The University Of Sheffield.

Department Of Economics.

Sheffield Economic Research Paper Series.

Household Portfolios and Monetary Policy

Authors: Sarah Brown, Alexandros Kontonikas, and Alberto Montagnoli

ISSN 1749-8368

SERPS no. 2020001

Jan 2020

Household Portfolios and Monetary Policy*

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*

January 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 two measures of monetary policy shifts over the period 1999-2007. We also show that the impact of monetary policy changes is stronger for active investors. In addition, our hurdle model estimates reveal that monetary shocks strongly affect the decision to hold high risk assets, but not the decision to hold low risk assets. Finally, our results highlight the role of self-reported risk attitudes as well as that of mortgage-holder status in affecting the response of household portfolios to monetary policy changes.

Keywords: Household Financial Portfolio Allocation; Monetary Policy.

JEL classification: D14, G11, E52.

*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. 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 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 lies in tackling this question by conducting empirical analysis of the effects of monetary policy actions on the asset allocation of US households.

We analyse household-level data drawn from the biennial US Panel Study of Income Dynam-

[1]The debate on the link between monetary policy and financial stability predates the recent 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 Hall 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.

ics (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 good estimates of policy shocks, over a long period stretching from the mid-1980s to the recent financial crisis (Bernanke and Blinder, 1992; Romer and Romer, 2004).

Our baseline econometric estimation method is a random effects Tobit model, with portfolio shares regressed on monetary policy shifts and a range of household and macro-controls. We find that expansionary monetary policy is associated with higher allocation to high risk assets and lower allocation to low risk assets. Our empirical evidence suggests that reaching for yield is not confined to financial institutions, and can also characterise the behaviour of households. A caveat that may underlie this finding is related to the separation of 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 this issue, we proceed by separating the sample into households

classified as active and inactive investors based on their response to a survey question about buying or selling specific financial assets over the previous year. The previous literature points out that a minority of sophisticated households (i.e. 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; Bilias et al., 2010). We find that the monetary policy effects are stronger for active investors. These findings can be interpreted as suggesting that, while a portion of the overall response of portfolio shares may be attributed to passive valuation effects, active rebalancing is likely to play an important role for some households. 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 from this approach is consistent with our previous results: expansionary policy has a positive (negative) effect on high (low) risk asset shares.[2]

To further explore the robustness of our findings, we use a double-hurdle estimation method following Cragg (1971). This is motivated by the fact that zero and non zero values of the asset shares are included in the sample, since some individuals do not hold any low risk and/or high risk assets. The double-hurdle approach allows us to evaluate the effects of monetary policy on whether high and/or low risk assets are held and, conditional on holding an asset type, the impact of monetary policy on the portfolio share. Interestingly, while the monetary policy effects on portfolio shares are in line with the baseline findings, an important difference arises in the selection equation. Specifically, in accordance with intuition, monetary shocks strongly affect the decision to hold high risk assets, but not the decision to hold low risk assets.

We consider possible mechanisms that can explain the response of household portfolios to changes in monetary conditions. Our results show that self-reported attitudes towards risk play

[2]We exclude from our analysis medium risk portfolios given the mix of assets included in this category. However, medium risk assets do form part of the denominator in the construction of the high and low risk asset shares, as discussed in Section 2.1

a key role. Specifically, the relationship between monetary policy shifts and the decision to hold high risk assets is stronger for households that are more tolerant towards risk. We also show that the link between the low risk asset share and monetary policy changes is more pronounced for mortgage-holders relative to non-holders, indicating the significance of household debt in the transmission of monetary policy. Thus, our household level analysis sheds new light on this important relationship and points towards explanations related to risk attitudes and secure debt holdings, which supplement the experimental analysis of Lian et al. (2019).

Our work 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; Dell'Ariccia et al., 2017), mutual funds (Hau and Lai, 2016; Di Maggio and Kacperczyk, 2017; La Spada, 2018), 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; Bianchi et al., 2016) 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.[3] 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 (low short-

[3]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 be met unless more risk is taken on the asset side through higher yielding investments (Lucas and Zeldes, 2009; Rajan, 2011).

term interest rates). Nevertheless, their empirical work is conducted at the aggregate level, rather than the household level, using e.g. 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 (2018) 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.[4]

Our work is also related to the extensive literature on the determinants of household risk preferences. This literature has typically focused on micro-variables, such as age, gender, level of education, income and wealth (Guiso and Paiella, 2008; Dohmen et al., 2011). There are a small number of studies that consider the role of the underlying macroeconomic and financial conditions but they do not investigate the effects of monetary policy. Such studies have found that risk preferences, in general, and household asset allocation in particular, are linked to the economic environment (Christelis et al., 2013), business cycle fluctuations (Bucciol and Miniaci, 2015), and exposure to past economic and financial crises (Malmendier and Nagel, 2011; Ampudia and Ehrmann, 2017). The empirical findings in this paper are in line with monetary policy shocks exerting an important effect on risk preferences even after controlling for micro-characteristics and macro-conditions.

Finally, our work is informative about the effects of monetary policy on saving behaviour. Theoretically, the effect of interest rates on savings is ambiguous (Attanasio and Weber, 2010).[5]

[4]Luetticke (2018) 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. He finds that sorting households across different percentiles of net liquid wealth, monetary policy tightening shocks lead to reduction (increase) in the portfolio liquidity of households below (above) median wealth. Unlike our study, Luetticke (2018) 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).

[5]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.

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 (Bundesbank, 2015; 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 individual 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 Tobit estimations exploring the role of monetary policy in influencing household portfolio allocation. Section 4 analyses the implications of active investment behaviour for the relationship between monetary policy and household portfolio allocation. Section 5 presents the results from the robustness analysis using the double-hurdle estimation method 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 6 explores various potential mechanisms and discusses the results from further robustness checks. Finally, Section 7 concludes.

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/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).[6] The definitions of low risk and high risk categories correspond closely to those used in the seminal contributions of Carroll (2002) and Hurd (2002).[7]

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) 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 variables

[6]Our focus on portfolio shares is in line with the revealed preference strategy for measuring risk preferences (Guiso and Sodini, 2013). The revealed preference approach can be traced back to the seminal study of Friend and Blume (1975), where relative risk aversion was derived from household portfolio risky shares reported in surveys.

[7]Our focus here lies on the effect of monetary policy on the shares of low and high risk assets. It is important to note that a further group of assets exists, namely, medium risk assets, which form part of the denominator of the asset shares. The value of which is elicited from the following survey question: Do [you/you or anyone in your family living there] have any other savings or assets, such as cash value in a life insurance policy, a valuable collection for investment purposes, or rights in a trust or estate that you haven't already told us about? The total value of the medium risk assets is defined from the responses to this question plus the value of non-risky pension accounts, which forms part of the denominator used to construct the 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 do not hold any high risk assets in their portfolios.

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 head of household'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 individuals 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, a head of household 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". Also, any household joining the panel after 1996 is effectively excluded from the sample.

2.2 The monetary policy measures and the macroeconomic environment

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.[8] 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 Fed'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 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.[9]

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

[8]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).

[9]We would like to thank Kostas Mouratidis for sharing the monetary policy shocks data. 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.

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).[10] Moreover, the existing literature on the effects of monetary policy on financial markets during the crisis/ZLB period often uses VAR-based (Wright, 2012; Gertler and Karadi, 2015) and/or event study approaches (Gagnon et al., 2011; Ait-Sahalia et al., 2012) along with high-frequency data. These methods are not compatible with the lower frequency at which the household survey data are available.[11]

Finally, 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.

3 Modelling asset shares in household portfolios

We firstly model the portfolio shares observed in the unbalanced panel of data drawn from the PSID, denoted by y_{it}, as censored outcomes via a random effects Tobit specification, across households $i = 1, ..., N$ and time $t = 1, ...5$, for the time period 1999-2007. We estimate a set of

[10] The financial crisis had a significant impact on the Fed'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 Fed resorted to non-conventional monetary policy tools. It provided assurances about the intention to keep the FFR at the ZLB and aimed to put downward pressure on long-term rates through changes in the size and composition of its balance sheet.

[11] In additional results (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.

specifications based on an equation as follows:

$$y_{it}^{*} = \boldsymbol{X}_{it}'\boldsymbol{\beta} + \boldsymbol{M}_{t}'\boldsymbol{\gamma} + \pi r_t + \epsilon_{it} \tag{1}$$

where y_{it}^{*} denotes the underlying latent propensity to hold asset shares, X_{it} is a vector of household and head of household covariates as described in Section 2.1 and β is the associated parameter vector, M_t is a vector of macroeconomic controls and γ is the associated parameter vector, r_t is the measure of monetary policy as defined in Section 2.2, α_i is a household-specific random error and ϵ_{it} is a white noise error term. Hence, π is our key parameter of interest, which captures the relationship between monetary policy and household portfolio allocation. The observed asset share variable, y_{it}, is such that:

$$y_{it} = \begin{cases} y_{it}^{*} & \text{if } 0 < y_{it}^{*} < 1 \\ 0 & \text{if } y_{it}^{*} \leq 0 \\ 1 & \text{if } y_{it}^{*} \geq 1 \end{cases} \tag{2}$$

If the latent propensity is negative or zero, we observe households at zero, if the latent propensity is greater than or equal to 1, we observe households at 1, otherwise the observed shares equal the latent propensity ($y_{it} = y_{it}^{*}$). Accordingly, this model is estimated as a Tobit model with censoring from below at zero and above at 1.

Prior to including any macroeconomic and monetary policy controls, in Table 2, we present the marginal effects for all microeconomic determinants for the low risk share and high risk 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 risk tolerance, income and net worth being positively (negatively) related to the share of high

(low) risk assets held. This is also the case for home and business ownership. Households with heads at the early stages of the lifecycle 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, e.g., Guiso et al., 1996; Guiso and Paiella, 2008; Ampudia and Ehrmann, 2017).

Table 3 reports estimates of the model described in Equation 1 above, which includes the monetary policy measures and other macroeconomic controls. With respect to the macroeconomic controls, we explore three different specifications: in the first specification, we do not include them (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). Finally, we estimate a fourth specification which does not incorporate macroeconomic controls but includes time fixed effects (Panel D).

Across all panels 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. The negative sign of the estimated π 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 ($\pi>0$). 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.

The magnitude of π does not differ substantially across the actual and unexpected interest rate changes. For example, in the case of the high risk share in Panel A, the marginal effects for FFR changes and the Romer and Romer shocks are -0.113 and -0.165, respectively. 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. In addition, the effect of monetary policy remains highly significant and increases in magnitude when time fixed effects replace the macroeconomic controls. Overall, our findings, which are consistent with reaching for yield behaviour amongst households, are consistent across a range of specifications.[12]

4 Active versus inactive investors

4.1 Splitting the sample into active and inactive 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. There is a potential important caveat, however, 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 policy shifts may reflect the increase in the value of stock-holdings, as opposed to, or 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 valuation changes.

In order to gain further insight on this issue, we divide the sample into households classified as active and inactive investors, and re-estimate the models for these two categories separately.[13] 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. They correspond to 13% of the sample, while the rest are classified as non-active. This low proportion is in line with previous studies which report that, whereas the majority of households

[12] Our findings are robust to including the means of time varying household covariates.

[13] We also attempted to control 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.

exhibit inertia in their investment behaviour, a minority of sophisticated households (i.e. the wealthy and the better educated) engage in more active portfolio rebalancing (Brunnermeier and Nagel, 2008; Calvet et al., 2009; Bilias et al., 2010).

Tables 4 and 5 report the Tobit estimates for active and non-active investors, respectively. The monetary policy effects remain highly significant with the monetary policy measures consistently being positively associated with the low risk asset share and inversely associated with the high risk asset share. Furthermore, there are some interesting differences in the magnitude of the effects, with the results highlighting a stronger role of monetary policy shifts for the case of active investors. The sensitivity of the asset shares to monetary policy shifts for active investors is twice the magnitude, or more, relative to that of inactive investors. For example, focusing on the results in Panel B of Tables 4 and 5, the estimated π of the low risk share when the Romer and Romer shocks are considered is 0.335 for active investors compared to 0.173 for non-active investors. For comparison, the overall response of the low risk share in Table 3 Panel B (0.261) lies in the middle of the aforementioned responses of active and non-active investors. 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.

4.2 Controlling for potential sample selection bias

Since active investors are likely to differ systematically from inactive investors, selection bias may arise in splitting the sample as in the previous section. To address such potential bias, 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 the inverse mills ratio term included in the second stage asset share equations 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:

$$y_{it} = \boldsymbol{X}'_{it}\boldsymbol{\beta} + \boldsymbol{M}'_{t}\boldsymbol{\gamma} + \pi r_t + \lambda\delta_{it} + \epsilon_{it} \tag{3}$$

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 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 coefficient of interest.

In addition to the set of controls in the probit model (X_{it} and M_t), a dummy variable indicating whether the household has received a financial windfall is included as an over-identifying instrument in the selection equation. Our instrument 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. As with all such sample selection corrections, the key issue lies in selecting a suitable identifying instrument for the first stage, specifically a variable which influences the probability of being an active investor but does not influence the shares of high risk and low risk assets held. We further comment on instrument validity below.

Table 6 presents the Heckman estimation results from modelling the low risk asset share (Panel A) and the high risk asset share (Panel B) across the four different specifications related to the inclusion of the macroeconomic controls and time fixed effects. The coefficients for the macro-controls are not shown for brevity, but available upon request. From the second stage regression, we can see that the Heckman results are in line with our previous evidence with expansionary monetary policy shifts increasing (decreasing) the share of high (low) risk

assets in household portfolios.[14] Regarding the validity of the chosen instrument, the first stage regression results show that the windfall variable is statistically significant thereby supporting its validity.[15]

5 The decision to hold assets types and the amount held

As we saw 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 risk assets in our analysis may lead to biased estimates of the effect of monetary policy on portfolio allocation.[16] Motivated by this issue, we explore the robustness of our findings to using the double-hurdle estimation method (Cragg, 1971). 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 the 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 hurdle model is defined by $Y_{it} = (S_{it} \times Y_{it}^*)$, where Y_{it} is the observed outcome of the dependent variable, i.e. the asset share:

$$S_{it} = 1(\boldsymbol{X'_{1it}}\boldsymbol{\beta_1} + \boldsymbol{M'_t}\boldsymbol{\gamma_1} + \pi r_t + \epsilon_{1it} > 0) \quad (4)$$

$$Y_{it}^* = \boldsymbol{X'_{2it}}\boldsymbol{\beta_2} + \boldsymbol{M'_t}\boldsymbol{\gamma_2} + \pi r_t + \epsilon_{2it} \quad (5)$$

[14] Table A1 in the Appendix presents OLS estimates of Equation 1 for low and high risk asset shares to facilitate comparison with the Heckman estimates.

[15] If included in the asset share models, we find that the windfall variable is statistically insignificant thereby further endorsing its use as a first stage instrument.

[16] It is important to acknowledge that in the Tobit 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.

The selection variable is given by S_{it}, which equals one if the dependent variable is not bounded (i.e. the household holds the asset type) and is zero otherwise, where X_{1it} is a vector of covariates, which influence the probability of holding the asset type. The continuous outcome is a latent variable Y_{it}^{*}. This is only observed if $S_{it} = 1$, i.e. if the household holds that type of asset. The outcome in Equation 5 is a linear model, where X_{2it} is a vector of explanatory variables which influence this part of the distribution. To identify the model, we follow Section 4.2 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 selection equation, i.e. in X_{1it}. Standard errors are clustered at the household level.

The results from estimating the hurdle models are presented in Tables 7 Panel A (low risk asset share) and Panel B (high risk asset share), where in each panel the upper set of results relates to the continuous part of the distribution, while the lower set relates to the selection part of the model. 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 all specifications. Hence, the monetary policy effects on household portfolios are in line with the baseline findings from the Tobit analysis. However, an important difference between high and low risk assets arises in the effects of monetary policy shifts on the participation equation. Specifically, while monetary policy changes strongly affect the decision to hold high risk assets, the corresponding impact on low risk assets is typically statistically insignificant across the various specifications. These findings suggest that the participation decision is influenced by factors other than monetary policy for the case of low risk assets.

6 Potential mechanisms

In the final part of our empirical investigation, we consider potential mechanisms that lie behind our results. We start by checking 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 re-run the double hurdle models, which reveal the effects of monetary policy at the two different parts of the asset share distributions, across three groups of households according to the self-reported risk tolerance variable. Risk Attitude 1 represents the least risk tolerant group, while Risk Attitude 3 is the most risk tolerant group, according to the household's response to the risk aversion section of the 1996 PSID survey.[17] The results in Table 8 suggest that the link between monetary policy shifts and the decision to hold high risk assets is stronger for households that are more tolerant towards risk.[18] For example, using the Romer and Romer shocks the magnitude of the monetary policy impact in the selection equation more than doubles when we switch from Risk Attitude 1 to 3 (-0.406 to -0.949). At the same time, and in line with the previous evidence in Table 7, the results in Table 9 indicate that the participation decision for low risk assets is not explained by monetary policy shifts.

We then re-run our double hurdle analysis splitting the households into those who hold a mortgage and those who do not hold a mortgage.[19] This analysis is motivated by the idea that households with a mortgage may be more informed about the prevailing interest rate as well as about possible changes in the near future. Recent evidence by Cloyne et al. (2019) indicates that the aggregate response of consumption to interest rates is driven by mortgage-holders, highlighting the role of household debt in the transmission of monetary policy. Our findings in Table 9 reveal that the response of the low risk asset share is stronger for mortgage-holders. For instance, the coefficient associated with actual changes in the FFR is 0.321 for households without a mortgage and 0.830 for those with a mortgage. On the other hand, the response of the high risk asset share to monetary policy shifts does not exhibit substantial variation across

[17] Risk Attitude 1 includes the households with risk tolerance index 0 and 1. In a similar fashion, Risk Attitude 2 (3) includes households with risk tolerance index 2 and 3 (4 and 5).

[18] The results presented in this section always include the CFNA as a macro-control. The coefficients of CFNAI (available upon request) are not presented for brevity.

[19] We re-iterate here that housing assets and liabilities are controlled for in our measure of net worth.

mortgage holders versus non-holders.[20]

Although we have explored two potential mechanisms, namely risk attitudes and mortgage holding, another potential mechanism that could be at work is related to preferences and psychology, reflecting differences in the perception and evaluation of the risk-return trade-offs in different interest rate environments. As Lian et al. (2019) point out, reference dependence and salience are key in explaining the stronger preference for risky assets when interest rates are low. The former implies that individuals experience discomfort when the risk-free interest rate falls below the reference point for investment returns, while the latter emphasizes the role of proportional thinking.[21] Given the nature of our dataset this channel cannot be explored further but it remains an interesting avenue for further research.

7 Conclusions

This study shows that expansionary monetary policy is associated with higher household portfolio allocation to high risk assets and lower allocation to low risk assets. We employ PSID 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 1999-2207. Our econometric approach encompasses Tobit estimation for the baseline analysis, sample splits and Heckman estimates to account for the effects of active investments, as well as double-hurdle estimation, to explore differences in the effects of monetary policy on the decision to hold low and/or high risk assets, and on the shares of the asset types held.

Our evidence for active investors reveals that the impact of monetary policy changes is stronger, relative to non-active ones, which is in line with the view that passive valuation effects on their own cannot fully explain the overall changes in household portfolio shares. The hurdle

[20] We have also experimented with splitting the sample by other household characteristics and our results (available upon request) do not reveal any important role in terms of identifying a heterogenous response to monetary policy shifts.

[21] For example, 6% average returns on the risky asset relative to 1% risk-free returns may appear more attractive than 10% average returns relative to 5% risk-free returns.

estimates show that the decision of households to hold low risk assets and the decision to hold high risk assets are not affected by monetary conditions in a similar manner. The former appears to be unrelated to monetary policy factors, while the latter is strongly affected by monetary policy shifts, especially in the case of households that are more tolerant towards risk. Furthermore, our findings highlight the role of mortgage-holder status in amplifying the response of low risk asset shares to monetary policy changes.

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 intuitive view of policymakers related to reaching for yield 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. For example, one could examine whether these results hold in a non-US context.

References

Acharya, V. and H. Naqvi (2019). On reaching for yield and the coexistence of bubbles and negative bubbles. *Journal of Financial Intermediation 38*, 1 – 10.

Adrian, T. and H. S. Shin (2010). Chapter 12 - Financial intermediaries and monetary economics. Volume 3 of *Handbook of Monetary Economics*, pp. 601 – 650. Elsevier.

Ait-Sahalia, Y., J. Andritzky, A. Jobst, S. Nowak, and N. Tamirisa (2012). Market response to policy initiatives during the global financial crisis. *Journal of International Economics 87*(1), 162–177.

Aizenman, J., Y.-W. Cheung, and H. Ito (2019). The interest rate effect on private saving: Alternative perspectives. *Journal of International Commerce, Economics and Policy 10*(01), 1950002.

Ampudia, M. and M. Ehrmann (2017). Macroeconomic experiences and risk taking of Euro area households. *European Economic Review 91*, 146–156.

Attanasio, O. P. and G. Weber (2010). Consumption and saving: Models of intertemporal allocation and their implications for public policy. *Journal of Economic Literature 48*(3), 693–751.

Beer, C., E. Gnan, D. Ritzberger-Grünwald, et al. (2016). Saving, portfolio and loan decisions of households when interest rates are very low - Survey evidence for Austrian households. *Monetary Policy & the Economy Q1/16*, 14–32.

Bekaert, G., M. Hoerova, and M. L. Duca (2013). Risk, uncertainty and monetary policy. *Journal of Monetary Economics 60*(7), 771–788.

Bernanke, B. S. and A. S. Blinder (1992). The Federal Funds Rate and the channels of monetary transmission. *American Economic Review 82*(4), 901–921.

Bernanke, B. S. and M. Gertler (2001). Should central banks respond to movements in asset prices? *American Economic Review 91*(2), 253–257.

Bernanke, B. S. and K. N. Kuttner (2005). What explains the stock market's reaction to Federal Reserve policy? *Journal of Finance 60*(3), 1221–1257.

Bianchi, F., M. Lettau, and S. C. Ludvigson (2016). Monetary policy and asset valuation. Working Paper 22572, National Bureau of Economic Research.

Bilias, Y., D. Georgarakos, and M. Haliassos (2010). Portfolio inertia and stock market fluctuations. *Journal of Money, Credit and Banking 42*(4), 715–742.

Borio, C. and P. Lowe (2002). Asset prices, financial and monetary stability: Exploring the nexus. BIS Working Paper 114, Bank for International Settlements.

Borio, C. and H. Zhu (2012). Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism? *Journal of Financial Stability 8*(4), 236–251.

Brown, S., G. Garino, and K. Taylor (2013). Household debt and attitudes toward risk. *Review of Income and Wealth 59*(2), 283–304.

Brunnermeier, M. K. and S. Nagel (2008). Do wealth fluctuations generate time-varying risk aversion? Micro-evidence on individuals. *American Economic Review 98*(3), 713–36.

Bucciol, A. and R. Miniaci (2015, 02). Household portfolio risk. *Review of Finance 19*(2), 739–783.

Bullard, J. B. (2012). Shadow interest rates and the stance of U.S. monetary policy. Presentation at the Center for Finance and Accounting Research Annual Corporate Finance Conference, Washington University in St. Louis.

Bundesbank, D. (2015). German households' saving and investment behaviour in light of the low-interest rate environment. Monthly report, October 2015, Deutsche Bundesbank.

Caglayan, M., O. Kandemir Kocaaslan, and K. Mouratidis (2017). Financial depth and the asymmetric impact of monetary policy. *Oxford Bulletin of Economics and Statistics 79*(6), 1195–1218.

Calvet, L. E., J. Y. Campbell, and P. Sodini (2009). Fight or flight? Portfolio rebalancing by individual investors. *The Quarterly Journal of Economics 124*(1), 301–348.

Carroll, C. D. (2002). Portfolios of the rich. In L. Guiso, M. Haliassos, and T. Jappelli (Eds.), *Household Portfolios*, Chapter 10, pp. 389–430. Cambridge: MIT Press.

Carroll, C. D. and A. A. Samwick (1998). How important is precautionary saving? *Review of Economics and Statistics 80*(3), 410–419.

Cecchetti, S., H. Genberg, and S. Wadhwani (2000). Asset prices and central bank policy. *Geneva Reports on the World Economy 2*.

Chodorow-Reich, G. (2014). Effects of unconventional monetary policy on financial institutions. *Brookings Papers on Economic Activity (Spring)*, 155–204.

Christelis, D., D. Georgarakos, and M. Haliassos (2013). Differences in portfolios across countries: Economic environment versus household characteristics. *Review of Economics and Statistics 95*(1), 220–236.

Cloyne, J., C. Ferreira, and P. Surico (2019). Monetary policy when households have debt: New evidence on the transmission mechanism. *The Review of Economic Studies (Forthcoming)*.

Cragg, J. G. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica (pre-1986) 39*(5), 829–844.

Delis, M., I. Hasan, and N. Mylonidis (2017). The risk-taking channel of monetary policy in the U.S.: Evidence from corporate loan data. *Journal of Money, Credit and Banking 49*(1), 187–213.

Dell'Ariccia, G., L. Laeven, and G. A. Suarez (2017). Bank leverage and monetary policy's risk-taking channel: Evidence from the United States. *The Journal of Finance 72*(2), 613–654.

Di Maggio, M. and M. Kacperczyk (2017). The unintended consequences of the zero lower bound policy. *Journal of Financial Economics 123*(1), 59–80.

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

Drechsler, I., A. Savov, and P. Schnabl (2018). A model of monetary policy and risk premia. *The Journal of Finance 73*(1), 317–373.

Friend, I. and M. Blume (1975). The demand for risky assets. *American Economic Review 65*(5), 900–922.

Gagnon, J. E., M. Raskin, J. Remache, and B. P. Sack (2011). Large-scale asset purchases by the Federal Reserve: Did they work? *Economic Policy Review* (May), 41–59.

Gertler, M. and P. Karadi (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics 7*(1), 44–76.

Guiso, L., T. Jappelli, and D. Terlizzese (1996). Income risk, borrowing constraints, and portfolio choice. *The American Economic Review 86*(1), 158–172.

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

Guiso, L. and P. Sodini (2013). Household finance: An emerging field. In *Handbook of the Economics of Finance*, Volume 2, pp. 1397–1532. Elsevier.

Haliassos, M. and C. C. Bertaut (1995). Why do so few hold stocks? *the Economic Journal 105*(432), 1110–1129.

Hau, H. and S. Lai (2016). Asset allocation and monetary policy: Evidence from the Eurozone. *Journal of Financial Economics 120*(2), 309–329.

Horioka, C. Y. and J. Wan (2007). The determinants of household saving in China: A dynamic panel analysis of provincial data. *Journal of Money, Credit and Banking 39*(8), 2077–2096.

Hurd, M. D. (2002). Portfolio holdings of the elderly. In L. Guiso, M. Haliassos, and T. Jappelli (Eds.), *Household Portfolios*, Chapter 11, pp. 431–472. Cambridge: MIT Press.

Hurst, E., A. Lusardi, A. Kennickell, and F. Torralba (2010). The importance of business owners in assessing the size of precautionary savings. *The Review of Economics and Statistics 92*(1), 61–69.

Jappelli, T., A. Scognamiglio, et al. (2018). Monetary policy, mortgages and consumption: Evidence from Italy. *Economic Policy 33*(94), 183–224.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica 82*(2), 463–505.

Joyce, M. A., Z. Liu, and I. Tonks (2017). Institutional investors and the QE portfolio balance channel. *Journal of Money, Credit and Banking 49*(6), 1225–1246.

Kimball, M. S., C. R. Sahm, and M. D. Shapiro (2008). Imputing risk tolerance from survey responses. *Journal of the American Statistical Association 103*(483), 1028–1038.

La Spada, G. (2018). Competition, reach for yield, and money market funds. *Journal of Financial Economics 129*(1), 87–110.

Lian, C., Y. Ma, and C. Wang (2019). Low interest rates and risk taking: Evidence from individual investment decisions. *Review of Financial Studies 32*(6), 2107–2148.

Lucas, D. J. and S. P. Zeldes (2009). How should public pension plans invest? *American Economic Review 99*(2), 527–32.

Luetticke, R. (2018). Transmission of monetary policy with heterogeneity in household portfolios. Discussion papers, Centre for Macroeconomics (CFM).

Malmendier, U. and S. Nagel (2011). Depression babies: Do macroeconomic experiences affect risk taking? *The Quarterly Journal of Economics 126*(1), 373–416.

Nabar, M. M. (2011). Targets, interest rates, and household saving in urban china. IMF Working Paper 11-223, International Monetary Fund.

Rajan, R. G. (2006). Has finance made the world riskier? *European Financial Management 12*(4), 499–533.

Rajan, R. G. (2011). *Fault lines: How hidden fractures still threaten the world economy.* Princeton University Press.

Romer, C. D. and D. H. Romer (2004). A new measure of monetary shocks: Derivation and implications. *American Economic Review 94*(4), 1055–1084.

Schildberg-Hörisch, H. (2018). Are risk preferences stable? *Journal of Economic Perspectives 32*(2), 135–54.

Wright, J. H. (2012). What does monetary policy do to long-term interest rates at the zero lower bound? *Economic Journal 122*(564), F447–F466.

Wu, J. C. and F. D. Xia (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking 48*(2-3), 253–291.

Yellen, J. L. (2011). Assessing potential financial imbalances in an era of accommodative monetary policy. *At 2011 International Conference: Real and Financial Linkage and Monetary Policy, Bank of Japan, 2 June 2011*.

Figure 1: Households portfolios asset shares

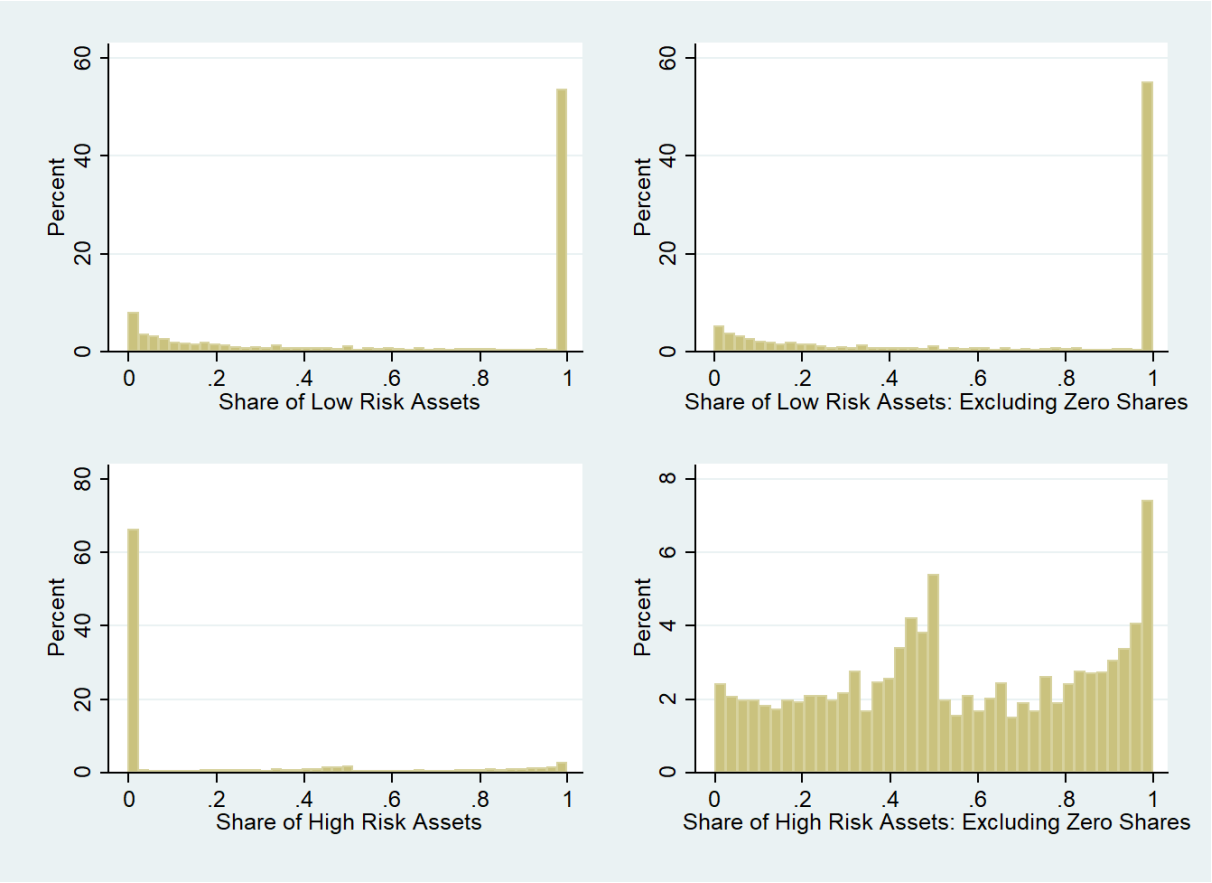

Figure 2: Monetary policy variables

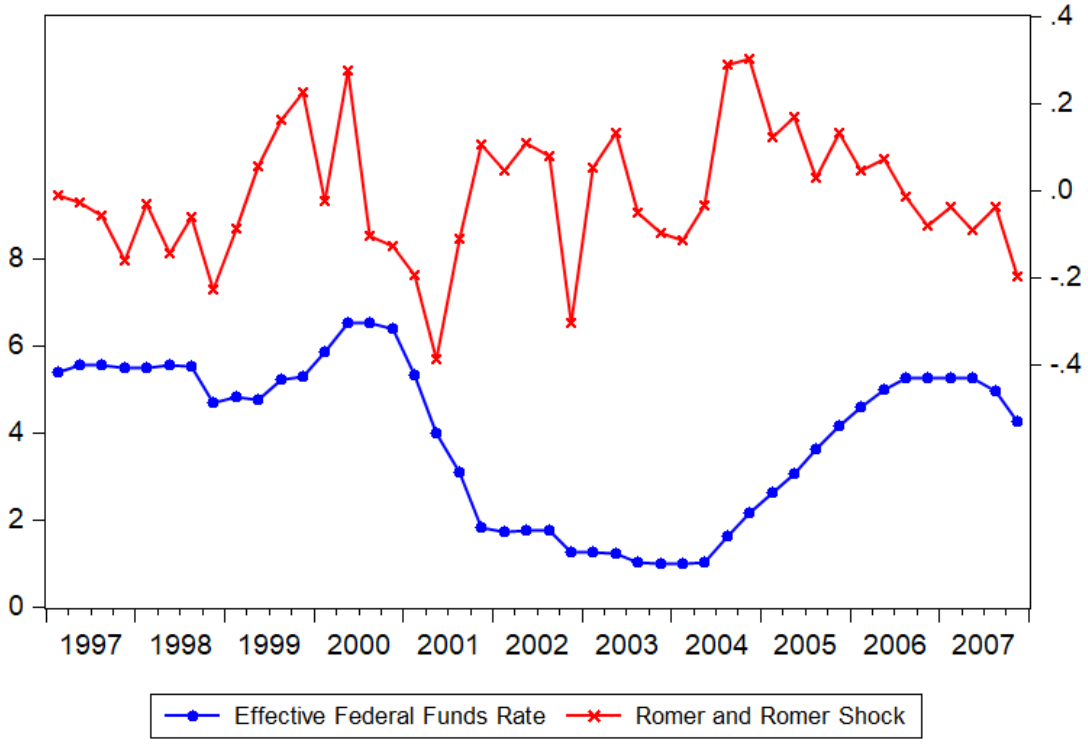

Table 1: PSID descriptive statistics

	Mean	St. Dev.
Low risk	0.627	0.413
High risk	0.213	0.325
Female	0.231	
Age 16-29	0.177	
Age 30-39	0.224	
Age 40-49	0.274	
Age 50-59	0.21	
Age 60-69	0.079	
Age 70+	0.036	
White	0.764	
Employed	0.867	
Retired	0.067	
Married	0.599	
Divorced	0.186	
Widowed	0.029	
High school and above	0.932	
Business owner	0.159	
Homeowner	0.705	
Health index	2.792	0.967
Log income	11.177	0.809
Log networth	9.765	7.047
Risk index	1.862	1.612
Observations	15,650	

Table 2: Micro determinants of households portfolios - Marginal effects

	Low risk asset share	**High risk asset share**
Female	0.00637	-0.0277
	(0.0251)	(0.0261)
Age 16-29	0.267***	-0.119**
	(0.0472)	(0.0484)
Age 30-39	0.178***	-0.0354
	(0.0444)	(0.0454)
Age 40-49	0.0699	0.0439
	(0.0431)	(0.0442)
Age 50-59	-0.0288	0.105**
	(0.0423)	(0.0433)
Age 60-69	-0.0369	0.0825**
	(0.0396)	(0.0408)
White	-0.247***	0.329***
	(0.0203)	(0.0214)
Employed	-0.0285	-0.00254
	(0.0259)	(0.0270)
Retired	-0.0775**	0.101***
	(0.0362)	(0.0371)
Married	0.00768	-0.0361
	(0.0264)	(0.0271)
Divorced	0.0795***	-0.0752***
	(0.0280)	(0.0290)
Widowed	-0.0383	-0.0096
	(0.0515)	(0.0538)
High school	-0.258***	0.342***
	(0.0357)	(0.0399)
Business owner	-0.0687***	0.0563***
	(0.0175)	(0.0172)
Homeowner	-0.0571***	0.0429**
	(0.0184)	(0.0190)
Health index	-0.0232***	0.0458***
	(0.00728)	(0.00746)
Log income	-0.126***	0.143***
	(0.0106)	(0.0108)
Log networth	-0.0219***	0.0170***
	(0.00116)	(0.00124)
Risk index	-0.0127**	0.0201***
	(0.00530)	(0.00538)
Constant	3.028***	-2.735***
	(0.122)	(0.128)
σ_u	0.454***	0.442***
	(0.00936)	(0.00969)
σ_e	0.503***	0.460***
	(0.00523)	(0.00535)
Observations	15,650	15,650

Notes: This table presents estimates of the household level determinants of the low and high risk asset shares. All regressions are based on a random effects Tobit model, where the dependent variable is constrained to be between zero and one. We report the number of households in the sample (N), the maximum number of time periods (T) and the total number of observations (N x mean(T)). The output shown in the table refers 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. Standard errors pertaining to these AMEs are shown in brackets.

Table 3: Households portfolios and monetary policy

	Low risk asset share		**High risk asset share**	
		Panel A: No macro controls		
FFR	0.138***		-0.113***	
	(0.018)		(0.014)	
RR shock		0.227***		-0.165***
		(0.030)		(0.024)
N	5,328	5,328	5,328	5,328
Max T	5	5	5	5
Observations	15,650	15,650	15,650	15,650
		Panel B: GDP growth		
FFR	0.283***		-0.241***	
	(0.022)		(0.018)	
RR shock		0.261***		-0.195***
		(0.031)		(0.025)
GDP	-0.023***	-0.010***	0.02***	0.008***
	(0.002)	(0.002)	(0.002)	(0.001)
N	5,328	5,328	5,328	5,328
Max T	5	5	5	5
Observations	15,650	15,650	15,650	15,650
		Panel C: CFNAI		
FFR	0.317***		-0.255***	
	(0.030)		(0.024)	
RR shock		0.237***		-0.168***
		(0.033)		(0.026)
CFNAI	-0.068***	-0.005	0.054***	0.001
	(0.009)	(0.006)	(0.007)	(0.005)
N	5,328	5,328	5,328	5,328
Max T	5	5	5	5
Observations	15,650	15,650	15,650	15,650
		Panel D: Year fixed effects		
FFR	0.614***		-0.538***	
	(0.045)		(0.036)	
RR shock		0.626***		-0.549***
		(0.046)		(0.037)
N	5,328	5,328	5,328	5,328
Max T	5	5	5	5
Observations	15,650	15,650	15,650	15,650

Notes: This table presents estimates of Equation 1 for the low and high risk asset shares. All regressions are based on a random effects Tobit model, where the dependent variable is constrained to be between zero and one. Each regression includes a set of micro determinants as in Table 2. We report the number of households in the sample (N), the maximum number of time periods (T) and the total number of observations (N x mean(T)). The output shown in the table refers 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. Standard errors pertaining to these AMEs are shown in brackets.

Table 4: Households portfolios and monetary policy - Active investors

	Low risk asset share		High risk asset share	
		Panel A: No macro controls		
FFR	0.193***		-0.243***	
	(0.039)		(0.047)	
RR shock		0.310***		-0.301***
		(0.061)		(0.074)
N	1,437	1,437	1,437	1,437
Max T	5	5	5	5
Observations	2,900	2,900	2,900	2,900
		Panel B: GDP growth		
FFR	0.428***		-0.528***	
	(0.045)		(0.054)	
RR shock		0.335***		-0.328***
		(0.061)		(0.074)
GDP	-0.038***	-0.018***	0.048***	0.023***
	(0.004)	(0.003)	(0.005)	(0.004)
N	1,437	1,437	1,437	1,437
Max T	5	5	5	5
Observations	2,900	2,900	2,900	2,900
		Panel C: CFNAI		
FFR	0.469***		-0.550***	
	(0.059)		(0.070)	
RR shock		0.332***		-0.319***
		(0.063)		(0.076)
CFNAI	-0.110***	-0.018	0.126***	0.015
	(0.018)	(0.012)	(0.021)	(0.0155)
N	1,437	1,437	1,437	1,437
Max T	5	5	5	5
Observations	2,900	2,900	2,900	2,900
		Panel D: Year fixed effects		
FFR	1.046***		-1.329***	
	(0.087)		(0.104)	
RR shock		1.068***		-1.356***
		(0.089)		(0.106)
N	1,437	1,437	1,437	1,437
Max T	5	5	5	5
Observations	2,900	2,900	2,900	2,900

Notes: This table presents estimates of Equation 1 for the low and high risk portfolio shares, selecting households classified as active investors. All regressions are based on a random effects Tobit model, where the dependent variable is constrained to be between zero and one. Each regression includes a set of micro determinants as in Table 2. We report the number of households in the sample (N), the maximum number of time periods (T) and the total number of observations (N x mean(T)). The output shown in the table refers 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. Standard errors pertaining to these AMEs are shown in brackets.

Table 5: Households portfolios and monetary policy - Non-active investors

	Low risk asset share		High risk asset share	
	Panel A: No macro controls			
FFR	0.121***		-0.089***	
	(0.020)		(0.014)	
RR shock		0.156***		-0.081***
		(0.035)		(0.026)
N	4,991	1,437	4,991	4,991
Max T	5	5	5	5
Observations	12,716	2,900	12,716	12,716
	Panel B: GDP growth			
FFR	0.211***		-0.144***	
	(0.025)		(0.019)	
RR shock		0.173***		-0.086***
		(0.036)		(0.027)
GDP	-0.014***	-0.004***	0.008***	0.001
	(0.002)	(0.002)	(0.001)	(0.001)
N	4,991	4,991	4,991	4,991
Max T	5	5	5	5
Observations	12,716	12,716	12,716	12,716
	Panel C: CFNAI			
FFR	0.214***		-0.119***	
	(0.035)		(0.026)	
RR shock		0.132***		-0.039
		(0.038)		(0.029)
CFNAI	-0.035***	0.010	0.011***	0.016
	(0.011)	(0.006)	(0.008)	(0.005)
N	4,991	4,991	4,991	4,991
Max T	5	5	5	5
Observations	12,716	12,716	12,716	12,716
	Panel D: Year fixed effects			
FFR	0.394***		-0.248***	
	(0.052)		(0.040)	
RR shock		0.402***		-0.253***
		(0.053)		(0.041)
N	4,991	4,991	4,991	4,991
Max T	5	5	5	5
Observations	12,716	12,716	12,716	12,716

Notes: This table presents estimates of Equation 1 for the low and high risk portfolio shares, selecting households classified as non-active investors. All regressions are based on a random effects tobit model, where the dependent variable is constrained to be between zero and one. Each regression includes a set of micro determinants as in Table 2. We report the number of households in the sample (N), the maximum number of time periods (T) and the total number of observations (N x mean(T)). The output shown in the table refers 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. Standard errors pertaining to these AMEs are shown in brackets.

Table 6: Households portfolios and monetary policy - Heckman selection model

			Panel A: Low risk asset share					
	No macro controls		GDP growth		CFNAI		Year fixed effects	
2nd Stage								
FFR	0.219***		0.470***		0.517***		1.149***	
	(0.048)		(0.063)		(0.078)		(0.119)	
RR shock		0.342***		0.363***		0.364***		1.171***
		(0.077)		(0.085)		(0.081)		(0.123)
1st stage (Active)								
Windfall	-0.108***	-0.104***	-0.100***	-0.099***	-0.100***	-0.100***	-0.107***	-0.103***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)
Observations	15,616	15,616	15,616	15,616	15,616	15,616	15,616	15,616
ρ	0.056	0.031	0.000	0.011	0.011	0.021	0.014	0.009
ρ (p-value)	0.635	0.785	0.998	0.921	0.915	0.751	0.831	0.879
			Panel B: High risk asset share					
	No macro controls		GDP growth		CFNAI		Year fixed effects	
2nd Stage								
FFR	-0.253***		-0.567***		-0.606***		-1.355***	
	(0.052)		(0.063)		(0.084)		(0.120)	
RR shock		-0.333***		-0.363***		-0.360***		-1.404***
		(0.094)		(0.084)		(0.088)		(0.125)
1st Stage (Active)								
Windfall	-0.107***	-0.103***	-0.100***	-0.099***	-0.099***	-0.099***	-0.107***	-0.103***
	(0.011)	(0.012)	(0.011)	(0.012)	(0.010)	(0.011)	(0.012)	0.012
Observations	15,616	15,616	15,616	15,616	15,616	15,616	15,616	15,616
ρ	0.038	0.062	0.109	0.089	0.090	0.073	0.078	0.282
ρ (p-value)	0.692	0.491	0.152	0.492	0.267	0.397	0.346	0.087

Notes: The table reports the results of the Heckman estimations for Eq. 3. Both the selection equation and the outcome equation includes a set of micro determinants as in Table 2. ρ is the coefficient of correlation between the first- and the second-stage errors. S.E. are clustered at the household level.

Table 7: Households portfolios and monetary policy - Hurdle models

	Panel A: Low risk asset share					
	No macro controls		GDP growth		CFNAI	
FFR	0.249***		0.474***		0.584***	
	(0.030)		(0.040)		-0.055	
RR shock		0.432***		0.489***		0.466***
		(0.050)		(0.056)		(0.060)
Selection equation						
FFR	0.243		0.586***		0.503*	
	(0.160)		(0.204)		(0.271)	
RR shock		0.290		0.361		0.274
		(0.290)		(0.286)		(0.307)
Observations	15,650	15,650	15,650	15,650	15,650	15,650
	Panel B: High risk asset share					
	No macro controls		GDP growth		CFNAI	
FFR	-0.111***		-0.436***		-0.540***	
	(0.036)		(0.05)		(0.060)	
RR shock		-0.307***		-0.397***		-0.413***
		(0.062)		(0.063)		(0.067)
Selection equation						
FFR	-0.642***		-1.081***		-1.048***	
	(0.080)		(0.104)		(0.140)	
RR shock		-0.753***		-0.816***		-0.628***
		(0.136)		(0.140)		(0.150)
Observations	15,650	15,650	15,650	15,650	15,650	15,650

Notes: The table reports the coefficients for the model in Equations 4 and 5. Each regression includes a set of micro determinants as in Table 2. The instrument in the selection equation is an inheritance or gift worth $10,000$. S.E. are clustered at the household level.

Table 8: Household's portfolios and monetary policy - Hurdle models and the role of risk attitudes

	Panel A: Low risk asset share					
	Risk Attitude 1		Risk Attitude 2		Risk Attitude 3	
FFR	0.516***		0.661***		0.665***	
	(0.08)		(0.10)		(0.13)	
RR shock		0.389***		0.558***		0.556***
		(0.09)		(0.11)		(0.14)
Selection equation						
FFR	0.519		0.547		0.502	
	(0.39)		(0.50)		(0.57)	
RR shock		0.446		0.512		-0.380
		(0.43)		(0.56)		(0.70)
Observations	7,462	7,462	5,074	5,074	3,114	3,114
	Panel B: High risk asset share					
	Risk Attitude 1		Risk Attitude 2		Risk Attitude 3	
FFR	-0.540***		-0.635***		-0.423***	
	(0.10)		(0.11)		(0.13)	
RR shock		0.369***		-0.578***		-0.255*
		(0.11)		(0.11)		(0.14)
Selection equation						
FFR	-0.783***		-1.176***		-1.437***	
	(0.20)		(0.25)		(0.31)	
RR shock		-0.406*		-0.745***		-0.949***
		(0.22)		(0.26)		(0.33)
Observations	7,462	7,462	5,074	5,074	3,114	3,114

Notes: The table reports the coefficients for the model in Equations 4 and 5. Each regression includes a set of micro determinants as in Table 2. The instrument in the selection equation is an inheritance or gift worth 10,000. S.E. are clustered at the household level.

Table 9: Household's portfolios and monetary policy - Hurdle models and the role of mortgages

	Panel A: Low risk asset share			
	Mortgage		Non-Mortgage	
FFR	0.830***		0.321***	
	(0.09)		(0.07)	
RR shock		0.632***		0.301***
		(0.09)		(0.08)
Selection equation				
FFR	0.387		0.747	
	(0.32)		(0.51)	
RR shock		0.157		0.514
		(0.36)		(0.57)
Observations	11,035	11,035	4,615	4,615
	Panel B: High risk asset share			
	Mortgage		Non-Mortgage	
FFR	-0.535***		-0.529***	
	(0.07)		(0.18)	
RR shock		-0.411***		-0.355*
		(0.07)		(0.20)
Selection equation				
FFR	-1.098***		-0.961***	
	(0.16)		(0.29)	
RR shock		-0.592***		-0.804**
		(0.17)		(0.32)
Observations	11,035	11,035	4,615	4,615

Notes: The table reports the coefficients for the model in Equations 4 and 5. Each regression includes a set of micro determinants as in Table 2. The instrument in the selection equation is an inheritance or gift worth $10,000$. S.E. are clustered at the household level.

Appendix

Table A1: OLS estimation low and high risk asset shares and monetary policy (Actives)

	Panel A: Low risk asset share					
	No GDP		GDP Growth		CFNAI	
	1999-2007	1999-2007	1999-2007	1999-2007	1999-2007	1999-2007
FFR	0.221***		0.470***		0.521***	
	(0.05)		(0.06)		(0.08)	
RR shock		0.351***		0.366***		0.373***
		(0.08)		(0.08)		(0.08)
N	2900	2900	2900	2900	2900	2900
	Panel B: High risk asset share					
	No GDP		GDP Growth		CFNAI	
	1999-2007	1999-2007	1999-2007	1999-2007	1999-2007	1999-2007
FFR	-0.252***		-0.542***		-0.571***	
	(0.05)		(0.06)		(0.08)	
RR shock		-0.314***		-0.332***		-0.330***
		(0.09)		(0.09)		(0.09)
N	2900	2900	2900	2900	2900	2900

Note: This table presents estimates of Equation 1 for the low and high risk portfolio shares, using only households classified as active investors. All regressions are based on OLS. Each regression includes a set of micro determinants as in Table 2. Robust standard errors are reported in parenthesis.