 3.4.

Following the existing literature, the head of household and household level covariates, $\mathbf{X}_{it}$, that we condition on are as follows: gender; a quadratic in age; labour market status - specifically employed or self-employed, unemployed, sick or disabled, homemaker, other state, with retired as the reference category; marital status - married or cohabiting (which forms the omitted category), separated, never married, divorced and widowed; and the number of children in the household. In terms of educational attainment, we control for the highest qualification obtained by the respondent (International Standard Classification of Education, ISCED levels 6 to 1): second-stage tertiary; first-stage tertiary; post secondary; upper secondary; lower secondary; primary education, where no formal education is the reference group. We control for whether the respondent owns a business and also whether they are a homeowner (owned outright or via a mortgage). To control for household income and wealth, we condition on the natural logarithm of net income received by all household members in an average month in the previous year, and the natural logarithm of the household's net worth (defined as financial wealth plus housing wealth minus any debts).

Finally, we include a proxy for the head of household's risk attitudes, which is derived from responses to the question: *'When people invest their savings they can choose between assets that give low return with little risk to lose money, for instance a bank account or a safe bond, or assets with a high return but also a higher risk of losing, for instance stocks and shares. Which of the statements on the card comes closest to the amount of financial risk that you 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; and* (4) *Not willing to take any financial risks.* Hence, the risk attitudes index is defined on a scale 1 to 4, which is increasing in the level of risk aversion.[7]

Table 1 reveals that 56% of respondents are female, the average age in the sample is 66 and, as expected, the most common labour market state is retired at 57%, and 72% of respondents are married or cohabiting. The majority of heads of household have upper secondary education at 32% and just under 5% have no formal qualification.

2.2 Evolution of asset shares over time

The time period that we consider incorporates the 2007-2008 GFC and the 2010-12 ESDC, as well as their aftermath. Figure 2 reveals some interesting differences in terms of the average share of assets over time. First, the average share of safe assets increased during the crisis era, reaching a maximum in 2011. At the same time, the average shares of stocks, bonds and mutual funds declined. These patterns are consistent with a "flight to safety" behaviour by European

[7]This measure of risk attitudes from SHARE has been used in the existing literature, e.g. Bonsang and Dohmen (2015).

households. Second, there appears to be a structural break in 2013, as from that wave onward the average share of mutual funds increased significantly. This feature is particularly evident at higher levels of the financial literacy index. Considering the other assets, the crisis-era rise in the average share of safe assets dissipates, whereas the average share of stocks remained rather flat. On the other hand, the average share of bonds continued to decline across all levels of the financial literacy. It appears that in the post-crisis period, an era also characterized by ultra-expansionary monetary policy with the negative ECB policy rate since 2014 and QE since 2015, more financially literate households tended to investment in non-safe assets *indirectly*, via higher holdings of mutual funds, as opposed to directly.

2.3 Modelling approach

We start by exploring the correlation between asset allocation and financial literacy. To this end we estimate the following Tobit model:[8]

$$y_{it}^{k} = \mathbf{X}_{it}'\beta + \gamma FL_i + \alpha_j + \zeta_t + \xi_m + \epsilon_{it} \tag{2}$$

Where y_{it}^{k} denotes the four asset shares $(k = 1, .., 4)$ observed across heads of household, $(i = 1, ..., 52541)$ and time $(t = 2004, ..., 2017)$ which are modelled as censored outcomes using a random effects Tobit model, with censoring at 0 (for all outcomes excluding safe assets) and 1 (for safe assets only). Finally, α_j is a country fixed effect, ζ_t is the year fixed effect, ξ_m is the month fixed effect and ϵ_{ijt} is the error term.

In order to overcome the issue of bi-directional causality between our key independent variable, FL_i, and the outcome variables, y_{it}^{k}, we instrument the financial literacy index, FL, by using measures of maths and language skills at age 10, given in the vector $\mathbf{Z}_i$. This is a common approach in the existing literature (see e.g. Jappelli and Padula (2013)) and helps to alleviate endogeneity concerns that may stem from the financial literacy measure (for a detailed discussion see Lusardi and Mitchell (2014)). In SHARELIFE, survey participants report their mathematical ability at age 10 in response to the question: *'How did you perform in Maths compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than average?'* There is a similar question regarding their language skills: *'How did you perform in* [*country's Language*] *compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average?'* We re-order the responses to be increasing in ability. Both maths and language ability are measured on a scale of 1 to 5, where Table 1 reveals that the mean response to both questions is 'about the same'. From the responses to the aforementioned questions, we create two binary instruments for maths and language ability, which equal one if the individual responds 'much better' or 'better' and zero otherwise. To instrument financial literacy, we then estimate the following IV Tobit model using maximum likelihood:

[8]The mean of time varying covariates are also included as controls so that the estimators approximate that of fixed effects, see Mundlak (1978) and Wooldridge (2010).

$$FL_i = \mathbf{X}'_{it}\beta_1 + \mathbf{Z}_i\phi + \alpha_{1j} + \zeta_{1t} + \xi_{1m} + \epsilon_{1it} \tag{3}$$

$$y^k_{it} = \mathbf{X}'_{it}\beta_2 + \widehat{FL_i}\gamma + \alpha_{2j} + \zeta_{2t} + \xi_{2m} + \epsilon_{2it} \tag{4}$$

Where $\zeta_{1,2t}$ and $\xi_{1,2m}$ are the year fixed effects and the month fixed effects, respectively. To gauge the causal effects of financial literacy across the post-crisis period and the period that preceded it, we estimate the following equation:

$$y^k_{it} = \mathbf{X}'_{it}\beta_1 + \mathbf{C}'_{jt}\beta_2 + FL_{it}\gamma + \theta\text{Post-crisis}_t + \delta(FL_i \times \text{Post-crisis}_t) + \alpha_j + \zeta_t + \xi_m + \varepsilon_{it} \tag{5}$$

where $\mathbf{X}_{it}$ is the vector of household level characteristics; and $\mathbf{C}_{jt}$ is a set of country level covariates included to control for valuation effects that could drive asset prices. Specifically, $\mathbf{C}_{jt}$ includes: the real GDP growth rate (%); the natural log of the economic sentiment index; the Euro overnight index average (EONIA) rate; and the natural log of the volatility of each country's main stock market.[9] We also incorporate a dummy variable for the pre-crisis period from 2004 to 2007.

The 'Post-crisis' indicator is a binary variable, which is equal to unity if the year is 2013 or after and zero otherwise. The ESDC was largely over by the end of summer 2012, following a significant reduction in the euro-area government borrowing costs (Afonso et al., 2018). This happened in the aftermath of the announcement of a new crisis-fighting tool in the the statement by President Draghi on 26 July 2012, where he pointed out that the *"ECB is ready to do whatever it takes to preserve the euro"*.

Following Rodnyansky and Darmouni (2017), all household and head of household controls are interacted with the 'Post-crisis' indicator to allow for possible heterogeneous responses and thus account for a structural break.

3 Results

3.1 Asset allocation and financial literacy

The results from estimating equation 2 are shown in Table 2, where each column refers to a different outcome: (1) safe assets; (2) bonds; (3) stocks; and (4) mutual funds. For all models, average marginal effects (AMEs) are reported, and our key focus lies on the estimate of γ. As expected and in line with the previous literature, financial literacy has a statistically significant association with each asset share and is positive in all instances with the exception of safe assets, where the effect is negative and statistically significant. This result is in line with the previous literature (Christelis et al., 2010; van Rooij et al., 2011). For example, a one unit increase in the financial literacy index is associated with a decrease in the proportion held in safe assets of 5.7% and increases in the proportions of assets held in bonds, stocks and mutual funds of 5.7%,

[9]The respective data sources are: (i) OECD from the quality of Governments dataset; (ii) `http://ec.europa.eu/eurostat/web/products-datasets/-/teibs010`; (iii) `http://sdw.ecb.europa.eu`; and (iv) Bloomberg, from the Global Financial Development database.

52% and 4.8%, respectively. Indeed, these are sizable effects given the mean of each dependent variable: Bonds have an average of 0.030 with a standard deviation of 0.141, while mutual funds exhibit a mean of 0.058 and a standard deviation equal to 0.189. Interestingly, in terms of economic magnitude, the effects from financial literacy are larger than those stemming from gender or marital status. The findings related to the other control variables are also consistent with findings reported in the existing literature.[10] For example, investment in safe (risky) assets is decreasing (increasing) in the level of risk tolerance and the shares of stocks and mutual funds are increasing in educational attainment. The age term and the associated squared term are statistically significant with the exception of the estimated coefficients on stocks (albeit of the correct sign). We cannot reject the hypothesis that the squared term is different from zero; interestingly, the coefficient switched sign. This suggests that at a later age individuals start to increase the amount of savings allocated to safe assets and they reduce the amount allocated to the other asset classes. This shifting of risk is in accordance with the life-cycle asset allocation of funds.

For purposes of comparison, the first row of Table 3 Panel A reports the same estimates shown in Table 2 from the random effects Tobit models, where financial literacy is treated as exogenous. In Panel B, the models are re-estimated as pooled cross sectional Tobit specifications with clustered standard errors at the individual level. The reason for showing this additional specification is that when we move to the IV Tobit specifications, where financial literacy is instrumented, it is only possible to cluster the standard errors at the household level. Hence, comparing the estimates between Panels A and B enables us to ascertain the sensitivity of the results to a longitudinal estimator. As can be seen, there is very little variation in the estimates of the effects of financial literacy on each of the four outcomes.

In Panels C to E of Table 3, financial literacy is treated as an endogenous variable and is instrumented using the binary indicators for maths and/or language ability at age 10, as described above.[11] In all specifications, the diagnostic tests show that: (i) the null hypothesis that financial literacy is exogenous is rejected in all cases at the 5% level; (ii) both the maths and/or language scores at age 10 are individually statistically significant (see Panels C and D), and also jointly statistically significant (see Panel E) in the first stage, i.e. equation 3; and (iii) the Kleibergen-Paap underidentification test is passed.

The reported AMEs on the instrumented financial literacy index are consistent with those found when the variable was treated as exogenous in terms of statistical significance and the direction of influence. However, the magnitudes of the IV estimates are much larger. This is in line with the existing literature, as noted in the review of the literature conducted by Lusardi and Mitchell (2014) who conclude that '...the noninstrumented estimates of financial literacy may underestimate the true effect.' (p. 27).[12]

[10] See e.g. Lusardi and Mitchell (2014) for a survey of the literature.

[11] In alternative specifications, we have treated the instruments as continuous and the results are the same.

[12] This might be a result of endogeneity stemming from measurement error or interviewer effects, which may influence survey answers, see Crossley et al. (2021).

3.2 Asset allocation, financial literacy and the post-crisis period

We now present the results of estimating equation 5 in Figure 3, where the AMEs associated with the summation of γ and δ are shown, i.e. the effects of financial literacy in the post-crisis period upon each asset share are shown. Table 4 shows the key AMEs.[13]

Figure 3, which is based on a random effects Tobit model for each outcome, shows that the share of safe assets and mutual funds (stocks and bonds) is higher (lower) in the post-crisis period survey waves, relative to the waves that preceded it. Importantly, for safe assets and stocks there is no gradient with respect to the household's level of financial literacy, while for bonds there is a negative gradient (higher bond holdings at lower financial literacy levels) but this is not statistically significant. However, considering the share of assets held in mutual funds post-crisis, the proportion allocated increases as financial literacy improves, and there is a statistically significant difference between the most literate and illiterate households.

3.3 The role of mutual funds

The existence of a financial literacy related-gradient in the post-crisis era households' holdings of mutual funds is a novel finding. Mutual funds is a broad term that identifies companies which collect funds from savers and allocates them to various asset classes. These can have various degree of risk based on the asset class they are invested in. What makes them distinctively different from the other asset classes covered in the previous section of the paper is the fact the investment decisions are managed by a financial specialist (an asset manager) rather than by the saver herself. The saver could have invested in shares directly, but instead decides to delegate this purchase to a outside "specialized" professional. There are two main reasons why this would happen; firstly the individual decided that by buying a mutual fund his/her portfolio would be better diversified and, second, the individual feels that they are better off if their savings are managed by someone that has a better understanding of the markets. Although both mechanisms could be at play, we argue that in our context the "delegation" mechanism is of particular relevance due to the particular characteristics of the post-crisis era.

Specifically, in the aftermath of the twin-crises (GFC, ESDC) European households experienced an environment of ultra-expansionary monetary policy. Hence, on the one hand, there was a strong push to "search for yield" by allocating more funds to riskier assets, whilst conversely hand the negative experience of recent economic and financial turmoil made households more cautious. The latter argument is in line with an extensive literature considering the impact of financial crisis on investment behaviour (See e.g. Malmendier (2021); Malmendier and Nagel (2011); Kuchler and Zafar (2019)). It appears that the compromise that was reached

[13] Whilst interpreting interaction effects is straightforward in linear models, in a non-linear framework such as the Tobit model, the coefficient on the interaction term does not provide the change in the partial effect of either variable on the conditional mean function. Hence, interpreting the first derivative of the multiplicative term is insufficient as the cross partial derivative between the two variables needs to be taken into account, e.g. see Ai and Norton (2003) and Greene (2010). Moreover, the statistical significance of the interaction term cannot be assessed with a simple t-test. In order to resolve this issue, we examine the interaction effects of two variables graphically, by plotting how the partial effect of financial literacy changes post-crisis and we provide the corresponding confidence intervals.

involved indirect, as opposed to direct, participation in riskier assets via higher holdings of mutual funds, what we deem as "flight to delegation". This behaviour is strongly linked to the level of financial literacy, with more literate households displaying a heavier use of mutual funds as means to invest in riskier assets.

We further investigate the role of mutual funds, by splitting them into three groups according to their composition. The groups are derived from the responses to the following question: *'Are these mutual funds and managed investment accounts mostly stocks or mostly bonds?' 1. Mostly stocks; 2. Half stocks and half bonds; 3. Mostly bonds.*[14] From the six waves in which this question is asked, we have a total of 10,969 responses. The responses to this question allow us to define three groups of investors based on their portfolio allocation; 29.4% of the respondents have their mutual funds mainly in stocks; 47.2% have half in bonds and half in stocks, and the remaining 23.4% mostly in bonds.

The results in Figure 4, reveal that all three types of mutual funds' shares are higher in the post-crisis period. Considering the link with financial literacy, there is a negative gradient in the case of "mostly stocks" but the differences are not statistically significant across the various levels of financial literacy. The finding of a positive link between financial literacy and overall Mutual Funds holdings, identified in Figure 3, is only reflected in the behaviour of the "half bonds and half stocks" type in Figure 4. Again, though, in the more restricted sample the differences across levels of financial literacy are non-significant.

4 Conclusions

We analyse data on European household financial portfolios over the period 2004-2017, to explore how households change their asset allocations following the recent twin financial crises. The post-crisis period is particularly interesting since it combines the investors' recent experience of large economic and financial upheaval with a very expansionary monetary policy stance. Hence, there is a tension between the recent negative experience of exposure of investors, which is expected to make them more cautious, and the tendency of lower interest rates to generate to "search for yield" behaviour. We further build on these arguments by positing that the degree of financial literacy of households can also affect this trade-off. We consider a wider set of alternatives to safe assets by incorporating mutual funds in to the standard set of stocks and bonds.

Our estimates show that the post-crisis period is associated with changes in European household asset allocation behaviour. Specifically, there are elevated holdings of safe assets and lower holdings of stocks and bonds, in line with the argument for cautiousness. At the same time, though, our findings reveal higher holdings of mutual funds in the post-crisis period. Hence, we provide novel evidence which suggests that "search for yield" during the post-crisis period took place not by raising the direct holdings of stocks and bonds, but rather indirectly through higher mutual funds' holdings. This is consistent in line with a "flight to delegation", that is,

[14] It is interesting to note that the interviewee is provided with the following somewhat loose definition of mutual funds: *Mutual funds are a pool of money belonging to many investors who trust a manager to invest it in stocks and or/bonds.*

the utilisation of the perceived expertise of mutual funds managers. Crucially, this behaviour is strongly linked to the level of financial literacy, since the most literate households tend to hold significantly more mutual funds.

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Table 1: Summary statistics

	Mean	Standard Deviation	Minimum	Maximum
	(1)	(2)	(3)	(4)
Panel A: Dependent variables, y_{it}				
Safe assets	0.869	0.285	0	1
Bonds	0.030	0.141	0	1
Stocks	0.041	0.153	0	1
Mutual Funds	0.058	0.189	0	1
Panel B: Individual/household covariates, $\mathbf{X}_{it}$				
Female	0.555	0.497	0	1
Age	66.466	9.859	50	103
Retired	0.567	0.495	0	1
Employed / Self-emp.	0.251	0.434	0	1
Unemployed	0.026	0.159	0	1
Sick/disabled	0.030	0.171	0	1
Homemaker	0.114	0.317	0	1
Other emp. status	0.012	0.111	0	1
Married	0.719	0.449	0	1
Separated	0.012	0.108	0	1
Never married	0.058	0.234	0	1
Divorced	0.074	0.262	0	1
Widowed	0.136	0.343	0	1
Number of children	2.119	1.338	0	19
No formal education	0.046	0.210	0	1
Primary education	0.199	0.399	0	1
Lower secondary	0.185	0.389	0	1
Upper Secondary	0.316	0.465	0	1
Post secondary	0.032	0.177	0	1
First-stage tertiary	0.210	0.407	0	1
Second-stage tertiary	0.011	0.106	0	1
Business owner	0.054	0.226	0	1
Home owner	0.791	0.406	0	1
Ln(Household income)	7.578	1.103	0	41.447
Ln(Net worth)	11.249	2.205	0	41.447
Financial risk aversion	3.742	0.536	1	4
Panel C: Country specific controls, $\mathbf{C}_{it}$				
Real GDP growth rate (%)	1.639	1.818	-1.827	7.597
Log of economic sentiment index	4.594	0.089	4.343	4.772
Euro overnight index average (EONIA) rate	0.724	1.167	-0.359	4.063
Log of the volatility of stock market	2.924	0.283	2.189	3.747
Panel D: Financial literacy, FL_{it}, and instruments, $\mathbf{Z}_{it}$				
Financial literacy score	3.375	1.092	1	5
Mathematics score at age 10	3.280	0.879	1	5
Language score at age 10	3.344	0.851	1	5
Number of individuals (N)		52,541		
Number of observations (NT)		102,861		

Table 2: Asset allocation and financial literacy

	Safe assets	Bonds	Stocks	Mutual funds
	(1)	(2)	(3)	(4)
Female	-0.044***	0.057***	0.021**	0.048***
	(0.010)	(0.016)	(0.011)	(0.012)
Age (/10)	-0.272***	0.278***	0.041	0.440***
	(0.051)	(0.089)	(0.056)	(0.065)
Age squared (/100)	0.018***	-0.015**	-0.002	-0.032***
	(0.004)	(0.006)	(0.004)	(0.005)
Employed / Self emp.	0.017	-0.064***	0.007	0.004
	(0.013)	(0.023)	(0.014)	(0.016)
Unemployed	0.039	-0.054	-0.031	-0.047
	(0.026)	(0.050)	(0.029)	(0.034)
Sick / disabled	0.097***	-0.119**	-0.073**	-0.099***
	(0.027)	(0.051)	(0.030)	(0.034)
Homemaker	0.002	-0.015	0.028*	0.002
	(0.015)	(0.025)	(0.017)	(0.019)
Other emp. status	0.005	0.050	0.030	0.018
	(0.033)	(0.058)	(0.036)	(0.042)
Separated	0.122***	-0.053	-0.122**	-0.136**
	(0.044)	(0.073)	(0.048)	(0.054)
Never married	0.034	-0.026	-0.043*	-0.052**
	(0.021)	(0.034)	(0.023)	(0.026)
Divorced	0.100***	-0.096***	-0.093***	-0.091***
	(0.019)	(0.033)	(0.020)	(0.022)
Widowed	0.104***	-0.054**	-0.159***	-0.072***
	(0.016)	(0.026)	(0.019)	(0.020)
Number of children	0.040***	-0.058***	-0.015***	-0.041***
	(0.004)	(0.006)	(0.004)	(0.005)
Primary education	-0.064**	-0.085	0.051	0.121***
	(0.031)	(0.052)	(0.036)	(0.041)
Lower secondary	-0.208***	0.068	0.220***	0.232***
	(0.031)	(0.052)	(0.036)	(0.041)
Upper secondary	-0.334***	0.175***	0.326***	0.330***
	(0.031)	(0.051)	(0.036)	(0.041)
Post secondary	-0.357***	0.296***	0.353***	0.349***
	(0.041)	(0.067)	(0.046)	(0.052)
First-stage tertiary	-0.467***	0.313***	0.423***	0.452***
	(0.032)	(0.052)	(0.037)	(0.041)
Second-stage tertiary	-0.489***	0.270***	0.462***	0.473***
	(0.048)	(0.078)	(0.051)	(0.058)
Business owner	-0.164***	0.145***	0.168***	0.088***
	(0.015)	(0.026)	(0.016)	(0.019)
Home owner	0.266***	-0.246***	-0.142***	-0.261***
	(0.014)	(0.023)	(0.016)	(0.018)
Ln(Household income)	-0.004	0.004	-0.005	0.005
	(0.004)	(0.008)	(0.005)	(0.006)
Ln(Net worth)	-0.110***	0.103***	0.068***	0.103***
	(0.003)	(0.005)	(0.003)	(0.004)
Financial risk aversion	0.291***	-0.174***	-0.261***	-0.288***
	(0.007)	(0.011)	(0.007)	(0.008)
Financial literacy score	-0.060***	0.066***	0.053***	0.049***
	(0.005)	(0.008)	(0.005)	(0.006)
Mundlak FEs	✓	✓	✓	✓
Country FEs	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓
Month FEs	✓	✓	✓	✓
Mean dep. var.	.87	.03	.041	.058
Observations (NT)	102,861	102,861	102,861	102,861

Notes. Estimates are average marginal effects from Random Effects Tobit models. The omitted category for: employment status is 'Retired'; marital status is 'Married / living together / Registered partnership'; and for education is 'No formal education'. Standard errors are in parentheses. ***,**,* Statistically significant at the 1%, 5% and 10% level respectively.

Table 3: Asset allocation and financial literacy - IV analysis

	Safe assets	Bonds	Stocks	Mutual funds
	(1)	(2)	(3)	(4)
Panel A: Panel random effects Tobit				
Financial literacy score	-0.060***	0.066***	0.053***	0.049***
	(0.005)	(0.008)	(0.005)	(0.006)
Observations (NT)	102,861	102,861	102,861	102,861
Panel B: Pooled Tobit clustered standard errors (SEs)				
Financial literacy score	-0.053***	0.061***	0.048***	0.043***
	(0.005)	(0.008)	(0.006)	(0.006)
Observations (NT)	102,861	102,861	102,861	102,861
Panel C: IV maths pooled Tobit clustered SEs				
Instrumented financial literacy score	-0.190***	0.139***	0.202***	0.137***
	(0.039)	(0.059)	(0.041)	(0.046)
H_0: Exogeneity $\chi^2(1)$; p-value	14.31; p=0.000	2.39; p=0.122	15.70; p=0.000	4.82; p=0.028
H_0: β_{maths}=0: z-statistic; p-value		630.22; p=0.000		
Kleibergen-Paap F-statistic; p-value		507.14; p=0.000		
Observations (NT)	76,258	76,258	76,258	76,258
Panel D: IV language pooled Tobit clustered SEs				
Instrumented financial literacy score	-0.234***	0.249**	0.130***	0.260***
	(0.074)	(0.113)	(0.077)	(0.088)
H_0: Exogeneity $\chi^2(1)$; p-value	6.66; p=0.010	3.19; p=0.074	1.25; p=0.264	6.72; p=0.010
H_0: β_{lang}=0: z-statistic; p-value		173.83; p=0.000		
Kleibergen-Paap F-statistic; p-value		476.98; p=0.000		
Observations (NT)	76,227	76,227	76,227	76,227
Panel E: IV maths and language pooled Tobit clustered SEs				
Instrumented financial literacy score	-0.196***	0.151***	0.197***	0.149***
	(0.038)	(0.058)	(0.041)	(0.045)
H_0: Exogeneity $\chi^2(1)$; p-value	15.74; p=0.000	3.19; p=0.074	15.03; p=0.000	6.25; p=0.012
H_0: β_{maths}=β_{lang}=0: $\chi^2(2)$; p-value	649.79; p=0.000	649.74; p=0.000	649.60; p=0.000	649.81; p=0.000
Kleibergen-Paap F-statistic; p-value		321.09 (498.79); p=0.000		
Observations (NT)	76,154	76,154	76,154	76,154

Notes. Estimates are average marginal effects. Controls as in Table 2. Standard errors are in parentheses. ***,**,* Statistically significant at the 1%, 5% and 10% level respectively. In panels C-E the instruments are binary based upon maths and/or language ability at age 10.

Table 4: Average marginal effects underlying Figure 3

	Safe assets	Bonds	Stocks	Mutual funds
	(1)	(2)	(3)	(4)
Post-crisis, θ	0.045***	-0.245***	-0.088***	0.101***
	(0.014)	(0.026)	(0.016)	(0.019)
Financial literacy score (FL), γ	-0.059***	0.062***	0.053***	0.049***
	(0.005)	(0.008)	(0.006)	(0.006)
FL $\times$ Post-crisis, δ				
(FL=1) δ_1	0.060***	-0.181***	-0.084***	0.021
	(0.023)	(0.046)	(0.027)	(0.032)
(FL=2) δ_2	0.051***	-0.205***	-0.087***	0.062***
	(0.017)	(0.033)	(0.020)	(0.024)
(FL=3) δ_3	0.046***	-0.233***	-0.091***	0.094***
	(0.014)	(0.027)	(0.016)	(0.020)
(FL=4) δ_4	0.042***	-0.269***	-0.087***	0.121***
	(0.014)	(0.027)	(0.016)	(0.020)
(FL=5) δ_5	0.036**	-0.280***	-0.086***	0.141***
	(0.017)	(0.032)	(0.019)	(0.023)
Observations (NT)	102,861	102,861	102,861	102,861

Notes. Estimates are average marginal effects from estimating equation 5. Controls as in Table 2. Standard errors are in parentheses. ***,**,* Statistically significant at the 1%, 5% and 10% level respectively.

Figure 1: Asset share distribution

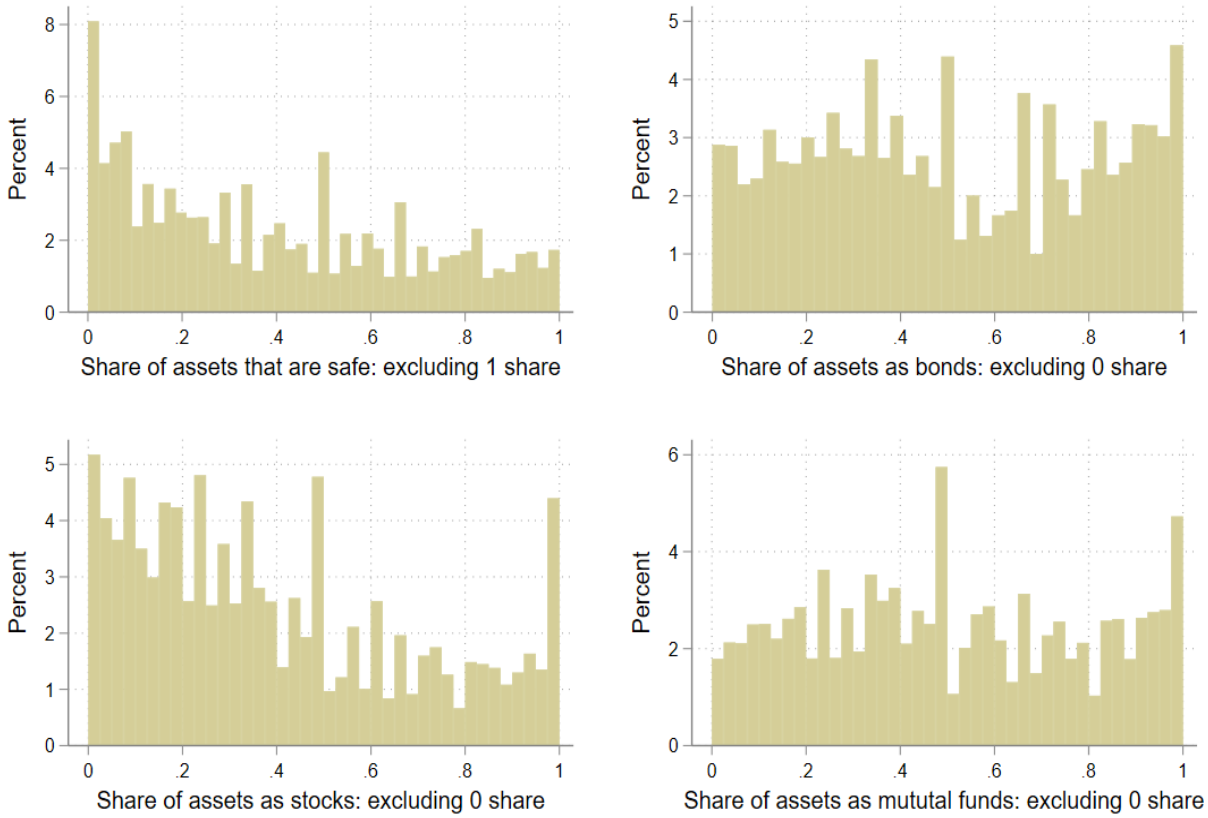

Figure 2: Evolution of asset shares over time

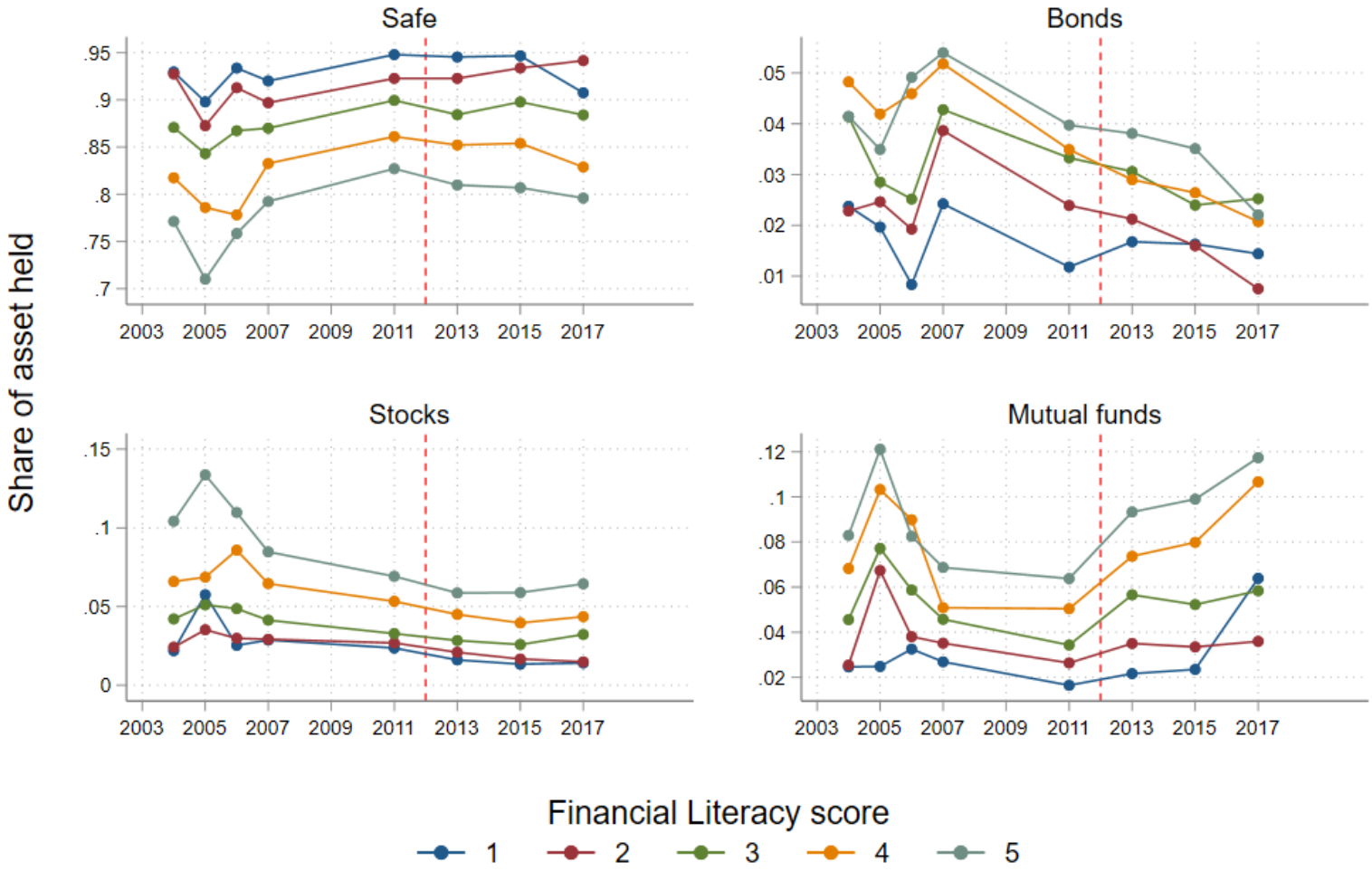

Figure 3: Effect of financial literacy on assets

Figure 4: Composition of mutual funds - financial literacy