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**A version of this SERPS paper was published in Jan 2020. If you would like to obtain this original PDF file then please email Alberto Montagonoli (a.montagnoli@sheffield.ac.uk)*

Sheffield Economic Research Paper Series

SERPS no. 2020001

ISSN 1749-8368

November 2020

Household Portfolios and Monetary Policy*

Raslan Alzuabi[1], Sarah Brown[1], Alexandros Kontonikas[2], and Alberto Montagnoli[1]

[1] *Department of Economics, University of Sheffield, UK*

[2] *Essex Business School, University of Essex, UK*

November 2020

Abstract

We show that expansionary monetary policy is associated with higher household portfolio allocation to high risk assets and lower allocation to low risk assets, in line with "reaching for yield" behaviour. Our findings are based on analysis of US household level panel data using alternative measures of monetary policy shifts over the period 1999-2007. Using the two-part Fractional Response Model, we also show that changes in the Federal Funds Rate (FFR) have a stronger impact on the decision to hold high risk assets relative to the impact on the decision to hold low risk assets. Furthermore, our results highlight the role of self-reported risk attitudes in affecting the response of household portfolios to monetary policy changes. Finally, our findings indicate that the impact of FFR changes is stronger for active investors.

Keywords: Fractional Response Models; Household Financial Portfolio Allocation; Monetary Policy.

JEL classification: D14, G11, E52.

*We are grateful to the Editor for valuable comments, and especially for suggesting the use of the Fractional Response Model. The authors are grateful to Andrew Bryce for excellent research assistance. We would like to thank Alessandro Bucciol, Dan Gray, Tullio Jappelli, Mirko Moro, Karl Taylor and the participants at the second Sheffield Household Finance Workshop, May 2019, for helpful comments and suggestions on an earlier version of the paper. We thank Kostas Mouratidis for providing data on monetary policy shocks. All remaining errors are ours.

1 Introduction

We show that monetary policy conditions matter for household asset allocation. The recent experience of historically low interest rates in the US, as well as in other countries, has stimulated a body of research on the effects of monetary policy on financial markets and the real economy. A widely held view is that by reducing interest rates, central banks have increased the appetite of investors for risk-taking, the so-called "reaching for yield", in an effort to improve financial market conditions and support economic activity. Reaching for yield is a double-edged sword since it distorts asset allocations in favour of risky assets, a development that can have adverse consequences for financial stability (Rajan, 2006; Borio and Zhu, 2012). In the aftermath of the 2007-2008 global financial crisis, policymakers have often called for vigilance regarding emerging risks to the financial system from highly accommodative monetary policy (Yellen, 2011).[1] At the same time, ultra-low interest rates have depressed returns from savings and have fuelled a debate on whether they discourage households from saving.

A body of literature has emerged on the important implications of reaching for yield. However, previous studies typically focus on the behaviour of financial institutions (Jiménez et al., 2014; Di Maggio and Kacperczyk, 2017; Chodorow-Reich, 2014) and little is known about how households respond to monetary policy conditions. Specifically, it remains unclear as to whether the composition of households' portfolios across high risk and low risk assets changes in response to monetary policy shifts. The main contribution of our paper

[1]The debate on the link between monetary policy and financial stability predates the 2007-2008 global financial crisis. A prevalent view among central bankers in the late 1990s to early 2000s was that monetary policy should not be used to counteract rapid increases in asset prices or credit growth. This was sometimes referred to as the "Jackson Hole consensus", and was supported by theoretical and empirical academic work (e.g. Bernanke and Gertler, 2001). On the other hand, Borio and Lowe (2002), among others, highlighted the dangers for financial stability from asset prices and credit booms and busts, while Cecchetti et al. (2000) supported a proactive monetary policy stance when responding to asset price misalignments.

lies in tackling this question by conducting empirical analysis of the effects of monetary policy actions on the asset allocation of US households. In addition, we consider channels that may explain these effects, such as the role of self-reported attitudes towards risk, which has attracted interest in the existing household finance literature.

We analyse household-level data drawn from the biennial US Panel Study of Income Dynamics (PSID) over the period 1999-2007, utilising 5 waves of PSID surveys. This information allows us to explore the allocation of financial assets into low risk (e.g. money in saving accounts) and high risk (e.g. stocks) categories. Specifically, we explore the determinants of the share of low risk assets and the share of high risk assets in the household portfolio. The PSID contains an extensive range of socio-demographic information, which enables us to control for a wide variety of household characteristics, as is standard in the household finance literature (see, e.g., Guiso et al., 1996; Dohmen et al., 2011).

Changes in monetary policy are measured using two approaches. The first uses changes in the effective Federal Funds Rate (FFR) prior to each survey and provides a simple and intuitive measure of monetary policy shifts that does not rely upon sophisticated econometric analysis. The second approach uses the methodology of Romer and Romer (2004), as refined by Caglayan et al. (2017), to obtain unexpected FFR changes. Both approaches are based on the idea that the FFR is the key US monetary policy indicator, with unexpected FFR changes providing reliable estimates of policy shocks, over a long period stretching from the mid-1980s to the 2007-2008 financial crisis (Bernanke and Blinder, 1992; Romer and Romer, 2004).

Our main econometric estimation method is a random effects Fractional Response Model (FRM), with portfolio shares regressed on monetary policy shifts and a range of household and macro-controls. The FRM, which is ideally suited to modelling dependent

variables that lie on the unit interval, has only recently been used in the household finance literature (see, for example, Bucciol et al., 2019; Stavrunova and Yerokhin, 2012). We find that expansionary monetary policy is associated with higher allocation to high risk assets and lower allocation to low risk assets. Hence, our empirical evidence suggests that "reaching for yield" is not confined to financial institutions, and can also characterise the financial behaviour of households.

To further explore the link between household portfolios and monetary policy, we use the two-part FRM estimation method following Ramalho and Silva (2009) and Schwiebert and Wagner (2015). This is motivated by the fact that zero and non zero values of the asset shares are included in the sample, since some households do not hold any low risk and/or high risk assets. The two-part FRM approach allows us to evaluate the effects of monetary policy on whether high and/or low risk assets are held (the probit part of the model) and, conditional on holding an asset type, the impact of monetary policy on the portfolio share (the fractional part of the model). Interestingly, while the monetary policy effects on portfolio shares in the fractional part are in line with the findings from the standard FRM approach, an important difference arises in the participation equation. Specifically, the findings indicate that the decision to hold high risk assets and the decision to hold low risk assets are both related to actual changes in the FFR, rather than policy shocks. Furthermore, the impact of actual changes in the FFR on the decision to hold high risk assets is much stronger than its impact on the decision to hold low risk assets.

We also investigate possible mechanisms that might explain the response of household portfolios to changes in monetary policy conditions. Our results suggest that self-reported attitudes towards risk play an important role here. Specifically, the relationship between monetary policy shifts and household portfolio allocation is stronger for households that

are less tolerant towards risk. On the other hand, the effect of monetary policy changes on the decision to hold high or low risk assets as well as the associated portfolio shares is statistically insignificant for households that are the most tolerant towards risk, suggesting that the asset allocation decisions of such households are motivated by other factors.

An important caveat that underlies our findings is related to the distinction between active portfolio rebalancing versus passive valuation effects (Bucciol and Miniaci, 2015), since even the portfolio share of a household with full inertia in its investment behaviour may display variation over time, driven by valuation changes. To shed more insight on the implications of this issue for our findings, we separate our sample into households classified as active and inactive investors based on their response to a survey question on buying or selling financial assets over the previous year. The previous literature points out that a minority of financially sophisticated households (generally the wealthy and better educated) tend to rebalance their portfolios more actively, in contrast to the majority of households who exhibit considerable inertia (Brunnermeier and Nagel, 2008; Calvet et al., 2009). To address potential selection bias arising from the fact that active investors are likely to differ systematically from inactive investors, we explore the robustness of our findings to adopting the Heckman selection estimation approach. The evidence is consistent with the FRM results: expansionary policy has a positive (negative) effect on high (low) risk asset shares, thereby endorsing the robustness of our findings.

Our study is relevant to several strands of the existing literature. A key related strand is concerned with the risk-taking channel of monetary policy. Previous empirical studies have examined the behaviour of banks (Jiménez et al., 2014; Delis et al., 2017; Alzuabi et al., 2020), mutual funds (Hau and Lai, 2016; Di Maggio and Kacperczyk, 2017), and pension funds (Chodorow-Reich, 2014; Joyce et al., 2017). These studies typically provide

evidence in support of greater propensity for undertaking riskier investments by financial institutions when interest rates are low. In addition, empirical evidence demonstrates that accommodative monetary policy reduces the credit spreads of firms (Gertler and Karadi, 2015), risk premia (Bernanke and Kuttner, 2005) and market-based measures of risk aversion (Bekaert et al., 2013). The underlying theoretical mechanisms may differ across studies, but the common thread is that investors respond to expansionary monetary policy by reaching for yield.[2] We contribute to the risk-taking channel literature by empirically modeling the link between portfolio allocation and monetary policy using household-level data.

In a similar spirit to our paper, Lian et al. (2019) conclude that US household investment decisions are characterised by reaching for yield when monetary policy is expansive (i.e. low short-term interest rates). Nevertheless, 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. Hence, their econometric analysis cannot account for household characteristics. The recent study by Luetticke (2020) is also concerned with the effects of monetary policy shocks on household portfolio choices. However, it focuses on the choice between liquid and illiquid assets and the potential heterogeneity in portfolio responses to policy shocks across households with different levels of wealth.[3]

[2]In theoretical models of the risk-taking channel of monetary policy, a reduction in the policy rate causes higher risk-taking by financial institutions, resulting in lower risk premia and amplifying the magnitude of the interest rate cut. These models highlight the role of leverage (Adrian and Shin, 2010), funding conditions (Drechsler et al., 2018), and institutional frictions (Acharya and Naqvi, 2019). Moreover, some financial institutions, such as pension funds, have long-term liabilities which, when discounted at low interest rates, are increasingly difficult to meet unless more risk is taken on the asset side through higher yielding investments (Lucas and Zeldes, 2009; Rajan, 2011).

[3]Luetticke (2020) uses repeated cross-sectional data on household portfolios from the Survey of Consumer Finances (SCF). He defines liquid assets to include deposits, cash, debt securities and loans held directly, while all other real and financial assets are classified as illiquid assets. By sorting households across different percentiles of net liquid wealth, he finds that monetary policy tightening shocks lead to

Finally, our study is informative about the effects of monetary policy on saving behaviour in that the stock of savings forms a significant part of low risk asset holding for households. Theoretically, the effect of interest rates on savings is ambiguous (Attanasio and Weber, 2010).[4] Furthermore, the empirical evidence on the interest rate elasticity of savings is mixed. Some studies support the substitution effect (Horioka and Wan, 2007), especially when nominal rates are very low (Aizenman et al., 2019), while others find little/no effect (Beer et al., 2016), or even a negative relationship consistent with the income effect (Nabar, 2011). Importantly, many of these studies use data at the macroeconomic level, and, therefore, cannot shed light on the behaviour of households.

The rest of the paper proceeds as follows. Section 2 describes the household survey data and the measurement of monetary policy shifts. Section 3 presents evidence from the FRM estimations exploring the role of monetary policy in influencing household portfolio allocation. Section 4 presents the results from the two-part FRM analysis to explore whether monetary policy has different effects on the decision to hold asset types and on the shares of the asset types held. Section 5 explores various potential mechanisms and Section 6 analyses the implications of active versus inactive investment behaviour for the relationship between monetary policy and household portfolio allocation. Finally, Section 7 concludes.

a reduction (increase) in the portfolio liquidity of households below (above) median wealth. Unlike our study, Luetticke (2020) additionally considers the cross-sectional response of household consumption to monetary policy shocks; see also, among others, Jappelli et al. (2018) and Cloyne et al. (2019).

[4]A decrease in the interest rate represents an increase in the price of future consumption (relative to current consumption), generating an increase in current consumption and a decline in current savings. However, this substitution effect may be offset by an income effect since, given the lower interest rate, a target level of future consumption requires more savings. Moreover, a wealth effect, arising from asset revaluation, due to lower interest rates, can also lead to an increase in consumption and a decrease in saving, reinforcing the substitution effect.

2 Data

2.1 Household-level data

Our household-level data is drawn from the US PSID, a longitudinal survey, which began in 1968 and initially included approximately 5,000 families and 18,000 individuals. The PSID has been used extensively in the existing literature on household finance (Carroll and Samwick, 1998; Hurst et al., 2010; Guiso and Sodini, 2013). Since we are interested in the effects of monetary policy on household financial portfolios, we focus on the information contained in the supplementary Wealth Modules, which were collected biennially from 1999 onwards. Specifically, our analysis covers the following 5 waves of the survey: 1999, 2001, 2003, 2005 and 2007. The sample includes 5,328 households and 15,650 ($N \times T$) observations.

The information provided in the Wealth Modules allows us to explore the allocation of financial assets into low risk and high risk categories. Low risk assets are defined from the responses to the question: 'Do you [or anyone in your family living here] have any money in checking or savings accounts, money market funds, certificates of deposit, government savings bonds, or treasury bills, not including assets held in employer-based pensions or IRA's?' On the other hand, high risk assets are defined from the responses to: 'Do you [or anyone in your family living here] have any shares of stock in publicly held corporations, mutual funds, or investment trusts, not including stocks in employer-based pensions or IRA's?'

We also include the risky elements of a household's pension accounts. These are based firstly on the question: 'Do [you/ or your family living there] have any money in private annuities or Individual Retirement Accounts (IRAs)?' We then use responses to

the follow-up question: 'Are they mostly in stocks, mostly in interest earning assets, split between the two, or what?' Based on the response to the second question, we make the following assumption about how these assets are allocated. Specifically, if the household reports 'mostly stocks', 100% of the value of pension assets are coded to be high risk assets. This approach is consistent with Brunnermeier and Nagel (2008).

We aim to explore the impact of monetary policy on the share of assets held in each category, with the numerator of the low risk (high risk) share being defined as the dollar value of all financial assets held as asset types defined as low risk (high risk) and the denominator for both asset shares is the dollar value of all financial assets held at the time of the survey. Non-financial assets (e.g. housing wealth) are not included in the denominator as we control for them in the analysis as detailed below. Therefore, the values for the low risk and high risk asset shares are constrained to lie between zero and one. On average and in accordance with our expectations, as shown in Table 1, the low risk portfolio share is considerably higher (62.7%) than the high risk share (21.3%). Figure 1 plots the histogram of the low and high risk asset shares, including and excluding the cases of zero holdings. A key insight from this figure is that most households in our sample do not hold any high risk assets in their portfolios, which, as discussed in more detail below, is a common finding in the household finance literature.

The PSID contains an extensive range of household characteristics that are commonly controlled for in the existing household finance literature (see, e.g., Guiso et al., 1996; Guiso and Paiella, 2008; Dohmen et al., 2011). These include: household net worth, defined as an inverse hyperbolic sine transformation of the difference between total assets and total liabilities including the net value of real estate; total family (household) income in the previous calendar year; whether the respondent is a homeowner (i.e. whether they

or anyone else in the family living there owns or is buying the home, either fully or jointly); whether the respondent owns a business or has a financial interest in any business; the head of household's gender, age, race, labour market status, education, marital status and self-assessed health.

An important feature of the PSID is that it includes a measure of the respondent's risk attitudes based on the 1996 PSID Survey, which includes a risk aversion section. The risk aversion section contains five questions related to hypothetical gambles with respect to lifetime income. The series of questions enables us to place respondents into one of six categories of risk attitudes, where, faced with a 50-50 gamble of doubling income or cutting it by some given factor, the individual will accept the risky job if the expected utility from the job change exceeds that of the utility from remaining with the current job where income is certain (for full details, see, e.g., Brown et al., 2013; Kimball et al., 2008). We construct a risk tolerance index, which can take any integer value between 0 and 5, and is increasing in risk tolerance. Finally, as the set of risk aversion questions was only asked in 1996, there is no variation in risk attitudes within households across years, see for instance Schildberg-Hörisch (2018, p.148) who argues that "individual risk preferences appear to be persistent and moderately stable over time". Consequently, any household joining the panel after 1996 is effectively excluded from the sample.

2.2 Monetary policy measures

To identify monetary policy shifts, we use two approaches. First, we calculate the average change in the monthly value of the effective FFR across the two years preceding each

survey.[5] This approach has the benefit of simplicity and is consistent with the idea that most households are not sophisticated enough to rely upon advanced econometric models in order to evaluate the stance of monetary policy. Second, to isolate the unexpected component of FFR changes, we use monetary policy shocks that account for the Federal Reserve Board's response to expected economic conditions. Policy shocks are calculated using a well-established methodology proposed by Romer and Romer (2004). The calculation of Romer and Romer's shocks (*RR shock*) involves two steps. First, intended FFR changes around the Federal Open Market Committee (FOMC) meetings are identified. Second, the intended FFR changes are regressed on the internal FOMC forecasts for inflation and real economic activity, i.e. the Greenbook forecasts, around the dates of these forecasts. The residuals from that regression represent monetary policy shocks. The methodology of Romer and Romer is further developed by Caglayan et al. (2017) by introducing time-varying parameters and regime shifts into their model.[6]

The resulting shocks are plotted in Figure 2, highlighting, for instance, the expansionary policy surprises of the early 2000s that followed the collapse of the "dot-com" bubble. Our analysis of the impact of monetary policy shifts on household portfolios focuses on the period 1999-2007. This is motivated by the fact that, while there is wide agreement regarding the identification of monetary policy shocks before 2007, there is still no consensus on this issue for the period that includes the 2007-2008 crisis and the ensuing zero lower bound (ZLB).[7] Moreover, the existing literature on the effects of monetary

[5]There is substantial empirical evidence indicating that the FFR has been the key US monetary policy indicator since the mid-1980s (Bernanke and Blinder, 1992; Romer and Romer, 2004).

[6]The frequency of this data is quarterly and the series ends at 2008Q4. In line with our approach for the simple measure of monetary policy shifts, we average the quarterly shocks across the two years preceding each survey.

[7]The 2007-2008 financial crisis had a significant impact on the Federal Reserve Board's approach to monetary policy implementation. Following a series of FFR cuts, commencing in Autumn 2007, the ZLB was reached by the end of 2008 and the Federal Reserve Board resorted to non-conventional monetary policy tools. It provided assurances about the intention to keep the FFR at the ZLB and aimed to put

policy on financial markets during the crisis/ZLB period often uses VAR-based (Gertler and Karadi, 2015) and/or event study approaches (Gagnon et al., 2011) along with high-frequency data. These methods are not compatible with the lower frequency at which household survey data are generally available.[8]

3 Modelling asset shares

An important feature of the asset shares is that they are defined on the closed interval $y_{it} \in [0, 1]$, with a significant portion of the sample observations falling at one of the two extremes. Using linear models for bounded dependent variables, such as OLS, will often produce predicted values that lie outside these bounds. Furthermore, linear models will not account for the fact that bounded variables are subject to floor and ceiling effects. Hence, the results will be biased as they will reflect constant partial effects of changes in the explanatory variables even when the dependent variable approaches one of the bounds (Gallani and Krishnan, 2017).

Nonlinear models, such as logit and probit models, can be used to prevent predicted values from falling outside the closed interval of such bounded variables, but these models are appropriate in the case of binary response variables. Nonlinear models that are frequently used to model continuous variables that are bounded in nature, such as Tobit models, censored regressions and truncated models, also have limitations when a significant portion of the sample observations falls at one of the extremes.[9] While the truncated

downward pressure on long-term rates through changes in the size and composition of its balance sheet.

[8] In additional results, which are available upon request, we extend the sample period to 2015, using changes in the shadow rate of Wu and Xia (2016) from January 2009 onwards, and obtain evidence similar to the pre-crisis period. Some studies support the shadow rate as a measure of the monetary policy stance at the ZLB (Wu and Xia, 2016; Bullard, 2012), nevertheless this remains an area of debate in the literature.

[9] The results for Sections 3 and 5 are robust to using a Tobit estimator and are available on request.

models suffer from sample selection bias (Maddala, 1991), the Tobit model is sensitive to heteroscedasticity (Arabmazar and Schmidt, 1981) and relies on distributional assumptions that are frequently not reflected in survey data (Gallani and Krishnan, 2017). The Fractional Response Model (FRM), developed by Papke and Wooldridge (1996, 2008), provides an effective approach to overcome these limitations and it has been only recently employed in the area of household finance (see, for example, Bucciol et al., 2019; Stavrunova and Yerokhin, 2012).

The FRM approach assumes that the conditional mean of the fractional response variable, y_{it}, given a set of explanatory variables, X_{it}, is specified as:

$$E(y_{it}|X_{it}) = G(X_{it}\boldsymbol{\theta}). \tag{1}$$

The FRM requires a functional form for y_{it} that ensures that the fitted values lie on the unit interval. Papke and Wooldridge (1996) suggest any cumulative distribution function (logit or probit) as possible specifications for $G(.)$. In this paper, the fractional probit specification is used where the probit function will map X_{it} onto the (0,1) interval,

$$G(X_{it}\boldsymbol{\theta}) = \Phi\left(X_{it}\boldsymbol{\theta}\right), \tag{2}$$

where Φ is the standard normal cumulative distribution function and $\boldsymbol{\theta}$ is a vector of unknown parameters. The explanatory variables included in the vector X_{it} are: the household and head of household specific covariates as described in Section 2.1; macroeconomic controls, which are discussed below; and the measure of monetary policy, as defined in Section 2.2. The measures of monetary policy are our key parameters of interest, which will capture the relationship between monetary policy and household portfolio allocation.

Papke and Wooldridge (1996) propose estimating FRM by quasi-maximum likelihood (QML) based on the Bernoulli log-likelihood function, which is given by:

$$l_{it}(\boldsymbol{\theta}) = y_{it}\ log[G(X_{it}\boldsymbol{\theta})] + (1 - y_{it})\ log[1 - G(X_{it}\boldsymbol{\theta})]. \tag{3}$$

The marginal effects of a unitary change in x_k in the standard FRM is given by:

$$\frac{\partial E(y_{it}|X_{it})}{\partial x_k} = \boldsymbol{\theta}_k g(X_{it}\boldsymbol{\theta}). \tag{4}$$

We augment the FRM specification with Mundlak (1978) corrections to control for unobserved time-invariant household heterogeneity that is not captured by the data. Specifically, this approach entails including the means of the time-varying continuous variables, such as income and net wealth, in the set of explanatory variables. The estimates of the parameters in the model are regarded as an approximation to a standard panel fixed effects estimator, as shown in Wooldridge (2019).

As stated above, in our estimations, we control for macroeconomic conditions using the average quarterly percentage change in real GDP over the two years that precede each survey. For robustness, we also use the average of the Chicago Fed National Activity Index (CFNAI) across the two years before each survey. The CFNAI is a monthly index designed to gauge overall economic activity, and related inflationary pressures, by combining 85 existing monthly indicators.

Prior to including monetary policy measures and any macroeconomic controls, in Table 2, we present the marginal effects for all the household and head of household characteristics for the low risk asset share and high risk asset share equations. These

controls are included in all models presented in the paper, but, for brevity, we only present them in full in Table 2. In general, the findings tie in with previous studies with, for example, income and net worth being positively (negatively) related to the share of high (low) risk assets held. This is also the case for business ownership, being retired and for households that are more tolerant towards risk. Households with heads at the early stages of the life cycle appear to be less inclined to hold high risk assets, as is also the case for being non-white and having relatively low levels of education. These effects accord with intuition as well as the existing literature (see, for example, Guiso et al., 1996; Guiso and Paiella, 2008; Ampudia and Ehrmann, 2017), thereby endorsing our baseline model specification.

Table 3 reports estimates of the model described in Equation 2 above, which includes the monetary policy measures and the macroeconomic controls. With respect to the macroeconomic controls, to explore robustness, we explore three different specifications: in the first specification, we do not include any macroeconomic controls (Panel A); the second specification controls for past GDP growth (Panel B); in the third specification, we replace GDP growth with the CFNAI (Panel C).

Across all specifications in Table 3, the two measures of monetary policy, capturing actual FFR and unexpected FFR changes (*RR shock*), are statistically significant at the 1% level, except in specification 4, where the monetary policy measure is statistically significant at the 5% level and in specification 12, where it is not statistically significant. The negative sign of the estimated parameters associated with the monetary policy changes for the share of high risk assets indicates that expansionary monetary policy, as captured by interest rate cuts, is associated with higher allocation to high risk assets. In contrast, monetary easing is associated with lower allocation to low risk assets. These findings

are in line with the argument that low interest rates discourage households from saving, while encouraging them to hold relatively risky assets in accordance with reaching for yield behaviour.[10]

Overall, the magnitude of the estimated parameters in Table 3 differs substantially across the actual and unexpected interest rate changes with the former having a stronger impact and being consistently statistically significant. For example, in the case of the high risk asset share in Panel B, the marginal effects for FFR changes and the *RR shock* are -0.259 and -0.131, respectively. The difference in magnitudes accords with intuition and is in line with our expectations, since most households are not sophisticated enough to rely upon advanced econometric models in order to evaluate the stance of monetary policy. The robustness of this pattern of results to the inclusion of the macroeconomic controls is particularly noteworthy. The findings in Panels B and C indicate that a growing economy is associated with a higher (lower) share of high (low risk) assets. Overall, our findings, which accord with reaching for yield behaviour amongst households, are consistent across a range of specifications. We now turn to exploring robustness via alternative modelling approaches.

4 A two-part modelling approach

As shown in Figure 1, the majority of households do not hold high risk assets. Indeed, the 'stock-holding puzzle' whereby households appear disinclined to hold risky assets even in the presence of a historical equity premium, is well-known in the existing literature (Haliassos and Bertaut, 1995). The inclusion of households with zero holdings of high

[10]For all estimations, to aid comparison with the existing literature, we frame the discussion of the results in terms of expansionary monetary policy to accord with "reaching for yield" behaviour.

risk assets in our analysis may lead to biased estimates of the effect of monetary policy on portfolio allocation.[11] Motivated by this issue, we explore the robustness of our findings to using the two-part FRM estimation method. This approach allows us to examine the impact of monetary policy shifts on the two different parts of the distribution of the asset share variables. Specifically, we can evaluate monetary policy effects on whether high and/or low risk assets are held and, conditional on holding an asset type, the amount of the asset share held.

The two-part FRM was introduced by Ramalho and Silva (2009) as an extension of the original Papke and Wooldridge (1996) FRM approach. However, the two-part model proposed by Ramalho and Silva (2009) assumes independence between the decision to hold an asset type and the decision related to the level of holding. Schwiebert and Wagner (2015) proposed a generalisation of the two-part model, which allows for dependence between each part of the model. In this paper, the "Conditional Mixed Process" (CMP) framework developed by Roodman (2011) is used to allow for contemporaneous cross-equation error correlation. The CMP approach is based on a general seemingly unrelated regression (SUR) framework, in which, although the dependent variables are independent from each other, correlation between their error terms is allowed for.[12]

The first part of the generalised two-part FRM models the probability of a household holding an asset type using a binary choice framework defined as:

$$Pr(y_{it}^{*} = 1|Z_{it}) = Pr(y_{it} \in (0,1]|Z_{it}) = \Phi\left(Z_{it}\boldsymbol{\theta}\right), \tag{5}$$

[11] It is important to acknowledge that in the FRM analysis presented in Section 3, zero and non zero values of the asset shares are included in the estimations. Hence, the findings reveal the effect of monetary policy on the expected value of the asset share, which could be operating at zero or positive values of the asset share.

[12] Wulff (2019) provides an illustration of how the CMP suite of tools can be used to fit the generalized two-part fractional regression model in STATA.

where Φ is the standard normal cumulative distribution function, Z_{it} is a vector of covariates, which influence the decision to hold the specific asset type, and y_{it}^* is defined as follows:

$$y_{it}^* = \begin{cases} 0 & \text{for } y_{it} = 0 \\ 1 & \text{for } y_{it} \in (0, 1]. \end{cases} \tag{6}$$

The second part of the generalised two-part FRM relates to positive holding of the asset type, i.e. the magnitude of asset holding in the portfolio. In this case, the specification for this part is:

$$E(y_{it}|X_{it}, Z_{it}, y_{it}^* = 1) = \frac{\Phi\, 2(X_{it}\boldsymbol{\gamma}, Z_{it}\boldsymbol{\theta}; \rho)}{\Phi\,(Z_{it}\boldsymbol{\theta})}, \tag{7}$$

where $\Phi 2(.; \rho)$ denotes the bivariate standard normal distribution function with correlation coefficient, ρ, between the participation and the level of holding decisions. X_{it} is a vector of explanatory variables, which influence this part of the distribution. Standard errors are clustered at the household level.[13]

In addition to the set of controls in Equation 5 (i.e. the first part of the model), a dummy variable indicating whether the household has received a financial windfall is included as an over-identifying variable. This variable indicates whether the household has received a financial windfall during the previous two years in the form of an inheritance or gift worth $10,000 or more. The key issue lies in selecting a suitable identifying variable for the first stage, specifically a variable which influences the probability of holding an asset type but does not influence the shares of high risk and low risk assets held.[14]

[13]Full formulations of the generalised two-part FRM can be found in Schwiebert and Wagner (2015).

[14]This approach is similar to Spaenjers and Spira (2015) and Guiso et al. (2003), where income and wealth quartiles are included in the equation of the stock market participation decision, on the basis of the argument that the relationship between the decision to participate in the stock market and wealth is non-linear. This is because changes in wealth at very low or very high wealth quantiles will not have a

The results from estimating the generalised two-part FRM are presented in Table 4, where in Panel A no macro controls are included, in Panel B we control for past GDP growth and in Panel C we replace GDP growth with the CFNAI. For each specification, in each panel, we report the marginal effects relating to our key variables of interest for the probit part of the model (i.e. the decision to hold), the same for the fractional part (i.e. the level of holding) and the associated correlation coefficient, ρ, between the error terms of the two equations. Similar to the discussion related to the FRM in Section 3, the marginal effects are obtained to assess the effect of a change in the explanatory variables on the probability of holding an asset type and on the amount of held.

It is apparent that the measures of monetary policy shifts are positively (negatively) associated with the continuous part of the low (high) risk asset share distribution across most specifications. Hence, the monetary policy effects on household portfolios are in line with the findings presented in Section 3. In addition, the results related to the participation equation reveal some important differences across asset types. Specifically, the results in Table 4 show that changes in monetary policy have a larger impact on the decision to hold high risk assets.

Furthermore, an important difference in the effects of the two measures of monetary policy, the actual FFR and the unexpected FFR changes, on the participation equation can also be observed from the results presented in Table 4. Specifically, while changes in the actual FFR strongly affect the decisions to hold high and low risk assets, the impact of the unexpected FFR changes on the decisions to hold these assets is typically statistically insignificant across the various specifications. This suggests that the household's

pronounced impact on the probability of participating in the stock market. The results of the two-part FRM confirm the validity of the identifying variable. Specifically, the probit regression results for all specifications show that the windfall variable is statistically significant thereby supporting its validity. The results are available upon request.

participation decisions for low and high risk assets are only influenced by monetary policy actions as measured by the actual FFR changes. Furthermore, this finding is in keeping with the results presented in Table 3 and suggests that households' financial behaviours are mostly influenced by a simple measure of interest rates rather than a measure that is based on advanced econometric models designed to isolate the unexpected component of the stance of monetary policy.

In addition, the impacts of the macro controls on the level of asset holding are in line with theoretical expectations. Specifically, an increase in economic activity, whether measured by GDP growth or the CFNAI, is associated with an increase in the household's level of holding of high risk assets and a decrease in the holding of low risk assets. However, the impact of these macro controls on the decision to hold assets are mixed. Specifically, GDP growth has a positive impact on the household's probability of holding low or high risk assets, whereas the CFNAI growth has a negative impact.

Finally, the correlation between the error terms of the two equations, ρ, is reported for each specification in Table 4. These results support a statistically significant relationship between the unobserved characteristics of the decision to hold an asset type and the level of holding this asset. Such findings imply that there is interdependence between these decisions and endorse the use of a modelling approach that allows for such interdependence as it will provide more efficient coefficient estimates.

5 Potential mechanisms

In this section, we consider potential mechanisms that lie behind the results discussed in the previous two sections. Specifically, we investigate whether particular household

characteristics strengthen, or weaken, the response of asset shares to monetary policy shifts. Given the important role of risk attitudes in the household finance literature, we focus on risk attitudes and we re-run the FRM models for three samples of households categorised according to the self-reported 6-point risk tolerance index defined in Section 2.1. Risk Attitudes 1 represent the least risk tolerant sample of households (48%), while Risk Attitudes 3 include the most risk tolerant sample (20%), according to the head of household's response to the Risk Aversion Section of the 1996 PSID survey.[15] The head of household characteristics across these three groups tie in with expectations with, for example, the most (least) risk tolerant group being, on average, the youngest (oldest), characterised by a lower (higher) proportion of females and a higher (lower) proportion of business owners (see, for example, Barsky et al., 1997). Table A1 in the Appendix provides summary statistics of head of household characteristics by the three risk tolerance categories.

The results presented in Table 5 show that there are distinct differences in how monetary policy affects households depending on their attitudes towards risk.[16] It is apparent that the impact of both measures of monetary policy shifts is larger in magnitude and generally statistically significant for the less risk tolerant households (Panels A and B), as compared to the most risk tolerant group (Panel C). In line with the findings in the previous sections, FFR changes are found to be more important than policy shocks. The coefficients have the expected sign. Specifically, a decrease in the FFR is associated with lower (higher) holdings of low (high) risk assets. Such findings indicate that monetary

[15]Risk Attitudes 1 include the households with risk tolerance index values of 0 and 1. In a similar fashion, Risk Attitudes 2 (3) include households with risk tolerance index values of 2 and 3 (4 and 5).

[16]For brevity, the results presented in this section all relate to the models which include CFNAI as the macro-control. The results from the other specifications are in line with these findings and are available upon request.

policy changes induce relatively risk averse households to reshape their portfolios. In contrast, the evidence regarding the link between changes in monetary policy and the portfolio allocation decisions of the most risk tolerant group is weaker, especially when the holdings of high risk assets are considered. As shown in Panel C of Table 5, for that group only the link between FFR changes and holdings of low risk assets is statistically significant.[17]

In accordance with evidence from a range of household surveys, the majority of individuals generally fall into categories associated with risk aversion rather than risk tolerance.[18] Hence, we might expect that the financial decision-making of the most risk tolerant group is motivated by factors that differ to the majority of the population such as personality traits and indicators of locus of control. Overall, such findings indicate the heterogeneity in the response of asset allocation to monetary policy changes by attitudes towards risk.

6 Active investors

The main finding of our analysis so far is that expansionary monetary policy is associated with higher allocation to high risk assets and lower allocation to low risk assets in household financial portfolios. However, it is important to acknowledge a potential caveat related to the fact that portfolio shares may be shifting over time not only due to active portfolio rebalancing but also as a result of passive valuation effects (Bucciol and Miniaci, 2015). Thus, the increase in the share of high risk assets following expansionary monetary policy shifts may reflect an increase in the value of stock-holdings, as opposed to, or

[17]This pattern of findings is also robust to using the two-part FRM. For brevity, the findings are not presented here but are available on request.

[18]For example, Sung and Hanna (1996) used the U.S. SCF data and found that only 4% of the sample were willing to take substantial risks on investments in order to make a substantial return, i.e. the most risk tolerant category for the SCF risk attitudes measure.

in addition to, active portfolio rebalancing towards stocks. Generally, even the portfolio share of a household characterised by full inertia in its investment behaviour may display variation over time, driven by such valuation changes.

In order to gain further insight into how this issue affects the robustness of our findings, we repeat our analysis for a sample of active investors only.[19] Active investors are defined as households which indicate that someone (in the household) has bought or sold 'any shares of stock in publicly held corporations, stock mutual funds, or investment trusts, including any automatic reinvestments not including any IRAs' over the previous year. The active investors sample corresponds to 19% of the whole sample analysed in Sections 3, 4 and 5. This low proportion is in line with previous studies which report that, whereas the majority of households exhibit inertia in their investment behaviour, a minority of sophisticated households (i.e. generally the wealthy and the better educated) engage in more active portfolio rebalancing (Brunnermeier and Nagel, 2008; Calvet et al., 2009).[20]

Table 6 reports the FRM estimates for the sample of active investors. The monetary policy effects, as measured by actual changes in FFR, remain highly statistically significant and are consistently positively associated with the low risk asset share and inversely associated with the high risk asset share. The sensitivity of the high risk asset share to monetary policy shifts for the sample of active investors is much larger relative to the equivalent effects estimated for the whole sample, as reported in Table 3. For example, focusing on the results in Panel B of Table 6, the estimated parameter associated with

[19]We have also investigated the robustness of our findings to controlling for valuation changes by adding past stock market returns to the set of controls, as defined by the average monthly stock market return for the two years preceding the survey data. The pattern of results discussed in Section 3 is robust to its inclusion. The results are available on request.

[20]Indeed, Table A2 in the Appendix presents summary statistics for the sample of active investors, where distinct differences can be seen across the sample of active investors and the whole sample. For example, the heads of active investor households are more likely to be male, more risk tolerant and more highly educated.

actual changes in the FFR for the high risk asset share is -0.503 for active investors compared to -0.259 for the whole sample, as reported in Panel B of Table 3. The stronger sensitivity of active investors to such monetary policy shifts is consistent with the view that, while a portion of the overall response of portfolio shares may be attributed to passive valuation effects, an important component of that response may be driven by a minority of sophisticated and financially literate households.

Since active investors are likely to differ systematically from inactive investors, selection bias in the results presented in Table 6 may arise in splitting the sample in this way.[21] To further explore the robustness of our findings and to address such potential bias from splitting the sample in this way, we adopt the Heckman selection estimation approach for the sample of active investors only. The first stage models the probability of being an active investor, the results of which are used to calculate an inverse Mills ratio term, which is included in the second stage asset share equations in order to control for potential sample selection bias. Specifically, we re-estimate our share equations, with the standard errors clustered at the household level, for the sample of active investors only, as follows:

$$y_{it} = \boldsymbol{X}'_{it}\boldsymbol{\beta} + \boldsymbol{M}'_{t}\boldsymbol{\gamma} + \pi r_t + \lambda\delta_{it} + \epsilon_{it} \tag{8}$$

where $\delta_{it} = \phi(H_{it})/\Phi(H_{it})$ is the standard inverse Mills ratio term estimated from a probit model used to determine the probability of being an active investor, $H_{it} = \Phi^{-1}(P_{it})$ and P_{it} denotes the predicted probability of household i at time t having an active investor in the household, $\phi(.)$ represents the probability density function of the standard normal

[21] For brevity, the results of the two-part FRM related to the active investor sample are not presented here since they will also potentially be affected by sample selection bias. In addition, the results, which are available upon request, are generally in line with our previous findings.

distribution and $\Phi(.)$ denotes the cumulative density function of the standard normal distribution. r_t is the measure of monetary policy, as previously defined, and π is the key coefficient of interest. To identify the model, we follow Section 4 and control for receiving a financial windfall during the previous two years in the form of an inheritance or gift worth $10,000 or more in the probit model.

Table 7 presents the Heckman estimation results from modelling the low risk asset share and the high risk asset share with the same specifications as used in Table 6. From the second stage regression, we can see that the Heckman results are in line with our previous findings with expansionary monetary policy shifts increasing (decreasing) the share of high (low) risk assets in household portfolios. Furthermore, the sensitivity of the financial portfolios of active investor households to monetary policy shifts, mainly in the case of actual FFR changes, is apparent in the estimated coefficients from the Heckman estimation approach, see Table 7. Thus, the findings presented in Table 7 are in line with the findings observed in Table 6. In addition, to provide a basis for comparison, Table A3 in the appendix presents the OLS estimation results for the full sample to shed light on the relative magnitude of the estimated coefficients from the Heckman approach. The results reported in Table A3 confirm that the response of active investors to shifts in monetary policy is large relative to that estimated for the full sample. For example, focusing on the results in Panel B of Table 7, the estimated parameter associated with actual changes in the FFR of the high risk share is -0.527 for active investors compared to -0.244 for the whole sample, as reported in Panel B of Table A3. Overall, such findings provide additional support for the pattern of results presented and discussed in Section 3, which further endorses the important role played by monetary policy in household portfolio allocation decisions.

7 Conclusions

We have employed data on US household financial portfolios along with two measures of monetary policy shifts, based on actual and unexpected changes in the FFR, over the period 1999-2007, to explore how households react to changes in monetary policy. Our FRM findings show that expansionary monetary policy is associated with higher household portfolio allocation to high risk assets and lower allocation to low risk assets. In order to explore the robustness of our findings, we have estimated a two-part FRM in order to explore how monetary policy affects both the decision to hold as well as the extent of asset holdings for low risk and high risk assets. The findings from the two-part modelling approach show that monetary policy shifts have a stronger impact on the decision to hold high risk assets relative to the impact on the decision to hold low risk assets. In addition, we find that the effects of monetary policy shifts on household portfolio allocation are more pronounced for the least rather than most risk tolerant households, where risk tolerance is measured by responses to a series of questions associated with hypothetical gambles over lifetime income. Finally, our findings for active investors reveal that the impact of monetary policy changes on household portfolio allocation is stronger, relative to the whole sample, which is in line with the view that passive valuation effects on their own cannot fully explain the overall changes in household portfolio shares.

This study brings together two important strands of the existing literature, related to the risk-taking channel of monetary policy and household financial portfolios. It informs and extends both strands by demonstrating the existence of an empirical link between household portfolio allocation and monetary policy shifts. This link suggests that, in addition to financial institutions, households may also reach for yield. Our findings have

important policy implications since they empirically verify the intuition of policymakers related to reaching for yield behaviour on the part of households. Our findings suggest that this type of behaviour should be accounted for when calibrating the appropriate monetary policy response to economic and financial developments. Finally, our findings suggest several avenues for future work including further exploring the relationship between appetite for financial risk-taking at the household level and monetary policy as well as examining whether these results hold in a non-US context.

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Figure 1: Household portfolios: The asset shares

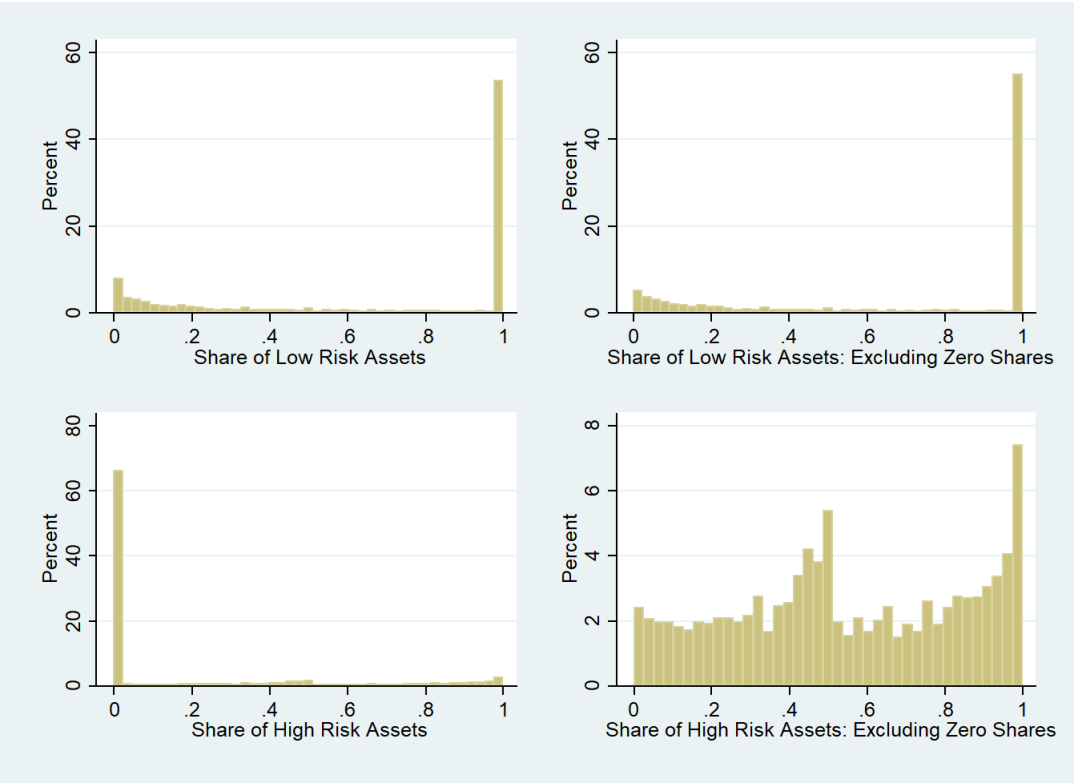

Figure 2: Monetary policy variables

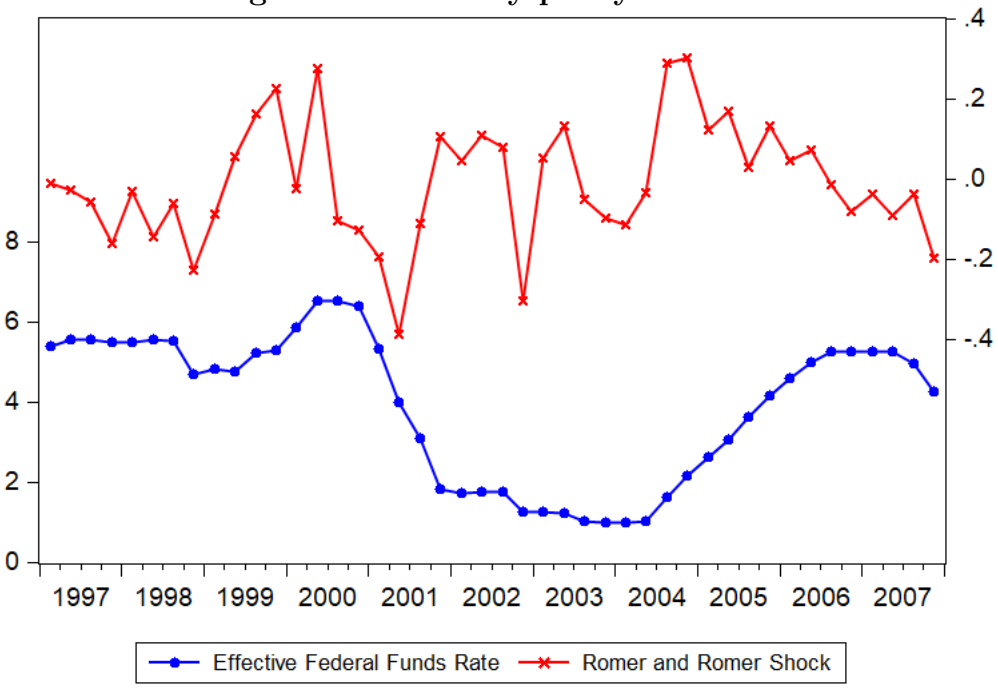

Table 1: PSID summary statistics

	Mean	St. Dev.
Dependent variables		
Low risk asset share	0.627	0.413
High risk asset share	0.213	0.325
Independent variables		
Age	43.50	13.26
Female	0.231	
White	0.764	
Business owner	0.159	
Homeowner	0.705	
Health index	2.792	0.967
Log income	11.043	0.809
Log networth	9.659	6.967
Risk attitudes	1.862	1.612
Employment status		
Employed (omitted)	0.867	
Unemployed	0.03	
Not in labour force	0.04	
Retired	0.067	
Marital status		
Single (omitted)	0.186	
Divorced	0.186	
Widowed	0.029	
Education		
High school and below (omitted)	0.686	
College degree	0.314	
Observations	15,650	

Table 2: Micro determinants of household portfolios - FRM

	Low risk asset share	**High risk asset share**
Female	-0.030**	0.014
	(0.014)	(0.011)
Age	-0.014***	0.014***
	(0.004)	(0.003)
Age squared	0.002***	-0.002***
	(0.000)	(0.000)
White	-0.094***	0.097***
	(0.010)	(0.009)
Business owner	-0.033***	0.017**
	(0.010)	(0.008)
Homeowner	-0.010	0.009
	(0.010)	(0.009)
Health index	-0.005	0.011***
	(0.004)	(0.003)
Log income	-0.013	0.011*
	(0.008)	(0.006)
Log networth	-0.010***	0.005***
	(0.001)	(0.001)
Risk attitudes	-0.006**	0.007***
	(0.003)	(0.002)
Employment status		
Unemployed	-0.005	0.014
	(0.021)	(0.016)
Not in labour force	0.014	0.025
	(0.021)	(0.016)
Retired	-0.036**	0.043***
	(0.017)	(0.013)
Marital status		
Married	0.033**	-0.042***
	(0.015)	(0.012)
Divorced	0.050***	-0.032**
	(0.015)	(0.013)
Widowed	0.028	-0.035
	(0.028)	(0.023)
Education		
College degree	-0.093***	0.082***
	(0.009)	(0.007)
Observations	15650	15650

Notes: (*i*) This table presents estimates of the household level determinants of the low and high risk asset shares based on a random effects FRM model, where the dependent variable is constrained to be between zero and one. (*ii*) The correction proposed by Mundlak (1978) is applied by including the means of the following time-varying continuous variables: age, age squared, income and net wealth. (*iii*) The results shown in the table refer to the average marginal effect (AME) of a one point change of the explanatory variable in question on the expected value of the dependent variable. (*iv*) Standard errors pertaining to these AMEs are clustered at the household level and shown in parenthesis.

Table 3: Monetary policy shifts and household portfolios: FRM

	Low risk asset share		**High risk asset share**	
	Panel A: No macro controls			
	(1)	(2)	(3)	(4)
FFR	0.140***		-0.104***	
	(0.022)		(0.017)	
RR shock		0.173***		-0.089**
		(0.043)		(0.035)
	Panel B: GDP growth			
	(5)	(6)	(7)	(8)
FFR	0.303***		-0.259***	
	(0.035)		(0.028)	
RR shock		0.218***		-0.131***
		(0.050)		(0.040)
GDP	-0.023***	-0.007**	0.022***	0.006***
	(0.004)	(0.003)	(0.003)	(0.002)
	Panel C: CFNAI			
	(9)	(10)	(11)	(12)
FFR	0.280***		-0.213***	
	(0.047)		(0.038)	
RR shock		0.140***		-0.054
		(0.052)		(0.042)
CFNAI	-0.051***	0.012	0.039***	-0.013*
	(0.015)	(0.008)	(0.012)	(0.007)
Observations	15,650	15,650	15,650	15,650

Notes: (*i*) See notes (*i*) to (*iv*) in Table 2. (*ii*) Each specification in each panel represents a separate regression and each regression includes the set of micro determinants as in Table 2.

Table 4: Monetary policy shifts and household portfolios: Two-part FRM

	Low risk asset share				**High risk asset share**			
	Panel A: No macro controls							
Specification	(1)		(2)		(3)		(4)	
	Probit part	Frac. part	Probit part	Frac. part	Probit part	Frac. part	Probit part	Frac. part
FFR	0.016	0.390***			-0.156***	-0.083		
	(0.011)	(0.065)			(0.025)	(0.076)		
RR shock			0.018	0.474***			-0.075	-0.241**
			(0.021)	(0.129)			(0.049)	(0.119)
ρ	0.589***		0.589***		0.898***		0.888***	
	(0.197)		(0.200)		(0.328)		(0.321)	
	Panel B: GDP growth							
Specification	(5)		(6)		(7)		(8)	
	Probit part	Frac. part	Probit part	Frac. part	Probit part	Frac. part	Probit part	Frac. part
FFR	0.050***	0.838***			-0.253***	-0.677***		
	(0.016)	(0.107)			(0.040)	(0.096)		
RR shock			0.030	0.595***			-0.057	-0.571***
			(0.023)	(0.151)			(0.056)	(0.144)
GDP	-0.005***	-0.064***	-0.002	-0.018**	0.014***	0.079***	-0.003	0.043***
	(0.002)	(0.011)	(0.001)	(0.008)	(0.004)	(0.011)	(0.003)	(0.009)
ρ	0.632***		0.600***		0.939***		0.932***	
	(0.186)		(0.196)		(0.333)		(0.336)	
	Panel C: CFNAI							
Specification	(9)		(10)		(11)		(12)	
	Probit part	Frac. part	Probit part	Frac. part	Probit part	Frac. part	Probit part	Frac. part
FFR	0.037*	0.785***			-0.138**	-0.742***		
	(0.022)	(0.144)			(0.054)	(0.133)		
RR shock			0.015	0.379**			0.059	-0.460***
			(0.024)	(0.157)			(0.058)	(0.156)
CFNAI	-0.007	-0.143***	0.001	0.034	-0.007	0.234***	-0.048***	0.076**
	(0.007)	(0.044)	(0.004)	(0.025)	(0.016)	(0.048)	(0.009)	(0.033)
ρ	0.596***		0.588***		0.937***		0.920***	
	(0.194)		(0.199)		(0.335)		(0.329)	
Observations	15,650	15,197	15,650	15,197	15,650	6,059	15,650	6,059

Notes: (*i*) This table presents estimates of the two-part FRM, where the probit part of the equation refers to the probability of holding the asset type and the Frac. part of the equation refers to the level of holding. (*ii*) The coefficient ρ represents the associated correlation between the error terms of these two equations. (*iii*) Each specification in each panel represents a separate regression and each regression includes the set of micro determinants as in Table 2. (*iv*) The correction proposed by Mundlak (1978) is applied by including the means of the following time-varying continuous variables: age, age squared, income and net wealth. (*v*) The results shown in the table refer to the average marginal effect (AME) of a one point change of the explanatory variable in question on the expected value of the dependent variable. (*vi*) Standard errors pertaining to these AMEs are clustered at the household level and shown in parenthesis.

Table 5: The role of risk attitudes in household portfolios: FRM

	Low risk asset share		**High risk asset share**	
	Panel A: Risk Attitudes 1			
FFR	0.276***		-0.208***	
	(0.068)		(0.053)	
RR shock		0.141*		-0.060
		(0.075)		(0.059)
CFNAI	-0.050**	0.011	0.037**	-0.013
	(0.021)	(0.012)	(0.016)	(0.009)
Observations	7,462	7,462	7,462	7,462
	Panel B: Risk Attitudes 2			
FFR	0.310***		-0.273***	
	(0.080)		(0.066)	
RR shock		0.179**		-0.137*
		(0.087)		(0.073)
CFNAI	-0.059**	0.008	0.057***	-0.004
	(0.025)	(0.015)	(0.020)	(0.012)
Observations	5,074	5,074	5,074	5,074
	Panel C: Risk Attitudes 3			
FFR	0.235**		-0.111	
	(0.111)		(0.093)	
RR shock		0.068		0.115
		(0.123)		(0.105)
CFNAI	-0.034	0.023	0.012	-0.026*
	(0.033)	(0.019)	(0.028)	(0.016)
Observations	3,114	3,114	3,114	3,114

Notes: See notes in Table 3.

Table 6: Household portfolios for active investors: FRM

	Low risk asset share		**High risk asset share**	
	Panel A: No macro controls			
FFR	0.155***		-0.182***	
	(0.047)		(0.052)	
RR shock		0.122		-0.055
		(0.083)		(0.092)
	Panel B: GDP growth			
FFR	0.394***		-0.503***	
	(0.070)		(0.075)	
RR shock		0.186**		-0.133
		(0.092)		(0.100)
GDP	-0.035***	-0.012**	0.046***	0.014***
	(0.007)	(0.005)	(0.007)	(0.006)
	Panel B: CFNAI			
FFR	0.325***		-0.371***	
	(0.089)		(0.096)	
RR shock		0.095		-0.003
		(0.093)		(0.103)
CFNAI	-0.063**	0.012	0.070**	-0.024
	(0.027)	(0.016)	(0.029)	(0.018)
Observations	2,900	2,900	2,900	2,900

Notes: See notes in Table 3.

Table 7: Household portfolios for active investors: Heckman selection model

	Low risk asset share		**High risk asset share**	
	Panel A: No macro controls			
2nd Stage				
FFR	0.159***		-0.182***	
	(0.048)		(0.052)	
RR shock		0.119		-0.059
		(0.084)		(0.092)
1st stage (Active)				
Windfall	0.372***	0.368***	0.372***	0.368***
	(0.051)	(0.051)	(0.051)	(0.051)
ρ	0.025	0.023	0.062	0.061
	Panel B: GDP growth			
2nd Stage				
FFR	0.416***		-0.527***	
	(0.074)		(0.075)	
RR shock		0.194**		-0.170*
		(0.094)		(0.102)
GDP	-0.037***	-0.013**	0.050***	0.018***
	(0.007)	(0.005)	(0.008)	(0.006)
1st stage (Active)				
Windfall	0.358***	0.357***	0.360***	0.358***
	(0.051)	(0.051)	(0.051)	(0.051)
ρ	-0.048	-0.053	0.196	0.201
	Panel B: CFNAI			
2nd Stage				
FFR	0.325***		-0.383***	
	(0.092)		(0.097)	
RR shock		0.086		-0.012
		(0.095)		(0.104)
CFNAI	-0.061**	0.015	0.074**	-0.022
	(0.027)	(0.016)	(0.030)	(0.018)
1st stage (Active)				
Windfall	0.359***	0.358***	0.360***	0.359***
	(0.051)	(0.051)	(0.051)	(0.051)
ρ	0.020	0.026	0.068	0.057
Observations	15,650	15,650	15,650	15,650

Notes: (*i*) The table reports the results of the Heckman estimations for Equation 8. (*ii*) Both the selection equation and the outcome equation include the set of micro determinants as in Table 2. ρ is the coefficient of correlation between the first- and the second-stage errors. (*iii*) Standard errors are clustered at the household level and shown in parenthesis. (*iv*) Each specification in each panel represents a separate regression and each regression includes a set of micro determinants as in Table 2. (*v*) The correction proposed by Mundlak (1978) is applied by including the means of the following time-varying continuous variables: age, age squared, income and net wealth.

Appendix

Table A1: Summary statistics: Risk attitudes

	Full sample	Risk Attitudes 1	Risk Attitudes 2	Risk Attitudes 3
Dependent variables				
Low risk asset share	0.627	0.641	0.618	0.609
High risk asset share	0.213	0.193	0.225	0.244
Independent variables				
Age	43.504	44.999	42.309	41.868
Female	0.231	0.254	0.216	0.204
White	0.764	0.737	0.777	0.807
Business owner	0.159	0.137	0.167	0.195
Homeowner	0.705	0.711	0.709	0.684
Health index	2.792	2.713	2.849	2.887
Log income	11.043	10.986	11.098	11.092
Log networth	9.660	9.709	9.704	9.471
Risk attitudes	1.862	0.402	2.493	4.331
Employment status				
Employed	0.867	0.841	0.895	0.883
Unemployed	0.029	0.028	0.029	0.035
Not in labour force	0.037	0.039	0.033	0.041
Retired	0.067	0.093	0.044	0.041
Marital status				
Single	0.187	0.172	0.193	0.211
Married	0.599	0.592	0.605	0.605
Divorced	0.186	0.194	0.182	0.173
Widowed	0.029	0.043	0.019	0.011
Education				
College degree	0.314	0.281	0.325	0.375
High school and below	0.686	0.719	0.675	0.625
Observations	15,650	7,462	5,074	3,114

Table A2: Summary statistics: Active investors

	Full sample	Active investors
Dependent variables		
Low risk asset share	0.627	0.300
High risk asset share	0.213	0.522
Independent variables		
Age	43.504	46.277
Female	0.231	0.124
White	0.764	0.921
Business owner	0.159	0.250
Homeowner	0.705	0.854
Health index	2.792	2.998
Log income	11.043	11.520
Log networth	9.660	12.230
Risk attitudes	1.862	2.106
Employment status		
Employed	0.867	0.866
Unemployed	0.029	0.019
Not in labour force	0.037	0.024
Retired	0.067	0.091
Marital status		
Single	0.187	0.141
Married	0.599	0.731
Divorced	0.186	0.108
Widowed	0.029	0.020
Education		
College degree	0.314	0.564
High school and below	0.686	0.436
Observations	15,650	2,900

Table A3: Monetary policy shifts and household portfolios: OLS estimation for the full sample

	Low risk asset share		**High risk asset share**	
	Panel A: No macro controls			
FFR	0.138***		-0.102***	
	(0.022)		(0.017)	
RR shock		0.166***		-0.085**
		(0.043)		(0.034)
Observations	15650	15650	15650	15650
	Panel B: GDP growth			
FFR	0.293***		-0.244***	
	(0.034)		(0.026)	
RR shock		0.210***		-0.129***
		(0.049)		(0.039)
GDP	-0.023***	-0.007***	0.021***	0.007***
	(0.003)	(0.003)	(0.003)	(0.002)
Observations	15650	15650	15650	15650
	Panel C: CFNAI			
FFR	0.275***		-0.210***	
	(0.047)		(0.037)	
RR shock		0.134***		-0.054
		(0.051)		(0.041)
CFNAI	-0.050***	0.012	0.040***	-0.012*
	(0.015)	(0.008)	(0.011)	(0.007)
Observations	15650	15650	15650	15650
Observations	15,650	15,650	15,650	15,650

Note: This table presents estimates of Equation 1 for the low and high risk portfolio shares for the full sample. All regressions are based on OLS. Each regression includes the set of micro determinants as in Table 2. Standard errors are clustered at the household level and shown in parenthesis.