Monetary Transmission in Equity Markets: Evidence from Financial Intermediaries

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March 2025

Abstract

Using three decades of institutional portfolio holdings data, we document how monetary policy shocks systematically reallocate equity holdings across financial intermediaries. Following a surprise monetary contraction, mutual funds exposed to performance-sensitive investors experience large fund outflows, forcing managers to liquidate their equity positions. These equity outflows are absorbed by bank intermediaries, which, being less exposed to performance-sensitive investors, provide liquidity to equity markets. Aggregating these institutional responses, we find that flow-performance sensitivity for intermediaries significantly amplifies equity price responses to monetary policy shocks. To explain these findings, we develop an intermediary asset pricing model in which heterogeneous financial intermediaries interact with performance-sensitive investors. Our model shows that intermediary heterogeneity and investor performance sensitivity are critical channels of monetary transmission to equity markets.

JEL Codes: E44, E52, G11, G12, G21, G23, G40.
Keywords: Monetary Policy, Financial Intermediation, Portfolio Allocation, Equity Markets, Risk Premia.

[1]We thank Eduardo Dávila and Alp Simsek for insightful feedback and support. For helpful conversations and comments, we thank Nicholas Barberis, Francesco Beraldi, Christopher Clayton, Paul Fontanier, Carlos Garriga, Stefano Giglio, Samuel Hanson, Joel Flynn, Allen Hu, Andrew Metrick, Christopher Neely, Julia Selgrad, and Kelly Shue. We also thank participants at the Midwest Macro Meetings, Yale seminars, and the AFA 2025. All errors are our own. Authors: Famiglietti (matthew.famiglietti@yale.edu), Garg (pranav.garg@yale.edu).

1 Introduction

The transmission of monetary policy to financial markets is a crucial channel through which central banks affect the economy. A well-documented feature of this transmission is that even small monetary policy surprises generate large movements in asset prices. While this amplification is well-established[1], the underlying mechanisms driving it remain unclear. We identify a novel amplification channel: the flows of performance-sensitive mutual fund investors, which we show play a critical role in magnifying monetary policy transmission in equity markets. Specifically, when monetary policy tightens and asset prices contemporaneously decline, mutual funds - whose investor flows are more responsive to recent performance - face capital outflows. These outflows force mutual funds to liquidate equity positions, exacerbating initial price declines. Critically, heterogeneous financial intermediaries play a role in this process. We find that banks, whose funding is inherently less sensitive to portfolio performance, act as market makers and absorb these forced sales at a discount.

The key innovation of our analysis is studying the role of performance-driven mutual funds as financial intermediaries within equity markets. Institutionally, mutual funds are open-ended and offer instant redemption, implying that any investor capital withdrawal leads to selling pressure. While prior research has established that financial intermediaries can be macreconomically significant through their effects on asset prices (He and Krishnamurthy, 2013; Brunnermeier and Sannikov, 2014), we extend this literature by demonstrating that heterogeneity across intermediaries is a key element of monetary transmission to asset markets. Specifically, using three decades of institutional portfolio holdings data, we show that mutual funds are financed by performance-sensitive investors, characterized as investors whose flows are positively correlated with prior returns.[2] We find that the typical intermediaries on the sell-side after a monetary contraction are mutual funds.[3] Banks, whose funding is less sensitive to short-term performance, purchase equities in exchange for a liquidity premium for market-making. The flows that these intermediaries generate within equity markets allow for small monetary policy surprises to have large effects on asset prices.

Our first empirical exercise examines how equity is redistributed across financial intermediaries following a contractionary monetary surprise. We measure changes in equity holdings across financial intermediaries using the S34 database of quarterly institutional investment manager equity holdings. Throughout the paper, we identify monetary shocks using a high-frequency approach following Bauer and Swanson (2023).

[1] See, for example, Bernanke and Kuttner (2005), Gürkaynak et al. (2005b), Cieslak and Pang (2021), Kashyap and Stein (2023).

[2] This feature of mutual funds has been explored in prior work including Chevalier and Ellison (1997) and Berk and Green (2004).

[3] Throughout the paper, we refer to the collective of mutual funds, ETFs, investment advisors, wealth managers and hedge funds as mutual funds. These intermediaries operate in a broadly similar manner: they raise funds through issuing shares to investors that are instantly redeemable, they are equity-only, and they mostly invest based on predetermined strategies/mandates.

We find that a one standard deviation monetary contraction causes mutual funds to sell 26% of their typical quarterly equity flow, a statistically and economically significant decline, given that mutual funds account for 74.6% of the AUM on average in the S34 database.[4] To absorb this selling pressure from mutual funds, we find that banks increase their equity purchases by an average of 40.5% of their typical quarterly flow. This baseline result highlights the relevance of financial intermediary heterogeneity in decomposing monetary transmission to asset markets.

To understand why mutual funds act as net sellers following contractionary monetary shocks, our second empirical exercise examines heterogeneity across mutual funds. Contractionary shocks lower equity returns contemporaneously, prompting liquidations for intermediaries if their investors are sensitive to recent portfolio performance. That mutual funds are exposed to this mechanism has been documented in seminal work by Chevalier and Ellison (1997) and Berk and Green (2004). Mutual funds and related intermediaries are natural targets for investor withdrawals due to their open-ended, equity-only[5], and instantly-redeemable features.

Specifically, we test whether mutual funds with more performance-sensitive investors experience greater outflows following a contractionary monetary policy shock. We define investor flow sensitivity to recent performance as an intermediary-specific factor. Following Chevalier and Ellison (1997), we construct a time-varying measure of flow-performance sensitivity for each fund manager in our sample. We regress realized fund flows (between t and $t+1$) on recent fund returns and on fund alphas as alternative measures of recent performance. Our constructed intermediary-specific measure reflects how a manager's assets under management (AUM) respond to its past performance: a higher sensitivity measure indicates greater inflows (outflows) following positive (negative) performance.

Using this measure, we document novel findings on how investor performance sensitivity interacts with monetary transmission to financial markets. We find that while bank flows are statistically insensitive to performance, mutual fund assets are highly responsive to recent returns.[6] Following a monetary contraction that temporarily lowers equity prices, mutual funds with more performance-sensitive investors experience greater liquidation of their equity holdings. Specifically, a mutual fund whose investors are one standard deviation more sensitive to performance relative to the average mutual fund experiences 34% more equity outflows than their usual amount in response to a monetary contraction. The performance insensitivity of bank intermediaries enables them to act as market makers, buying depressed shares and selling at higher prices in subsequent periods. Notably, after the period of monetary tightening in

[4]This is economically significant as the S34 represents all institutional investors which manage over $100 million in assets. In 2019, the S34 managers collectively managed around 70% of the U.S. stock market.

[5]When discussing "equity-only" in the context of mutual funds, we mean that most mutual funds and related intermediaries such as ETF managers or investment advisers tend to not be highly leveraged, but instead invest out of their net worth.

[6]Banks can generate large trading profits through market-making and liquidity provision. However, unlike mutual funds, these profits are not necessarily distributed to depositors and can be retained, reflecting the distinct business models of banks and mutual funds. Banks generally offer returns through fixed interest rates on illiquid accounts, such as time deposits or certificates of deposit, or through products like money market mutual funds.

2022-23, major banks in the U.S. and the E.U. reported record profits, attributing gains to their equity trading desks.[7]

A potential limitation of our baseline analysis with the S34 is that we observe only the equity holdings of institutional investors. This means the equity flows we measure cannot separately identify AUM outflows from portfolio rebalancing *within* fund across other asset classes. To address this, we construct a dataset linking S34 managers to mutual fund data that includes holdings of other asset classes. Using this merged dataset, we test whether mutual fund responses to monetary policy are driven by changes in portfolio weights across asset classes or by investor liquidations at funds. We find no statistical evidence that mutual fund managers rebalance towards different asset classes in response to a monetary shock at the manager level. Instead, we find that a one standard deviation contractionary shock lowers total net assets at mutual fund managers by 0.6% of their net assets — a highly significant amount. Moreover, these outflows are pronounced for mutual funds characterized by more performance-sensitive investors, with no discernible difference in portfolio weights across asset classes.

A key insight motivating this paper is that equity market transactions between heterogeneous financial intermediaries are aggregated into asset price movements. Our third set of empirical exercises examines the extent to which performance-sensitive mutual fund investors amplify monetary transmission to aggregate asset prices. To measure this, we construct a stock-level measure of exposure to intermediary performance-flow sensitivity by calculating the AUM-weighted average of institutional investor sensitivity. This stock-level characteristic captures how responsive investor ownership flows are to that stock's prior performance. We regress quarterly stock returns on interactions between this exposure and the time series of monetary policy shocks and find that stocks with one-standard-deviation higher investor sensitivity experience an additional 35 basis points decline in return following a contractionary shock. Extending our analysis, we incorporate a set of standard asset-pricing factors at the stock level. In summary, stocks held within the portfolios of more performance-sensitive investors strongly amplify the transmission of monetary policy to equity markets even when controlling for a rich set of stock characteristics. This result highlights investor-specific sensitivity as a critical factor in amplifying monetary transmission.

Our second primary contribution is to construct an analytical model that rationalizes our empirical findings on how equity flows between heterogeneous financial intermediaries in response to monetary policy. The model is purposefully stylized to yield testable conjectures, which we verify in the empirical exercises. We consider a two-period economy where the supply-side follows a standard New Keynesian framework, and a representative household chooses consumption and savings allocations based on its beliefs about financial returns. Rather than making a traditional portfolio choice between stocks and risk-free bonds, the household instead delegates its wealth across financial intermediaries as an extension of the intermediary asset pricing

[7]Reported by Bloomberg (July 16, 2024; October 15, 2024) and the Financial Times (April 25, 2024; July 24, 2024).

framework.[8] To introduce intermediary heterogeneity, we incorporate two financial intermediaries: a representative mutual fund and a bank, each offering distinct types of returns. Banks provide risk-free returns, characterized as savings or time deposit rates. Mutual funds offer inherently risky returns, which depend on the performance of the underlying financial assets.

The model's primary theoretical results characterize household wealth allocation and asset price dynamics to a monetary policy contraction and the role of sensitivity to prior returns in amplifying these dynamics. We show an increase in the risk-free rate controlled by the central bank induces the household to reduce its wealth allocation to mutual funds, leading to equity outflows from these funds. The model predicts that bank intermediaries act as market makers, absorbing these outflows. This reallocation occurs because the household forms expectations about future risky asset returns based on past mutual fund performance, and heightened performance-sensitivity to these returns affects their portfolio weights on mutual funds. In the model, households generate extrapolative beliefs regarding financial returns. Since bank returns are fixed and not performance-sensitive, banks use household deposits to provide liquidity in equity markets for a premium because of the difference in risk-aversion between the bank and household. We further show theoretical results which characterize that greater investor sensitivity to past performance amplifies asset price declines and mutual fund outflows in response to monetary contractions- a pattern consistent with our empirical findings.

Our model provides an alternative mechanism for how monetary policy affects risk premia. As has been demonstrated in prior research on asset pricing and monetary policy (Drechsler et al., 2018; Caballero and Simsek, 2021; Kekre and Lenel, 2022; Caballero and Simsek, 2023), contractionary monetary policy raises risk premia. Our framework explains this through the interaction of two forces: household belief sensitivity to financial returns and heterogeneous financial intermediaries. Households form expectations about risky asset returns based on past performance leading them to liquidate mutual fund holdings in response to a negative return shock triggered by tighter monetary policy. Asset prices decline because banks act as market makers when mutual fund investors liquidate, but they value equity less than the household, which depresses equity prices. We verify that these two forces jointly drive equity flows and asset prices in both theory and in data.

Related Literature. This paper contributes to several strands of literature on monetary transmission to financial markets and asset pricing both empirically and theoretically.

Empirically, our work contributes to the literature which measure the financial transmission of monetary policy. This literature notably includes early work by Bernanke and Kuttner (2005) and Gürkaynak et al. (2005b) which demonstrates the existence of large equity price effects caused by monetary policy. The asset price impact of monetary policy has continued to hold

[8]This assumption departs from traditional models where the household is directly invested in financial assets and is actively managing their financial portfolio. As discussed in Section 2, over three fourths of U.S. households rely on passive holdings of financial assets through various financial intermediaries.

in recent studies and in a variety of contexts (Nakamura and Steinsson, 2018; Ozdagli and Velikov, 2020; Swanson, 2021a; Miranda-Agrippino and Ricco, 2021; Nagel and Xu, 2024). This price impact has been rationalized with a wide array of mechanisms ranging from changes in discount factors to news regarding future dividends. We provide a novel interpretation of this price impact through an empirical framework which does not rely entirely on aggregate asset price data. Instead, we examine portfolio flows of equities across intermediaries and identify striking patterns which reveal a mechanism of investor return sensitivity which is novel to this large literature.

Although we do not use the same methodology, our focus on changes in quantities of asset holdings due to aggregate shocks has resemblance to the recent demand system asset pricing literature developed in Koijen and Yogo (2019) and Gabaix and Koijen (2021). Recent work by Lu and Wu (2023) studies how investors rebalance within and across asset classes due to monetary policy shocks using a similar high-frequency identification and intermediary portfolio data. Their methodology estimates the impact of investor rebalancing on aggregate asset prices due to monetary policy. Our study differs by treating the identification of flows as a primary outcome caused by a micro-founded mechanism, rather than estimating aggregate price elasticities to intermediary rebalancing forces. Related work has also been done empirically in the context of bond markets during quantitative easing episodes. Selgrad (2023) studies how institutional investors trade long-term bonds around quantitative easing events to study how investors rebalanced portfolios. This work highlights how these individual portfolio decisions in bond markets have aggregate price implications and are a powerful transmitter of monetary policy. We follow a related, quantity-based asset pricing approach but in the context of the equity market and for agents with heterogeneous beliefs instead of a preferred-habitat framework as in Vayanos and Vila (2021).

On the role of mutual funds within aggregate financial markets, our results provide empirical evidence supporting prior theoretical work which shows lower transaction costs amplify the incorporation of investor beliefs into asset prices (Dávila and Parlatore, 2021). Specifically, we identify that low-cost, open-ended mutual funds feature strong flow-performance sensitivity, which causes amplified equity price reactions to monetary policy shocks.

We contribute theoretically to the literature on intermediary asset pricing as developed in He and Krishnamurthy (2013), Brunnermeier and Sannikov (2014), and He et al. (2017). In standard intermediary asset pricing models, a household interacts with an intermediary where the intermediary is not a veil, but instead acts as the marginal investor in pricing assets. Our theoretical framework follows this insight, but introduces heterogeneous financial intermediaries and a household with an extrapolative belief structure to rationalize the empirical patterns of equity flows across different intermediary classes.

Our work also contributes to the growing theoretical literature on the interaction of monetary policy and asset pricing where monetary policy changes risk premia in the economy (Caballero and Simsek, 2021; Bianchi et al., 2022; Caballero and Simsek, 2023). Theories of

monetary policy changing risk premia have traditionally ascribed such changes to deleveraging forces caused by heterogeneity in risk tolerance (Caballero and Simsek, 2021; Drechsler et al., 2018; Kekre and Lenel, 2022) or heterogeneity in investor beliefs (Caballero and Simsek, 2020). Our model and empirical evidence proposes distinct but related mechanisms from the prior literature: financial intermediaries with heterogeneous business models, and a household with performance-driven beliefs on risky asset returns.

Finally, our theoretical model builds on a large literature in asset pricing which models some investor beliefs over future prices and returns as extrapolative.[9] Asset pricing models with extrapolative beliefs include Barberis and Shleifer (2003), Barberis et al. (2015), Barberis et al. (2018), and Jin and Sui (2022). Our framework is particularly related to Barberis et al. (2015), where some agents participating in financial markets have rational beliefs and others have extrapolative beliefs. In our model, we build on these earlier insights by introducing a non-trivial financial intermediation problem, where households infer future returns from previous-period realization and intermediaries are rational. Although our theoretical framework is micro-founded by extrapolative beliefs for tractability, we believe the underlying empirical flows we document can be rationalized with alternative micro-foundations that cause return beliefs and prior returns to be positively correlated such as mislearning (Bastianello and Fontanier, 2023) or internal rationality (Adam and Marcet, 2011; Adam et al., 2017).

The remainder of the paper is organized as follows. Section 2 provides background on household financial portfolio allocation in the U.S. and discusses institutional details of classes of heterogeneous financial intermediaries. Sections 3 and 4 present our data and empirical findings regarding equity flows. In section 5, we document how the equity flows caused by investor performance-sensitivity aggregate into asset price impacts. Section 6 presents a concise model which rationalizes the empirical evidence in general equilibrium. Section 7 concludes.

2 Details of Equity Market Intermediation

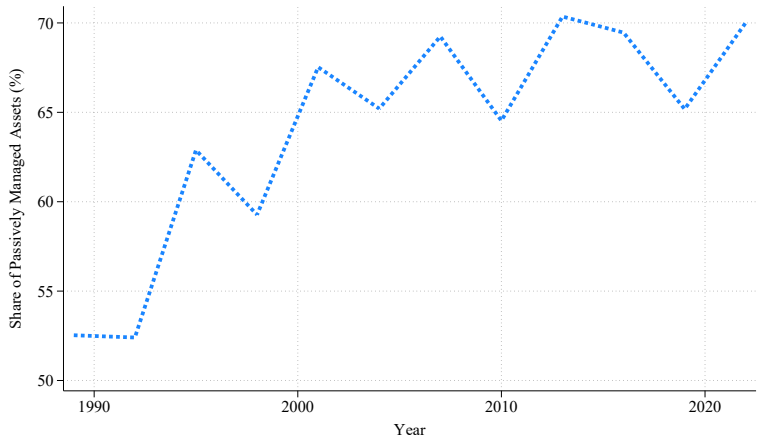
Over the 2010-2020 decade, the U.S. equity market represented 45% of the $112 trillion global equity market cap, or $50.8 trillion in value (SIFMA Report, 2021). The impact of monetary policy announcements by the Federal Reserve are of first-order importance to not only the U.S. financial markets, but the global financial economy. In this section, we briefly present the institutional details on U.S. equity ownership and the business models of key intermediaries in this market to facilitate our empirical and theoretical analysis. Doing so is a prerequisite to understanding the flows underlying aggregate price impacts of Fed policy on U.S. equities.

Over recent decades, U.S. households have increasingly delegated equity investments to

[9]That we model the household as forming beliefs over past realizations of returns is consistent with a large body of empirical work. Household extrapolation of previous financial performance is a robust empirical finding. Empirical work which has documented this phenomenon includes Chevalier and Ellison (1997), Vissing-Jorgensen (2003), Berk and Green (2004), Greenwood and Shleifer (2014), Kuchler and Zafar (2019), and Cassella and Gulen (2018)

passive financial intermediaries rather than actively managing portfolios. Figure 1 utilizes data from the Survey of Consumer Finances (SCF) to highlight the growing role of financial intermediaries (mutual funds, banks, pension funds, life insurance funds, hedge funds, etc.) in management of household portfolios. Mutual funds and ETFs have emerged as dominant vehicles, driven by innovations in financial products, reduced trading costs, and instant liquidity. By 2019, approximately two-thirds of U.S. household financial wealth was managed through these entities.

Figure 1: Share of Passively Managed Financial Assets



Data from Survey of Consumer Finances Table 6 (SCF). Passive share of wealth managed is calculated as the average median wealth within an asset class across net-worth bins, weighted by total financial assets. Active management includes holdings in stocks, bonds, savings bonds, CDs, and brokerage accounts. Passive categories are retirement counts, investment funds, life insurance, and other managed assets.

To understand how monetary policy impacts equity markets, we start by outlining key institutional details. Two classes of institutions are primary intermediaries in the US equity market: mutual funds and banks. Together, these institutions control over three-quarters of US equity holdings in institutional data but differ substantially in their funding structures, investor bases, and trading behavior. We present the salient differences here, and discuss their business models in depth in Appendix A.

Mutual funds and related entities are predominantly equity-financed, open-ended investment vehicles whose shares are instantly redeemable at net asset value. Their investors - primarily retail investors - can enter or exit positions with minimal frictions, often at low or negligible costs. This structure renders these intermediaries highly sensitive to short-term fluctuations in investor sentiment. When markets experience negative returns, performance-sensitive investors can quickly redeem shares, forcing mutual funds and ETFs to sell equities promptly. As a consequence, investor belief changes rapidly translate into equity flows from mutual funds and asset price movements.

Banks, in contrast, operate as leveraged agents, financing themselves predominantly through banking deposits and longer-maturity liabilities. Bank liabilities, such as demand deposits and

certificates of deposits, have either contractual returns or are illiquid. Banks' trading activities are thus structurally insulated from rapid investor redemptions. Moreover, banks are regulated (e.g., via the Volcker Rule) to limit proprietary trading using depositor funds but can actively engage in market-making and liquidity provision as brokers with appropriate capital regulation. Due to these institutional features, banks are ex ante different than mutual funds within equity markets, acting as stabilizing forces by absorbing liquidity shocks, often at advantageous prices.

The interaction between mutual funds and banks in U.S. equity markets facilitates over $ 2.5 billion in daily trading volume. The stark contrast in their business models between mutual funds/ETFs and banks underlies significant differences in their responses to monetary policy shocks. In subsequent sections, we empirically document how these institutional differences lead to equity reallocation following monetary policy announcements, and develop these important implications for asset pricing and equity market risk premia in a theoretical model.

3 Data Description

3.1 Institutional Equity Holdings Data

Our primary data source for measuring intermediary flows is administrative data on institutional investor equity holdings. Data on equity holdings of institutional investors is reported by the Thomson Reuters Institutional Holdings Database (S34 file) at the fund manager $\times$ equity $\times$ quarterly date level. This source is compiled from the quarterly filings of Securities and Exchange Commission Form 13F. Fund managers are uniquely identified by an identification number (FUNDNO) and equities are uniquely identified by their CUSIP. All institutional fund managers with equity investment accounts exceeding $100 million in total market value are required by the SEC to file Form 13F, in 2019 this was approximately 70% of the US stock market.

Within the S34 file, fund managers are grouped into six classes: mutual funds, independent investment advisors, banks, pension funds, life insurance funds, endowments (universities and foundations). We rely on classifications by Thomson Reuters prior to 1998 since classifications after 1998 are poorly recorded, and rely on Koijen and Yogo (2019) and work by Brian Bushee for updating classifications after 1998. Finally, we manually cross-check and recategorize the top 100 fund managers by assets-under-management (AUM) to ensure the accuracy of our approach. All non-identified managers are categorized as others, and compose less than 1% of our sample by AUM.[10]

We merge institutional equity holdings with equity-level characteristics using data from the Center for Research in Security Prices (CRSP). Security price data allows us to index stock prices to the prior quarter to remove valuation effects of capital gains and losses, which provides more direct identification of equity quantity flows. The CRSP data for equities further allows

[10] Appendix table C.1 provides a list of the ten largest fund managers by AUM in our dataset.

us to measure and control for stock splits and dividend payouts for each stock in every fund manager's portfolio over time.

3.2 Fund Portfolio Composition and Net Worth

The S34 dataset provides rich information on intermediary equity holdings, however it does not capture non-13F securities on balance sheets, such as cash and bond positions. To study the effect of monetary policy shocks on portfolio weights across all asset classes within funds, we leverage individual fund data provided by the CRSP Mutual Funds Database (MFDB) to study holdings of bonds, cash and other securities at the quarterly frequency. This dataset provides additional information on returns, net asset value (NAV), total net assets (TNA), expense ratios, loads, and other fees for funds. The CRSP MFDB dataset reports fund characteristics from 1961 onward, and holdings data from 2003 onward. We will leverage this joined dataset for identifying mutual fund equity flows as net outflows from the manager rather than rebalancing across asset classes.

We link fund manager-level holdings of the S34 with individual fund-level data of the MFDB by exploiting the S12 database as a bridge. The S12 database is the compilation of SEC N-30D filings to the SEC from individual mutual fund companies. This data provides equity holdings of mutual fund companies at the individual fund-level, whereas the S34 provides aggregate information across all individual funds under a single manager.[11] Wharton Research Data Services (WRDS) provides a fund manager-to-individual fund crosswalk, enabling us to link S34 to S12. After merging S12 funds with S34 managers at the individual fund $\times$ quarterly date level using the MFLinks Linking Table provided by WRDS, we merge the CRSP MFDB dataset. We aggregate individual fund-level data on portfolio holdings of non-13F securities and returns, NAV, TNA and fees to the fund manager-level using the share of each fund's assets-under-management (AUM) within the same fund manager family as a weight.

3.3 Monetary Policy Surprise Measure

Our preferred measure for a monetary policy surprise is proposed by Bauer and Swanson (2023). This measure identifies interest rate surprises from high frequency changes in Fed Fund Futures and EuroDollar contracts around monetary policy meetings as developed in earlier work for innovations in economic news and professional forecast revisions between Fed announcements.[12]

[11] The basic relationship between the S34 and S12 sets comes from the fact that almost every fund in the S12 set has a manager in the S34 set, and the latter provides aggregated totals for the holdings of all funds under the manger's control (i.e. a fund family). For example, in S34, Fidelity (MGRNO=27800) reports as a single entity and aggregates the holdings of all funds and trusts that it manages into its quarterly 13F filings. At the same time, in S12, Fidelity reports holdings of individual funds such as Magellan (FUNDNO=21858), its largest equity fund, both in fund prospectuses and official SEC filings.

[12] Other notable examples of high frequency identification of monetary policy shocks and the identification arguments for them include Gürkaynak et al. (2005a), Gertler and Karadi (2015), and Nakamura and Steinsson (2018).

Specifically, this measure condenses the monetary policy surprise into a single dimension by taking the first principal component of rate changes in short-maturity federal funds futures contracts and two- to four-quarter-ahead Eurodollar futures contracts in a narrow, 30-minute window surrounding each FOMC announcement. The resultant time series reflects the monetary surprise at both the short-horizon and along the longer-maturity yield curve. Bauer and Swanson (2023) then purge these monetary surprises of any remaining explainable time-variation by orthogonalizing the surprises on a vector of economic news to create a series of monetary policy surprises. Utilizing a high-frequency approach for identification of monetary shock transmission is increasingly common in the empirical literate.[13] We will subsequently describe our assumptions for identification when discussing our empirical specifications.

One difficulty arises because high-frequency monetary policy surprises are, by nature, constructed to capture a short-window where the monetary policy stance has been altered by policy makers. However, our data on institutional holdings are of quarterly frequency. To measure the MPS of a quarter our baseline is to aggregate all MPS events in a given quarter as has been performed in a variety of empirical applications measuring the effects of monetary policy at the quarterly frequency including Ottonello and Winberry (2020) and Altavilla et al. (2019).

We aggregate the MPS events in a given quarter by weighting each event by the time from the beginning of the quarter to the event, implying that later monetary events receive a larger weight. Our rationale for this weighting scheme is that traditional models of portfolio choice (Merton, 1971) emphasize instantaneous portfolio rebalancing by investors, and even recent work on mutual fund flows has demonstrated that mutual funds actively rebalance at least at the quarterly frequency (Parker et al., 2023). Therefore, our preferred measures allows for monetary policy events that occur closer to the report date to receive more weight.[14]

Our series for monetary surprises begins in 1989, whereas the institutional investor holdings data begins earlier. Therefore, results throughout the paper are calculated for the years 1989-2019 to begin the sample as early as possible, while avoiding the period encompassing the COVID-19 pandemic.

Appendix C.2 provides summary statistics for all key variables employed in our paper.

4 Monetary Policy Induced Equity Flows

We document that contractionary monetary policy causes equity to flow from mutual funds and related intermediaries to banks. We propose a mechanism which drives this relationship: underlying investor sensitivity to prior returns. This flow-performance sensitivity is particularly relevant for mutual funds because they are equity-based, open-ended, and instantly redeemable

[13] See, for example, Ottonello and Winberry (2020), Swanson (2021b), Ma and Zimmermann (2023), and Kroen et al. (2023).

[14] We check for robustness for all results in Section 4 in Appendix C.4 using an alternative MPS variable where the shocks in a quarter are simply summed with equal weights and confirm that our empirical results do not depend on this particular construction of monetary policy surprises.

relative to other intermediary classes. We demonstrate that these equity flows are not portfolio rebalancing to other asset classes within mutual funds but instead result from a loss of capital at intermediary driven by underlying investor withdrawals. The identified equity flows are somewhat mitigated at mutual funds with higher exit fees, demonstrating that the institutional characteristics of intermediaries play a role in monetary transmission to equity markets.

4.1 On-Impact Equity Flows

This section identifies equity flows induced by a monetary surprise across the universe of financial intermediaries discussed in Section 2. In order to study equity flows, we must first build a measure which captures changes in equity holding quantities within financial managers. We construct a fund manager $\times$ quarterly date measure of equity flows that control for valuation effects of capital gains, to study the purely quantity-based effects of monetary policy. This measure is informed from work on active portfolio rebalancing by Calvet et al. (2009). Specifically, we measure

$$\Delta Q_{m,t} = \sum_s \Delta Q_{m,s,t} = \sum_s \frac{P_{s,t-1} \times \Delta S_{m,s,t}}{H_{m,t-1}}$$

with fund manager holdings, $H = \sum_s (P_{s,t-1} \times S_{m,s,t-1})$, and quarterly changes in fund manager stock holdings, $\Delta S_{m,s,t} = S_{m,s,t} - S_{m,s,t-1}$. We label $\Delta Q_{m,t}$ as equity flows and this captures the change in equity holdings as a share of a fund's previous period equity portfolio value, independent of portfolio price changes. It is analogous to the portfolio turnover ratio that is commonly used by practitioners.

Our empirical strategy throughout this section is to regress measured equity flows on the identified monetary policy shock aggregated from Bauer and Swanson (2023). Identification in this framework hinges on the assumed orthogonality of the aggregate monetary shock measure to other aggregate, time-varying factors. Because our monetary shocks are constructed using a high-frequency window around policy announcements and further orthogonalized to macroeconomic news released around the meeting, we interpret the coefficients of the monetary shock measure as the causal effect of monetary policy on equity flows.

In our first exercise, we identify how equity flows across financial intermediary classes due to a monetary shock. Therefore, we regress equity flow changes on monetary surprise as follows,

$$\Delta Q_{m,t} = \gamma \cdot \text{MPS}_t + \alpha_m + \varepsilon_{m,t} \tag{1}$$

where the explanatory variable is scaled by average flows for that manager class, and MPS_t is scaled by its standard deviation to aid in interpretation of the coefficients. We include fund manager specific fixed effects to control for any level differences in flows between managers due to unobservable covariates that are idiosyncratic. Finally, our regressions are weighted by lagged

holding levels for each manager, which implies that our coefficients aggregate to economy-wide equity flows following the strategy of Amiti and Weinstein (2018).

We also estimate an alternative pooled specification to test how monetary policy redistributes equity flows in a statistically and economically significant manner as follows,

$$\Delta Q_{m,t} = \sum_{k \in \{\text{MF\&IA, Banks, P\&LI}\}} \gamma^k \cdot (\text{MPS}_t \times \mathbb{1}_k) + \alpha_m + \varepsilon_{m,t}, \tag{2}$$

where $\text{MPS}_t \times \mathbb{1}_k$ captures the heterogeneous effect of a monetary contraction on a specific class of financial intermediary.

Table 1: Equity flow response to a monetary surprise

	Dependent variable: $\Delta Q_{m,t}$					
	Full sample	Mutual funds & Investment advisors	Banks	Pension & Insurance funds	University & foundation endowments	Other funds
	(1)	(2)	(3)	(4)	(5)	(6)
MPS	-0.098	-0.259***	0.405**	0.250	0.360	-0.787**
	(0.077)	(0.064)	(0.202)	(0.170)	(0.370)	(0.330)
Manager FE	Y	Y	Y	Y	Y	Y
Observations	284,005	241,783	23,152	13,581	994	4,495
Adjusted R^2	0.161	0.196	0.040	0.035	0.093	-0.020
$\mathbb{E}$(Y)	0.9%	0.7%	1.4%	1.3%	2.7%	1.2%
AUM share	100%	74.6%	17.1%	7.1%	0.1%	1.1%

Note:

Coefficients are scaled by the mean of the dependent variable. Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 1 estimates (1) for each class of intermediary we consider. The first column estimates the flows for the entire economy, and columns two to six separate the effect by intermediary class. On aggregate, a one standard deviation contractionary monetary surprise does not create equity flows across all traders, implying that within the S-34 sample of fund managers, equity flows net out and there is no outflow out of S-34 fund managers into direct holdings by households or by the rest of the world.[15] The notable result of Table 1 is that the direction of flows are vary considerably: mutual funds & investment advisors actively reduce their holdings of equity, whereas banks sharply increase their quantities of equity. These two classes of institutions (columns two and three) capture most of the equity market, with their combined AUM comprising 91.7% of the total AUM for all S34 institutions. The third largest category of traders,

[15] In Appendix table C.3, we verify that, if at all, non-S34 managers experience a small inflow of equity holdings.

pension and life insurance funds, do not respond to a temporary shock in the form of the MPS. Together, these three traders capture 98.2% of all S-34 holdings.

We report the results of estimating (2) for the pooled sample of intermediaries in Table 2. The pooled regression delivers similar conclusions regarding buying and selling behavior caused by monetary policy. Our findings of redistribution of equity flows across classes of finanical intermediaries due to monetary policy are robust to using an alternatively aggregated measure of MPS and are reported in table C.5.

Table 2: Equity flow response to a monetary surprise

	Dependent variable: $\Delta Q_{m,t}$
	Aggregate economy
	(1)
MPS $\times$ MF & IA	-0.259***
	(0.064)
MPS $\times$ Banks	0.405**
	(0.202)
MPS $\times$ PF & LI	0.250
	(0.170)
Manager FE	Y
Observations	284,005
Adjusted R^2	0.162
$\mathbb{E}$(Y)	0.7%

Note:

Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses. AUM share of Mutual Funds & Investment Advisors is 74.6%, of Banks is 17.1%, and of Pension and Insurance Funds is 7.1%.

*p<0.1; **p<0.05; ***p<0.01

As discussed in Section 2, the equity flows of banks are likely driven by their market-making business. The fact that bank equity flows respond to monetary policy in the opposite direction of other participants is supportive evidence for their role as liquidity providers in equity markets. Our results in Table 2 imply that banks absorb mutual fund selling pressures, ensuring that equity markets clear following a monetary policy shock. That the coefficient on MPS $\times$ Banks is larger than the corresponding coefficients for mutual funds and investment advisers is not surprising. Because banks hold a smaller share of aggregate equities, they proportionally increase their flows more than other intermediaries in response to contractionary policy, consistent with their role as liquidity providers.

Mutual funds in the United states operate business models where funds are equity-driven, open-ended, and offers instant redemption.[16] As a result, mutual fund flows in equity markets are directly driven by underlying investor portfolio demand forces. An open question in the literature on monetary transmission to financial markets is how individual investors respond to aggregate monetary shocks. Table 2 is indicative that investors withdraw capital from mutual funds following a contractionary monetary shock.[17]

We posit that mutual fund investors' sensitivity to fund performance drives the observed selling behavior[18] due to monetary contractions. A large body of research, such as Bernanke and Kuttner (2005), has established that contractionary monetary surprises generate large, contemporaneous negative returns on equities. To the extent that mutual fund investors update their beliefs of fund ability or the distribution of equity returns using realized returns, contractionary monetary shocks have the ability to cause equity outflows from mutual funds. To test whether underlying investor sensitivity to return performance drives equity flows in response to monetary policy, we exploit heterogeneity in the flow-performance sensitivity of financial intermediaries.

To formally test the channel of investor return sensitivity, we construct a quarterly fund manager-level measure of flow-performance sensitivity, informed by prior literature. Specifically, we measure investor return sensitivity ($\tilde{\varphi}$) as follows,

$$\text{Flows}_{m,t} = \tilde{\varphi}_{m,t} \cdot \text{Performance}_{m,t-1} + \alpha_m + \alpha_t + \varepsilon_{m,t}, \quad \forall\, t \in \{s, ..., s-12\},\ \forall\, m \tag{3}$$

where,

$$\text{Flows}_{m,t} = AUM_{m,t} - AUM_{m,t-1} \cdot (1 + R_{m,t})$$

and $\text{Performance}_{m,t-1}$ is the fund manager-α from 12 quarter rolling regressions on the five factor model proposed by Fama and French (2015) and the momentum factor from Carhart (1997). In our estimations, we impose that a fund manager have at least 40 quarters of data to be included in our sample. Our measure $\tilde{\varphi}_{m,t}$ captures the magnitude of how recently realized returns affect fund AUM.

Table 3 report these flow-performance sensitivities by fund manager class. Past fund performance significantly impacts flows for mutual funds & investment advisors, consistent with prior findings: higher (lower) performance relative to the 6-factor benchmark raises (lowers) flows into the fund. Consistent with the market-making business model which is not equity driven that we have documented, such a relationship is not significant for banks. The full sample is

[16] In Table A.1, we report the aggregate balance sheet of mutual funds in the United States, showing that their only liability is investor shares.

[17] The S34 data cannot separately identify investor liquidations of funds from manager rebalancing reactions because the data only covers held equities. We return to this point in Section 4.2 to test directly whether these flows are rebalancing or investor withdrawals.

[18] Mutual fund investors' sensitivity to performance is well-documented in the literature, notably by Chevalier and Ellison (1997), Berk and Green (2004), Huang et al. (2007), Agarwal et al. (2013), and Shive and Yun (2013).

convex combination of all fund classes, with mutual funds and banks receiving a large share of the aggregation weights, 75.1% and 16.9% respectively. Results for other classes are reported in Appendix table C.6, and we find a null result similar to banks for these classes. As robustness, we estimate the same relationship using quarterly returns as a coarser (and possibly endogenous) measure of fund performance. Results are qualitatively unchanged and reported in Appendix table C.7.

Table 3: Flow-performance sensitivity

	Dependent variable: $\text{Flows}_{m,t}$		
	Full sample	Mutual funds & Investment advisors	Banks
	(1)	(2)	(3)
Performance (α)	0.821***	0.981***	0.871
	(0.214)	(0.241)	(0.691)
Manager FE	Y	Y	Y
Time FE	Y	Y	Y
Observations	260,944	217,568	24,587
Adjusted R^2	0.158	0.166	0.148
$\mathbb{E}$(Y)	\$93M	\$91M	\$103M
AUM share	100%	75.1%	16.9%

Note:
Coefficients are scaled by the mean of the dependent variable. Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors are in parentheses.
*p<0.1; **p<0.05; ***p<0.01

Armed with the time-varying measure of flow-performance sensitivity for each fund manager from (3), we test the relevance of this channel for equity flows caused by monetary policy by estimating the following regression,

$$\Delta Q_{m,t} = \sum_{k \in \{\text{MF\&IA, Banks, P\&LI}\}} \left[\gamma_1^k \cdot (\text{MPS}_t \times \tilde{\varphi}_{m,t-1} \times \mathbb{1}_k) + \gamma_2^k \cdot (\text{MPS}_t \times \mathbb{1}_k) \right] + \alpha_m + \alpha_t + \varepsilon_{m,t}. \tag{4}$$

In line with the intuition we have provided[19], we would expect that mutual funds & investment advisors should experience greater outflows if they are exposed to more performance-sensitive

[19]Section 6 provides a micro-foundation in a general equilibrium model which explicitly generates these comparative statistics.

investors. Accordingly, γ_1 should be negative for this class of intermediaries. In contrast, banks and pension & life insurance funds are not exposed to such performance-sensitivity. We would expect γ_1 be null for these classes. Finally, owing to their market-making role, we would expect γ_2 be positive for banks.

Table 4: Equity flow response to a monetary surprise

	Dependent variable: $\Delta Q_{m,t}$	
	Aggregate economy	Aggregate economy
	(1)	(2)
MPS $\times$ $\tilde{\varphi}$ $\times$ MF & IA	-0.335***	-0.276***
	(0.082)	(0.083)
MPS $\times$ MF & IA	-0.211***	1.588*
	(0.080)	(0.914)
MPS $\times$ $\tilde{\varphi}$ $\times$ Banks	0.013	-0.008
	(0.042)	(0.044)
MPS $\times$ Banks	0.749**	2.544***
	(0.332)	(0.954)
MPS $\times$ $\tilde{\varphi}$ $\times$ PF & LI	-0.031	-0.008
	(0.129)	(0.125)
MPS $\times$ PF & LI	0.026	1.846**
	(0.130)	(0.921)
Manager FE	Y	Y
Time FE	N	Y
Observations	134,636	134,636
Adjusted R^2	0.183	0.232
$\mathbb{E}$(Y)	0.7%	0.7%

Note:
Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses. AUM share of Mutual Funds & Investment Advisors is 74.6%, of Banks is 17.1%, and of Pension and Insurance Funds is 7.1%.
*p<0.1; **p<0.05; ***p<0.01

Table 4 reports our findings from estimating (4) on the pooled sample of intermediaries. For the average mutual fund, a one standard deviation increase in investor sensitivity amplifies outflows by by 34% following a contractionary shock. When controlling for time effects to account for aggregate trends in equity flows, the outflow is attenuated to 28%, though it remains large and highly significant.By contrast, bank flows exhibit no significant sensitivity to portfolio performance, as shown in Table 3, leading to an insignificant estimate of γ_1. This finding

suggests that heterogeneity in bank flow-performance relationships does not influence monetary transmission to these intermediaries in equity markets. However, while banks as a whole are insensitive to performance-driven flows, they increase their equity purchases in response to a contractionary monetary shock, as reflected in a positive and significant γ_2.

These results indicate that intermediaries most exposed to investors with high flow-performance sensitivity, primarily mutual funds, are the source equity outflows following contractionary monetary policy. In contrast, intermediaries with no significant flow-performance relationships, notably banks, act as liquidity providers, absorbing mutual fund outflows and clearing asset markets. These findings remain robust when using an unweighted measure of MPS, as reported in Table C.8, reinforcing the role of investor sensitivity in shaping monetary transmission via equity flows.

As a visual representation of the mechanism of intermediary flow-performance sensitive translating to equity flows caused by monetary policy, Figure 2 plots the cross-sectional relationship between investor flow-performance sensitivity on the x-axis and the estimated $\Delta Q_{m,t}$ caused by a one standard deviation monetary contraction on the y-axis. There is a clear negative correlation: more performance sensitive investors cause higher outflows for fund managers following the returns generated by a surprise monetary contraction. Investor flow-performance sensitivity, a source of heterogeneity across financial intermediaries because of different intermediary business functions, amplifies equity flows in response to a monetary policy surprise.

To conclude our analysis of on-impact equity flows, we estimate the elasticity of equity flows for institutional fund managers in our data to aggregate stock market returns and report the results in Appendices C.9-C.11. This analysis establishes that the equity flow responses we have estimated in Tables 2 and 4 in the context of monetary policy shocks hold more generally and are related to aggregate stock market returns.

We first engineer shocks to stock market returns using to monetary policy shocks as instruments in table C.9. In line with prior literature, there is a negative impact of a contemporaneous contractionary monetary policy shock on stock returns, and this effect is short-lived. Constructing price shocks implied from the first stage in Table C.9, we then estimate equations (2) and (4) to estimate the equity flow elasticities to aggregate stock returns. Tables C.10 and C.11 report our findings. We find that following a positive return shock, mutual funds buy equities, and that mutual funds reliant on more flow-performance sensitive investors more equities. Banks continue to act as the counterparty to these trades in response to an aggregate stock market shock. Although not the primary focus of this study, this robustness exercise reveals that the equity flow patterns we have documented in this section may apply to other contexts and could be analyzed in future work.

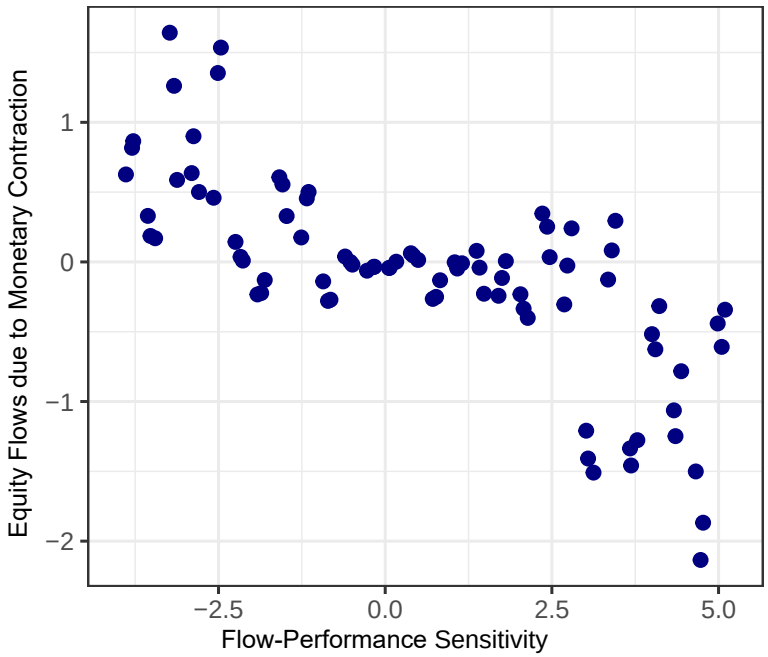


Figure 2: Correlation between equity flows and sensitivity

Note: This figure plots the cross-sectional relationship between intermediary flow-performance sensitivity and the equity flows caused by monetary policy across fund managers in our sample. The x-axis is a measure of flow-performance sensitivity estimated as $\tilde{\varphi}$ in (3) at the manager level. The y-axis is a measure of equity flow response as γ estimated through rolling regression of (1) at the manager level. The scatterplot is equally spaced-binned such that each point captures a similar number of managers in our entire sample. We find a negative correlation, i.e., more sensitive investors cause higher outflows for fund managers after poor returns.

4.2 Portfolio Rebalancing or Performance-Sensitive Outflows?

In a single asset economy, equity outflows by investors would reduce the total net worth of their fund managers. However, if fund managers hold diversified portfolios across multiple asset classes, equity outflows may not necessarily be driven by investor withdrawals. A relevant alternative explanation is that fund managers rebalance across asset classes, selling equities to purchase bonds, cash or other securities. In this case, negative equity flows would be offset by positive inflows into other asset classes, resulting in no loss of manager net worth. Our results in section 4.1 cannot directly rule out such a within-fund manager rebalancing narrative because the S34 only covers intermediary equity holdings. In this section, we show that mutual fund portfolios do not significantly rebalance in response to monetary policy. Instead, they experience net worth losses, indicating that the observed equity outflows are primarily investor withdrawals rather than portfolio adjustments.

We formally test whether the observed negative equity outflows for mutual funds occur because of investor redemptions or fund manager rebalancing. If performance-sensitive investors are liquidating equity positions, we should observe a decline in the net worth of fund managers without a corresponding shift in portfolio weights across asset classes. If net worth declines without portfolio rebalancing, this would rule out the rebalancing hypothesis in favor of in-

vestor withdrawals. This finding would provide strong evidence that monetary transmission to equity markets operates through performance-sensitive investors invested in mutual funds. To implement these tests, we use a panel of mutual funds that can be linked between the previously described S34 and CRSP MFDB datasets. The CRSP MFDB provides detailed portfolio holdings across asset classes and total net assets (TNA), which we use as a measure of fund net worth.

We estimate (1) on this merged panel, replacing the dependent variable with one of the following measures: the change in portfolio weights for equities (Δ Equity Share), bonds (Δ Bond Share), or other securities (Δ Other Share) for each fund manager, as well as the change in their net worth (Δ TNA). Table 5 presents the estimation results, revealing two key findings.[20]

First, as shown in columns (1) to (3), we find no significant changes in portfolio weights across asset class, indicating a lack of rebalancing by fund managers. In fact, although statistically insignificant, we find evidence that mutual fund managers weakly *increase* their portfolio share in equities, which should suggest a positive equity flow for these intermediaries. These results make investor-driven wthdrawals the far more likely explanation for observed equity outflows caused by monetary policy.

Second, column (4) reports that a one standard deviation contractionary monetary surprise results in a 0.8% net worth decline for a mutual fund manager with high statistical significance. This result validates that negative equity flows are caused by investor withdrawals. Interestingly, these outflows are similar in economic and statistical magnitude to the outflows documented across all mutual funds in table 2, which we measured to be approximately 1.8% (0.259×0.7).

Table 5: Portfolio rebalancing and outflows for mutual funds

	(1) Δ Equity Share (%)	(2) Δ Bond Share (%)	(3) Δ Other Share (%)	(4) Δ TNA (%)
MPS	5.520	0.983	-2.454	-0.822***
	(3.574)	(1.904)	(3.486)	(0.136)
Manager FE	Y	Y	Y	Y
Observations	23,853	23,853	23,853	30,788
Adjusted R^2	-0.006	-0.007	-0.008	0.031

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

Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses.

To examine whether mutual fund net worth declines are driven by the flow-performance mechanism, we estimate (4) with the updated dependent variables. We report results in Table 6. Table 6 presents the results. Column (4) corroborates our earlier findings, showing that mutual fund net worth declines as a result of investor outflows. A one standard deviation contractionary shock reduces mutual fund net worth by 0.6%, a sizable effect given typical net worth

[20]These findings are all robust to an unweighted measure of MPS and are reported in Table C.12.

fluctuations. Moreover, for a mutual fund with one standard deviation higher flow-performance sensitivity ($\tilde{\varphi}_{m,t}$), net worth declines by an additional 0.6%.[21]

Consistent with our previous findings, we find little evidence that fund managers rebalance their portfolios in response to the monetary shock. Even after accounting for heterogeneity in investor flow-performance sensitivity, mutual funds do not shift their portfolios into bonds or other asset classes. Mutual funds in the merged sample weakly increase their equity portfolio share, suggesting that in the absence of investor withdrawals, contractionary monetary policy should lead to positive equity flows. The significant decline in TNA, along with the findings in Section 4.1, confirms that investor withdrawals, not fund manager rebalancing, drive the equity outflows following a contractionary monetary shock.

Table 6: Portfolio rebalancing and outflows for mutual funds

	(1)	(2)	(3)	(4)
	Δ Equity Share (%)	Δ Bond Share (%)	Δ Other Share (%)	Δ TNA (%)
MPS $\times$ $\tilde{\varphi}$	5.937	-3.067	-3.073	-0.553*
	(7.337)	(4.713)	(9.139)	(0.299)
MPS	13.106*	-1.046	-9.139	-0.639***
	(7.371)	(3.634)	(6.688)	(0.237)
Manager FE	Y	Y	Y	Y
Observations	9,294	9,294	9,294	11,654
Adjusted R^2	-0.009	-0.020	-0.008	0.003

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses.

For robustness, we extend our analysis to the fund level by using the entire CRSP MF database, not just the sample which can be merged to the S34. We report our findings in Appendix Tables C.14 and C.15. Because flow-performance sensitivity is estimated at the fund manager-level, for our analysis at the fund-level, we proxy for investor return sensitivity by using the expense ratio for investors to the fund. The manager flow-performance sensitivity is an investor demand characteristic, whereas expense ratio is a fund characteristic. The latter acts a friction *against* liquidation for investors, and should be inversely related to flow-performance sensitivity as it makes investor transactions more costly. Both Appendix tables estimate our specification (4) at the fund-level, and differ in the measure of the MPS employed (weighted vs. unweighted average). The fund-level results are similar to manager-level results, indicating that the equity flows and net worth responses are roughly symmetric across all funds within a fund manager and not a feature of some very large funds of a few managers in our sample. Furthermore, the estimates are very close to those reported in the tables within this subsection, supporting our findings at a finer level granularity, and alleviating concerns that funds able to be merged between the CRSP MFDB and the S34 are not subject to notable selection bias.

[21] As before, these findings remain robust to an unweighted measure of MPS, as reported in Table C.13.

4.3 Dynamics of Equity Flows

Thus far, our analysis has focused on the immediate response of financial intermediaries to a surprise monetary contraction. However, understanding the persistence of these effects is crucial for assessing the full impact of monetary policy on equity markets. If monetary surprises are uncorrelated over time, the initial negative return impact should revert in subsequent periods due to mean-reversion in asset prices. Under this mean-reversion dynamic, return-sensitive mutual fund investors should alternate between selling and buying equity funds over time, consistent with our earlier findings on investor flow-performance sensitivity. In this setting, banks should act as market makers, absorbing selling pressure when markets are depressed and unwinding positions when equity prices recover. By doing so, they should earn profits from intertemporal arbitrage while ensuring market clearing.

To uncover these hypothesized dynamics, we estimate the response of equity flows over four quarters from the MPS through a local projection of (2) following Jorda (2005),

$$\Delta Q_{m,t+h} = \sum_{k \in \{\text{MF\&IA, Banks}\}} \gamma_k^h \cdot (\text{MPS}_t \times \mathbb{1}_k) + \alpha_m + \varepsilon_{m,t+h} \quad \forall h \in \{0, ..., 3\} \tag{5}$$

The dependent variable is the cumulative change between periods $t + h$ and $t - 1$. We present the dynamic coefficients from (5) in Figure 3.[22] Confidence intervals are plotted at 90% and generated using heteroskedasticity-robust standard errors clustered by fund manager and time. To compare flows across classes, we scale equity flows by their within-class mean values and then by the average market share of the class. Each coefficient captures the average flows in terms of the overall equity market resulting from a financial intermediary class. We see that, on impact of one standard deviation contractionary shock, mutual funds sell while banks buy, as demonstrated in preceding sections.

Dynamically, both classes of intermediaries oscillate with their equity flows next quarter, and stabilize their trading towards zero thereafter. In the fourth quarter, net flows into both intermediaries are zero, suggesting that equity flows caused by monetary policy decay within one year. After impact, the dynamics of equity flows and monetary policy are largely not statistically significant. Banks weakly sell equities in the quarter after the monetary shock. However, mutual funds do not clearly buy or sell equities in the periods after the shocks. That there is not much statistical significance after impact suggests that monetary impact on equity flows is short-lived.

[22] The counterpart to this figure under the unweighted MPS is shown in Figure C.1.

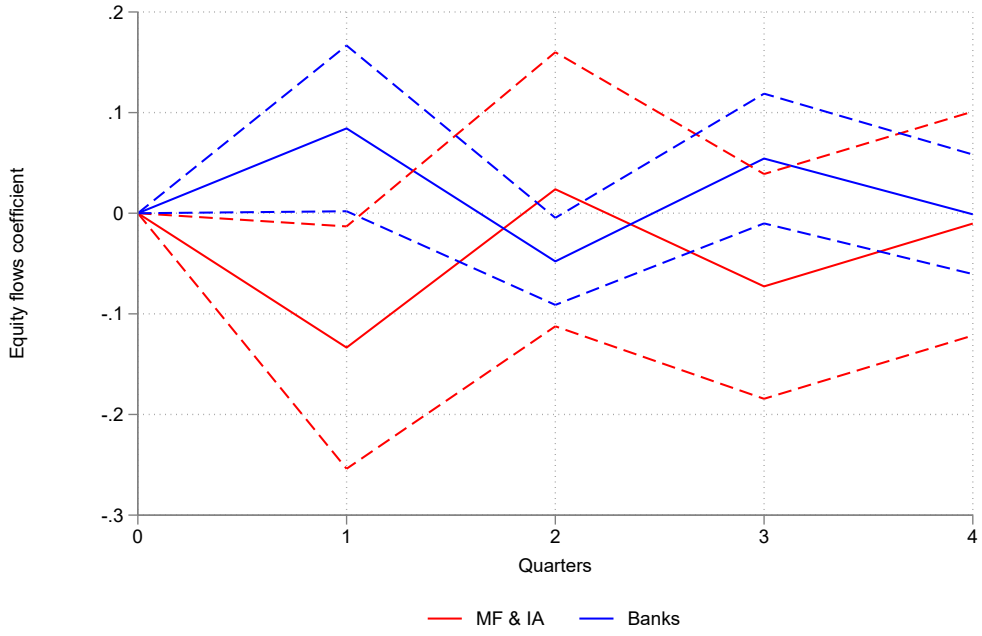


Figure 3: Local projection of equity flows

Note: This figure plots coefficients from (5) that capture the four-quarter equity flows induced by a contractionary monetary policy surprise for mutual funds & investment advisors and banks.

5 Equity Price Impacts due to Monetary Policy

Thus far, our analysis has documented how financial intermediaries' equity flows respond to monetary policy shocks. We argue that understanding the underlying mechanisms of granular equity flows provides deeper insight into the large price impacts of monetary policy. This section examines whether our proposed mechanism of investor flow-performance sensitivity can explain a quantitatively significant share of equity price variation caused by monetary policy. Specifically, we investigate whether aggregating the flow-performance sensitivity across managers and time affects the price elasticity to monetary shocks for equity prices.

The flow-performance sensitivity mechanism predicts that a security held by intermediaries with more performance-sensitive investors will face greater selling pressure because of underlying investor withdrawals. To test whether greater flow-performance sensitivity amplifies price elasticities in response to monetary policy, we exploit heterogeneity in stock-level exposure to flow-performance sensitive institutional owners (intermediaries). We define a stock-specific, time-varying measure of exposure to flow-performance sensitivity based on the characteristics of its intermediary owners. Specifically, for each stock s, we compute the weighted average of intermediary flow-performance sensitivity $\tilde{\varphi}_{m,t}$. We construct:

$$\tilde{\varphi}_{s,t} = \sum_{\mathcal{M}} \frac{AUM_{m,s,t} \times \tilde{\varphi}_{m,t}}{AUM_{s,t}}. \tag{6}$$

In (6), for each stock, s, we take the weighted average of intermediary flow-performance sensitivity, $\varphi_{m,t}$, estimated from (3) at a time t. The weights for a given intermediary are the size of holdings in stock s. This measure captures the extent to which a stock is exposed to flow-performance sensitivity among its institutional owners, and will be used as an exposure to the flow-performance mechanism.

Using this measure of stock-level exposure to the flow-performance sensitivity of its institutional owners, we estimate the following regression:

$$r_{s,t,t+1} = \alpha_s + \alpha_t + \beta_1 \cdot (\text{MPS} \times \tilde{\varphi}_{s,t}) + \beta_2 \cdot \tilde{\varphi}_{s,t} + \varepsilon_{s,t}, \tag{7}$$

where $r_{s,t,t+1}$ is the log return for stock s between periods t and $t+1$, and $\tilde{\varphi}_{s,t}$ is the stock's exposure to the flow-performance sensitivity of institutional fund managers. The key coefficient of interest β_1, captures whether stocks more exposed to performance-sensitive intermediaries experience larger return effects following a monetary shock. We also control directly for any direct impact of intermediary flow-performance sensitivity on stock returns, independently of monetary shocks.

Results from the estimation of (7) are presented in Table 7[23], where the columns variously add time effects and weight by stock market capitalization. Interpreting column (3) where we weight stocks by market cap to infer an aggregate equity market effect, we find that stocks with one standard deviation higher exposure to flow-performance sensitivity experience a 68.1 bps decline in returns for one standard deviation contractionary monetary policy shock. The implications of this estimate are robust to the inclusion of manager and time fixed effects, with an estimate of a 34.6 bps decline and notably an R^2 of .31 when including time effects. Given these results, we conclude that flow-performance sensitivity is a factor which has considerable explanatory power in both generating and amplifying the significantly negative returns caused by contractionary monetary policy shocks.

Table 7: Price elasticity to monetary policy shocks

	(1)	(2)	(3)	(4)
	Return_{t+1}	Return_{t+1}	Return_{t+1}	Return_{t+1}
MPS $\times \tilde{\varphi}$	-0.448***	-0.114***	-0.513***	-0.356**
	(0.032)	(0.032)	(0.108)	(0.173)
Stock FE	Y	Y	Y	Y
Time FE	N	Y	N	Y
Weighted	N	N	Y	Y
Observations	650,422	650,422	625,860	625,860
Adjusted R^2	0.025	0.169	0.033	0.314

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

Heteroskedasticity-robust standard errors clustered by CUSIP are in parentheses.

[23] We report similar findings for the unweighted monetary policy shock in table C.16.

The use of exposure to intermediary flow-performance sensitivity in these asset pricing regressions bears some comparison to traditional asset pricing models. Unlike traditional factor betas (FF5 and momentum) which reflect static stock characteristics, our flow-performance sensitivity measure captures a dynamic and institutional characteristic. If underlying investors to intermediaries generate beliefs over future returns using realized returns, the exposure measure to intermediary flow-performance captures how these investor beliefs affect asset prices. We micro-found and formalize this argument theoretically Section 6. Empirically, we demonstrate that this asset pricing factor built on characteristics of the institutional owners explains substantial asset price movements.

To assess the economic significance of our proposed channel for monetary transmission, we augment our previous results by including time-varying stock-level betas into our analysis. Specifically, we estimate betas from the six-factor model (FF5 + momentum) for all CUSIPs in our sample. We extend our baseline regression (7) by incorporating these well-established asset pricing factors, leading to the following augmented specification,

$$r_{s,t,t+1} = \alpha_s + \alpha_t + \beta_1 \cdot (\text{MPS} \times \tilde{\varphi}_{s,t}) + \beta_2 \cdot \tilde{\varphi}_{s,t} + \Gamma'(MPS_t \times \text{F}_{s,t}) + \varepsilon_{s,t}, \tag{8}$$

where $\text{F}_{s,t}$ is the vector of the 6 stock-specific asset pricing comprising the Fama-French five factors plus momentum.

Table 8 reports our results from estimating (8). In column (1), we find that the effect of flow-performance sensitivity exposure is more than twice as large as the effect of monetary policy on the market beta factor. Moreover, the flow-performance sensitivity exposure measure remains highly significant and exhibits a larger magnitude than all traditional asset pricing factors, underscoring its explanatory power. A second notable finding is that momentum—despite being a stock-level characteristic that could plausibly relate to flow-performance sensitivity exposure—shows no significant economic or statistical effect. Our findings continue to hold with the inclusion of time fixed effects in column (2) and when using an unweighted measure of monetary policy, as reported in Table C.17.

The large and significant coefficient on the sensitivity exposure measure highlights the critical role of financial intermediary flows in amplifying monetary transmission. These findings validate our novel approach of analyzing equity flows between heterogeneous intermediaries as a key channel through which monetary policy affects asset markets.

Table 8: Price elasticity to monetary policy shocks (with FF6)

	(1) Return$_{t+1}$	(2) Return$_{t+1}$
MPS $\times\ \tilde{\varphi}$	-0.477***	-0.142***
	(0.035)	(0.035)
MPS $\times \beta^{\text{MKT}}$	0.234***	0.082*
	(0.051)	(0.047)
MPS $\times \beta^{\text{SMB}}$	0.427***	0.164***
	(0.056)	(0.050)
MPS $\times \beta^{\text{HML}}$	0.427***	0.222***
	(0.063)	(0.059)
MPS $\times \beta^{\text{RWM}}$	0.000	0.017
	(0.051)	(0.046)
MPS $\times \beta^{\text{CMA}}$	0.393***	0.147**
	(0.064)	(0.059)
MPS $\times \beta^{\text{MOM}}$	-0.088	-0.057
	(0.055)	(0.051)
Stock FE	Y	Y
Time FE	N	Y
Observations	475,799	475,799
Adjusted R^2	0.020	0.177

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Heteroskedasticity-robust standard errors clustered by CUSIP are in parentheses.

6 Model

In this section, we develop a two-period model that analytically characterizes how monetary policy affects equity flows across different classes of financial intermediaries and the resulting asset price dynamics. In the model, monetary policy shocks reallocate wealth across heterogeneous financial intermediaries, generating the observed patterns in equity flows of the previous sections. These flows influence asset prices through shifts in risk premia.

The model has two primary objectives. First, we examine how equity flows differ across financial intermediaries, extending beyond traditional intermediary asset pricing models where trading occurs between households and a representative intermediary. Unlike standard frameworks (e.g., He and Krishnamurthy (2013) and Brunnermeier and Sannikov (2014)), our model explicitly incorporates heterogeneity across financial intermediaries. Them model yields comparative statics on how equity flows respond to monetary policy shocks.

The second objective is to study how flow-performance sensitivity—the key mechanism identified in our empirical findings—shapes equity flows and amplifies asset price dynamics in response to monetary shocks. The key agent in the model is a representative household

that delegates a portion of its wealth to a mutual fund. The household forms expectations about future mutual fund returns based on past performance, which generates the equity flow and price dynamics observed in the data. We find that both the household belief formation process and the presence of heterogeneous financial intermediaries are crucial to explaining the documented equity flow patterns and price dynamics.

Our model builds on the risk-centric macroeconomic framework developed in Caballero and Simsek (2020), in which asset prices and monetary policy influence real economic output. We extend this framework by incorporating heterogeneous financial intermediaries and a household belief formation process based on past performance.

6.1 Model Environment

The model is set in two periods, $t \in \{0, 1\}$. In period 0, a representative household allocates wealth between consumption today and investment in heterogeneous financial intermediaries (mutual funds or banks) which offer the household different returns. Financial intermediaries then invest household wealth in equity and bond markets. The central bank sets its policy rate, which is the return of a risk-free bond which endogenously affects asset prices and output in the economy. In period 1, the household consumes its savings and accrued financial returns from the investment decision.

Production in the Economy

We derive the supply-side of the model in detail in Appendix B.1 and here offer a brief summary. There is a representative hand-to-mouth (HTM) household which supplies labor to the economy, which is the only factor of production. There is a continuum of monopolistically competitive intermediate goods firms and a competitive final goods producer as in the canonical New Keynesian model. Prices are perfectly sticky in this stylized framework. We assume that output will be at its potential in $t = 1$, and focus on its endogenous determination in $t = 0$ to characterize the relevant comparative statics. In $t = 1$, log potential output[24] is given

$$y_1^* = y_0^* + z_1, \quad z_1 \sim N(\mu_z, \sigma_z^2), \tag{9}$$

such that y_0^* refers to potential output in $t = 0$ and z_1 is a permanent productivity shock.

Financial Markets

In this economy, there are two financial assets[25]. The first asset is the *market asset* which we refer to as the equity market. This asset represents a claim on the share of output accrued to firms, which we show in Appendix B.1, to be a constant share of output: αY_t. Its gross return is denoted R_t. The second asset is a *risk-free bond*, which yields a return of R^f and is in net-zero

[24] Throughout the remainder of Section 3, lower-case variables denote log variables.

[25] See Appendix B.2 for a full description of financial markets and derivation of return processes.

supply.

A representative household generates demand in the economy and is endowed with initial wealth A_{-}. The household allocates its wealth between current consumption and investment, setting aside A_0 for consumption in $t = 1$.

Rather than holding financial assets directly, the household delegates investment decisions to two financial intermediaries: a mutual fund (M) and a bank (B).Each intermediary offers a log-return on investment: mutual fund shares yield mutual fund shares return r^M, which is risky, while the bank returns r^B, which is certain.[26] The household has Epstein-Zin preferences over consumption with unitary EIS, risk aversion γ, and discounts the future at rate $\exp(-\rho)$. Appendix B.3 provides a formal derivation of the household's optimization problem and its optimality conditions.

The true distribution of mutual fund returns is not in the information set of the household. The household forms beliefs about future returns by forecasting that mutual fund returns follow an AR(1) process:

$$r_1^M = \varphi r_0^M + \varepsilon, \quad \varphi > 0, \tag{10}$$

where $\varepsilon \sim N(0, \sigma_\varepsilon^2)$ is a shock to the household's return forecast which is believed to be normally distributed.

Given the household's belief about mutual fund returns, its optimal portfolio allocation follows from standard expected utility maximization. Following Campbell and Viceira (2002), the household's portfolio choice for the mutual fund is approximately given by

$$\omega_0^M \approx \max\left(\frac{1}{\gamma}\frac{\varphi r_0^M - r^B + \frac{1}{2}\sigma_\varepsilon^2}{\sigma_\varepsilon^2}, 0\right), \tag{11}$$

where lower case variables indicate log returns. The household's portfolio share allocated to the mutual fund is proportional to the perceived Sharpe ratio, adjusted for risk aversion and scaled by perceived return volatility. A short-selling constraint ensures that the household's mutual fund allocation is non-negative.

Financial Intermediaries

Financial intermediaries receive household investments and allocate them across financial assets. Mutual funds allocate investments between the market asset and the risk-free bond, maintaining a fixed portfolio weight λ on the market asset.

Unlike mutual funds, the bank guarantees a fixed return to the household while earning profits from investing its own wealth in financial assets. The bank optimizes its portfolio allocation

[26]The bank offers a product similar to a one-period certificate of deposit or savings account to the household in this economy.

to maximize expected utility, choosing a portfolio weight θ^B on the market asset based on its relative risk aversion γ^B. A full derivation of the bank's optimization problem is provided in Appendix B.4.

Market clearing requires that total household investment in the market asset through both intermediaries equals the asset's valuation:

$$A_t \left(\omega_t^M \lambda + \left(1 - \omega_t^M\right) \theta_t^B\right) = P_t, \tag{12}$$

where total household wealth, A_t, invested in the market asset through the mutual fund and bank must be worth the valuation of the market asset, P_t.

6.2 The Effect of a Monetary Contraction

Asset Pricing

In the model, asset prices influence real economic activity by shaping household consumption and investment decisions, as in other risk-centric macroeconomic models such as Caballero and Simsek (2021) and Kekre and Lenel (2022). We formally derive this linkage in Appendix B.5. The connection between output and financial markets is captured by the output-asset pricing equation:

$$y_0 = p_0 + \rho - \log \alpha. \tag{13}$$

This equation captures the fundamental link between asset valuations and economic output, incorporating risk-adjusted returns and equilibrium conditions. It relies on several key components: the production of real output as dividend claims for the risky asset, household and intermediary portfolio allocations, returns on financial assets, and the central bank's policy rule for the risk-free rate. Appendix B.6 derives the return processes for the market asset and mutual fund, while Appendix B.7 outlines the central bank's policy rule for setting $r^f = r^{f,*} + \eta$, where $\eta \sim N(0, \sigma_\eta^2)$ is the monetary shock that we will subsequently study.

Since the risky asset is assumed to have a unitary supply and bonds are in net-zero supply, total household wealth satisfies $A_0 = P_0$. Combining the asset market clearing condition (12) with the household's portfolio choice (11) and the intermediary portfolio weights (λ, θ^B), we derive the *aggregate risk-balance* equation:

$$\frac{y_0^* + \mu_z + \log \alpha - p_0 + \frac{1}{2}\sigma_z^2 - r^f}{\sigma_z} = \gamma(\omega_0^M)\sigma_z, \tag{14}$$

$$\text{where} \quad \gamma(\omega_0^M) = \gamma^B \frac{1 - \lambda\omega_0^M}{1 - \omega_0^M}. \tag{15}$$

The term $\gamma(\omega_0^M)$ represents the inverse of the economy's aggregate effective risk aversion, weighted by the household's allocation across financial intermediaries. This term implicitly

determines the price of the market asset.[27]

Implications of a Monetary Policy Shock

To link the empirical findings of the previous sections to our micro-founded general equilibrium model, we provide comparative statics under sufficient conditions of equity flows across intermediaries and asset prices. Throughout this section we refer to comparative statics with respect to η, the monetary shock affecting the yield of the risk-free bond.

Proposition 1. *Consider a local monetary perturbation, η. For $r_0^* < \zeta$*

1. $\frac{\partial \omega_0^M}{\partial \eta} \leq 0$*, the household reduces its wealth weight on the mutual fund as a result of a contractionary shock and,*
2. $\frac{\partial (1-\omega_0^M)\theta^B}{\partial \eta} \geq 0$*, the bank absorbs the outflows of the market asset.*

Where $\zeta = \dfrac{\gamma\sigma_\varepsilon^2\left(1-\left(\frac{\varphi\lambda(\lambda-1)}{\gamma\gamma^B\sigma_\varepsilon^2\sigma_z^2}\right)^{\frac{1}{2}}\right)+r^B-\frac{1}{2}\sigma_\varepsilon^2}{\varphi}$.

Proof. See Appendix B.8. □

Proposition (1) establishes that contractionary shocks will redistribute wealth managed from mutual funds to the bank intermediary. This implies that contractionary shocks will cause equity flows where the mutual fund sells shares of the market asset to the bank, as we demonstrated empirically in Section 4.1. We provide Corollary 1 in Appendix B.8 to demonstrate that these results are driven by monetary shocks shifting risk premia. Our model provides an alternative explanation for how monetary policy affects risk premia through shifting household beliefs over future returns and the interaction of heterogeneous financial intermediaries within equity markets.

Next, we decompose the role of the household's sensitivity to prior returns for monetary transmission. We model household sensitivity to prior-returns (φ) as a micro-foundation for the flow-performance relationship observed for mutual funds in the data.

Proposition 2. *Consider a local monetary perturbation, η. For $r_0^* \in (0, \zeta)$,*

1. $\frac{\partial^2 p_0}{\partial \eta \partial \varphi} \leq 0$*, a more return-sensitive household amplifies price declines in the market asset due to monetary contraction and,*
2. $\frac{\partial^2 \omega_0^M}{\partial \eta \partial \varphi} \leq 0$*, equity flows from the mutual fund are amplified.*

[27] The risk-balance equation (14) expresses the economy's equilibrium Sharpe ratio as a function of effective risk aversion. Importantly, while household beliefs feature extrapolation from current mutual fund returns, they do not directly impact the Sharpe ratio, as the household delegates investment decisions to sophisticated financial intermediaries who fully understand the economy's data-generating process. Instead, household beliefs influence equilibrium asset prices indirectly by shifting the allocation of wealth across intermediaries, which alters the aggregate risk tolerance $\gamma(\omega_0^M)$ and, in turn, affects equilibrium asset pricing conditions.

Proof. See Appendix B.8. □

The model predicts that asset price declines caused by monetary policy will be amplified by a more return-sensitive household (higher φ). Furthermore, these price declines will result in a larger outflow of wealth from mutual funds to banks due to a monetary contraction. This result demonstrates that our analytically tractable model is capable of generating the price and equity flow dynamics we observed that were caused by mutual fund performance-flow sensitivity in the data.

Numerical Example of Monetary Dynamics

Figure 4 plots a numerical example of the dynamics of the model.[28] The calibration is meant to be illustrative to demonstrate the nonlinear, but monotonic, dynamics that our model is capable of generating. The dynamics demonstrate that, regardless of the household return-sensitivity parameter φ, monetary contractions cause asset prices to decline and equity flows from the mutual fund. During a contraction, the bank provides liquidity to equilibrate this redistribution in the market asset. The numerical example demonstrates that as φ sensitivity amplifies asset price changes and equity flows.

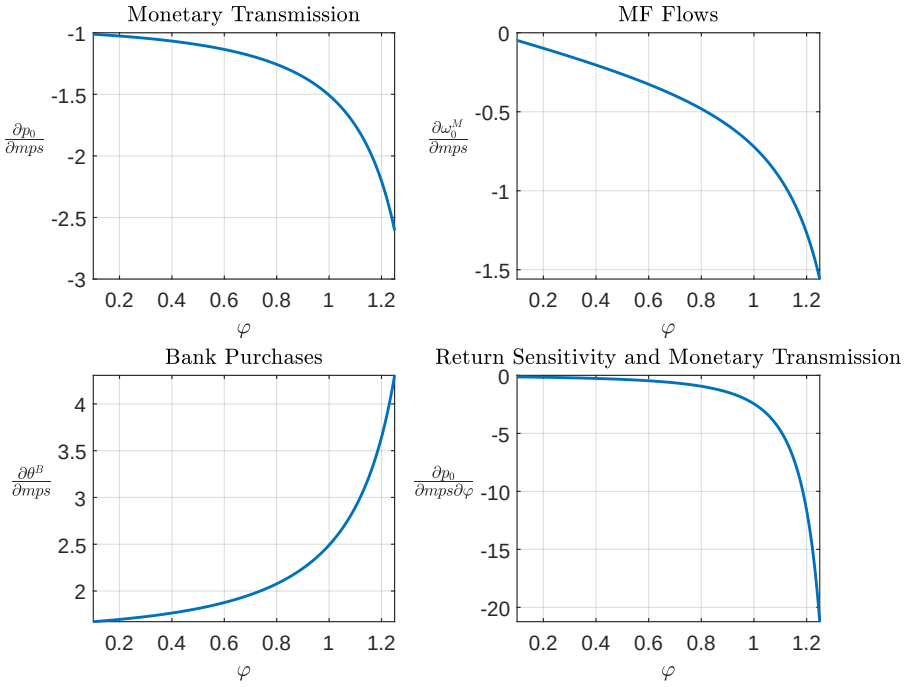


Figure 4: Theoretical Monetary Dynamics

Notes: We plot the numerical dynamics of asset prices, household wealth weights on the mutual fund, the bank portfolio weight due to a monetary contraction. We also plot how asset price declines change as the household becomes more sensitive. See Figure B.1 for the levels of prices and portfolio allocations.

[28] We provide the set of illustrative calibration parameters in Table B.1.

This numerical example is illustrative that if households generate beliefs which lead to flow-performance sensitivity for mutual funds, monetary transmission to asset markets naturally has a large price elasticity ($\left|\frac{\partial p_0}{\partial mps}\right| > 1$). This amplification of asset price declines due to monetary policy is a notable contribution of the model. The literature on monetary transmission often suggests that the empirical estimates of asset price elasticities to small monetary perturbations is puzzlingly large, Bernanke and Kuttner (2005) and Lu and Wu (2023). Both the empirical evidence we have compiled in Section 4.3 and the model developed in this section are capable of generating large price elasticities through equity redistribution between heterogeneous financial intermediaries.

7 Conclusion

In this paper, we develop a novel approach towards understanding equity market responses to monetary policy. At the heart of both the empirical analysis and the model is the observation that households delegate their wealth management between heterogeneous financial intermediaries. While previous work has attempted to decompose monetary transmission through study of aggregate asset prices, we alternatively identify how quantities of equity shares are redistributed across classes of financial intermediaries. We argue both empirically and theoretically that these equity flows cause and amplify the aggregate price fluctuation studied in the literature. The difference in our approach leads to salient insights.

Mutual funds offer households easy access to equity markets, but are also subject to large net worth shocks because investors tend to withdraw capital after poor performance (flow-performance sensitivity). In contrast, other intermediaries, especially banks, rely on longer maturity debt and are less exposed to performance-sensitive investors. Banks thus have the ability to provide liquidity to clear equity markets.

Empirically, we provide novel evidence on equity flows across financial intermediaries. We highlight that mutual funds are subject to flow-performance sensitivity which causes mutual funds to sell equities after monetary contractions. Importantly, we confirm that our results are not driven by rebalancing away from equities *within* a fund, but instead by investor redemption from funds. Finally, demonstrate that flow-performance sensitivity across intermediaries is highly significant for amplifying monetary transmission to asset prices.

We conclude by constructing an analytical intermediary asset pricing model that features a household which is performance-sensitive and heterogeneous financial intermediaries. The theory and methodology developed in this study has demonstrated the importance of both intermediary flows and investor return beliefs in explaining asset price movements caused by monetary policy. However, the framework developed is more general than simply being suited for studying monetary transmission. We believe future work could be done to study other aggregate shocks, as well as further exploring what impact investor return sensitivity has on other financial outcomes.

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A Institutional Background

In traditional models of intermediary-based asset pricing, financial intermediaries are majority claimants of risky assets, with households have little-to-none direct equity holdings. Financial institutions take up high leverage from households to invest in a portfolio of equity and debt instruments. Investors hold fixed claims on financial intermediaries, and have limited direct control on their investment portfolios. Hence, most intermediation occurs for the purpose of proprietary trading (intermediaries trading for their own profit rather than on behalf of customers), with little role for investor involvement in portfolio allocations.

Technological development in financial trading over the past three decades has drastically changed the landscape of portfolio reallocation: indexation has made passive investment increasingly accessible, while online trading platforms have given retail investors much greater control over portfolio rebalancing decisions. Furthermore, as discussed in Wurgler (2011), index funds generally have lower expenses and costs than actively managed funds, allowing for easy liquidation and reallocation of equities for investors. In order to study the impact of monetary policy on aggregate equity portfolio reallocation, it is essential to understand its impact on the business model of financial intermediaries that are the majority claimants of equities.

In this appendix, we the discuss the business models of the two largest financial intermediaries present in the U.S. equity markets: mutual funds and banks. Together, these institutions hold over two thirds of the aggregate U.S. stock market. However, these two classes of intermediaries are far from monolithic as assumed in traditional models. Their business models and reasons for holding equities differ drastically. We discuss these details in this section as grounds for a richer model of intermediary-based asset pricing that parsimoniously captures our empirical findings on the impact of monetary policy on aggregate equity portfolio reallocation in the U.S. over the past three decades.

A.1 Mutual Funds and ETFs as Intermediaries

As per a U.S. Securities and Exchange Commission (SEC) report for mutual fund investors, a mutual fund is an open-end investment company registered with the SEC that pools money from many investors to invest in stocks, bonds, short-term money-market instruments, and other securities. The combined securities and assets the mutual fund owns are known as its portfolio, which is managed by an SEC-registered investment adviser. Each mutual fund share represents an investor's proportionate ownership of the mutual fund's portfolio and the returns the portfolio generates. Investors in mutual funds buy their shares from, and sell/ redeem their shares to, the mutual funds themselves. Mutual fund shares are typically purchased from the fund directly or through investment professionals, often brokers. The price, the per-share value of the mutual fund's assets minus its liabilities, is called the NAV or net asset value. Mutual funds must sell and redeem their shares at the NAV.

Table A.1: Balance sheet for mutual funds

Assets		**Liabilities**	
Corporate equities	11138.9	Investor shares	16694.5
Debt securities	5081.0		
Other assets	474.6		
	16694.5		16694.5

Note:

This table is constructed using table L.122 from the Financial Accounts of the United States. The data is as of the end of 2019 Q4. Other assets include security repurchase agreements, syndicated loans to nonfinancial corporate businesses and unidentified miscellaneous assets. Values are in billions of dollars.

In Table A.1 we report key line items of the aggregate balance sheet of mutual funds from the Financial Accounts of the United States collected by the Federal Reserve Board. What is notable about the aggregate mutual fund balance sheet is that their assets and liabilities are largely of the same maturity. Their liabilities, investor shares, are redeemable at any point in time, and their assets are predominantly corporate equities or debt securities which trade in liquid markets. If investors redeem their shares, there will be selling pressure on mutual funds to reduce their holdings in liquid markets such as the market for corporate equities.

In this paper, we ask how equity holdings are reallocated across the entire U.S. stock market due to monetary policy shocks. Central to our question is the study of how those shocks affect investors of the largest equity-holding financial intermediary, namely mutual funds. Two previously established facts are worth highlighting. First, retail investors beliefs tend to be extrapolative of past financial returns[29]. Second, monetary policy affects stock market returns through an expectations channel.[30] Table A.1 suggests a potential mechanism: investor return expectations plays an increasingly prominent role in financial markets when a majority of the aggregate equities are held by mutual funds because of the open-ended and redeemable nature of their balance sheets.

A.2 Banks as Intermediaries

The most traditional class of financial intermediary explored in the academic literature is the bank. Traditionally, banks offer a return to their investors in the form of interest payed on de-

[29] See, for example, Vissing-Jorgensen (2003), Greenwood and Shleifer (2014), Cassella and Gulen (2018), and Kuchler and Zafar (2019).

[30] The seminal work on this topic is Bernanke and Kuttner (2005) which argues that monetary policy affects expectations of future dividends, but has been demonstrated times including recent work such as Ozdagli and Velikov (2020) and Miranda-Agrippino and Ricco, 2021.

posited accounts, such as time deposits or certificates of deposit. Banks earn returns on assets that comprise of loans and investments in securities. While banks can invest for proprietary trading, a majority of their equity and fixed-income portfolio holdings are for market-making. While academia has explored the deposit-taking and lending roles of traditional commercial banks, a potentially under-emphasized role of the investment segment of banks in academic literature is their business in market-making.[31] As a result of this business, banks buy and trade significant amounts of equities.

Banks often separate their commercial and investment banking activities. For example, deposits taken in by the commercial banking arm are generally used to fund loans and other traditional banking activities. The investment banking arm engages in trading and securities activities, typically funded through capital markets and not directly from customer deposits. However, investment banks may use deposits to fund various activities, including trading assets, but this is regulated and limited by several rules to ensure the stability and soundness of the financial system. Regulations such as the Volcker Rule (part of the Dodd-Frank Act) restrict banks from engaging in proprietary trading with depositor funds. However, there are exceptions, such as market-making, underwriting, and risk-mitigating hedging activities.

Table A.2 presents the consolidated financial statements reported by chartered depository institutions in the U.S.. The majority of banking assets are loans and debt security investments. On the liability side, their aggregate business model differs significant from that of mutual funds in Table A.1 because they rely significantly on leverage through deposits.

However, this aggregate balance sheet is not the entire picture. From an accounting perspective, investment banks typically classify equities under "trading assets" or "securities available for sale" rather than directly under "equity". These classifications allow for frequent buying and selling, aligning with their business models which focus on liquidity and market-making activities. As a result, these equities are reported in categories that encompass various types of financial instruments, not just stocks. Investment banks may also engage in off-balance sheet activities, such as derivatives trading and special purpose vehicles (SPVs), where equity investments are not directly shown on the balance sheet. These activities can obscure the direct visibility of equity holdings in standard financial reports.

[31] The market-making function of banks provides liquidity to a variety of financial markets. This role that banks play often composes an important part of their profitability, and their importance to the functioning and pricing of financial markets is well understood by regulators and central banks (BIS, 2014).

Table A.2: Balance sheet for banks

Assets		**Liabilities**	
Corporate equities	133.9	Deposits	12743.7
Mutual fund shares	58.0	Uninsured deposits	5325.1
Debt securities	4058.4	Other liabilities	5142.8
Loans	9665.5		
Other assets	2207	Equities	1821.7
	16064.8		16064.8

Note:

This table is constructed using table L.111 from the Financial Accounts of the United States. The data is as of the end of 2019 Q4. All units are reported as billions of dollars. Other assets include cash, reserves, security repurchase agreements, life insurance reserves, receivables and unidentified miscellaneous assets. Other liabilities include security repurchase agreements, payables and miscellaneous liabilities. Values are in billions of dollars.

To highlight the importance of trading for banks, we present in Table A.3 a breakdown of assets and liabilities across all business segments (Commercial, Corporate & Investment) for the largest bank in the U.S., JP Morgan Chase & Co. The table is reported in the Management's Discussion and Analysis (MD&A) in the Form 10-Q quarterly report pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934. Due to the commercial banking segment, a significant portion of the balance sheet is dominated by loans and deposits, emphasizing stability and liquidity. However, we now see that the investment banking segment features significantly in the balance sheet through the large volume of trading assets and investment in securities. This highlights the banks' focus on market activities for potential short-term profitability.

Table A.3: Form 10-Q for JPMorgan Chase & Co.

Assets		**Liabilities**	
Trading assets	495.9	Deposits	1525.3
Investment securities	394.3	Long-term debt	296.5
Loans	945.2	Other debt	678.5
Other assets	929.3	Total stockholders' equities	264.4
	2764.7		2764.7

Note:

This table is constructed using consolidated financial highlights (unaudited) reported in the Form 10-Q quarterly report pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934. The data is as of the end of 2019 Q4. All units are reported as billions of dollars.

B Theoretical Appendix

In this appendix we provide any derivations or proofs omitted from the main text.

B.1 Supply-Side of the Model

In this section we derive in full detail the supply-side of the model. As briefly described in Section 6, there is a continuum of intermediate goods producers indexed by $j \in [0, 1]$. A perfectly competitive, final good producer aggregates inputs to create the final good with technology

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}, \quad \theta > 1, \tag{B.1}$$

where θ is the elasticity of substitution, $Q_t(j)$ is an intermediate firm's price, and Q_t is the aggregate price index. All output is generated using labor as the input of production. To provide this labor, we assume there is a representative hand-to-mouth (HTM) household which supplies labor according to per-period utility maximization

$$\max_{L_t} \log C_t^{HTM} - \chi \frac{L_t^{1+\xi}}{1+\xi} \tag{B.2}$$

$$\text{subject to} \quad Q_t C_t^{HTM} = W_t L_t + T_t, \tag{B.3}$$

where we assume that the HTM household dislikes work and consumes out of labor earnings and government transfers. We will make an assumption on household transfers subsequently for tractability. Optimizing (B.2) implies a labor supply curve given by

$$\frac{W_t}{Q_t} = \chi L_t^{\xi} C_t^{HTM}. \tag{B.4}$$

Intermediate firms produce with technology

$$Y_t(j) = A_t L_t(j)^{1-\alpha} \tag{B.5}$$

where $L_t(j)$ is the labor hired by the intermediate producer, and A_t is an aggregate productivity parameter. These intermediates solve a cost-minimization problem to determine their price

$$Q_t Y_t = \min_{y_t(j) \in [0,1]} \int_0^1 Q_t(j) Y_t(j) dj \tag{B.6}$$

$$\text{subject to} \quad Y_t = \left(\int_0^1 Y_t(j)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}.$$

Standard optimization implies that intermediate firm demand is given by

$$y_t(j) \leq \left(\frac{Q_t(j)}{Q_t}\right)^{-\theta} Y_t. \tag{B.7}$$

We derive the standard aggregate price index to be

$$Q_t = \left(\int_0^1 Q_t^{1-\theta} dj\right)^{\frac{1}{1-\theta}}. \tag{B.8}$$

The labor market clearing condition is

$$\int_0^1 L_t(j) dj = L_t. \tag{B.9}$$

We make a simplifying assumption on the nature of lump-sum transfers to be given by

$$T_t = (1-\alpha) Q_t Y_t - W_t L_t, \tag{B.10}$$

which combined with the budget constraint of the HTM household implies that HTM consumption is simplified to be a constant share of output:

$$C_t^{HTM} = (1-\alpha) Y_t \tag{B.11}$$

Finally, note that if HTM consumption is given by (B.11), it must be the case that the share of output which intermediate firms accrue is αY_t.

B.1.1 Flexible Price Benchmark

Even with perfectly rigid prices, it is useful to define what the flexible-price benchmarks are to determine potential output. Without nominal rigidities the intermediate goods producing firm maximizes profit. We omit time subscripts for notation, and as every decision it within-period. This profit maximization is given by

$$\Pi(j) = \max_{Q(j), L(j)} Q(j) Y(j) - W_t L(j) - T_t \tag{B.12}$$

$$\text{subject to} \quad Y(j) = A L(j)^{1-\alpha} = \left(\frac{Q(j)}{Q}\right)^{-\theta} Y.$$

We can then derive the optimal flexible intermediate price as

$$Q(j) = \frac{\theta}{\theta - 1} \frac{W}{(1-\alpha) Y} L(j)^{\alpha}. \tag{B.13}$$

An intermediate firm in a flexible-price economy will take aggregate output prices, wages, and output as given and thus set $Q(j) = Q$ and $Y(j) = Y$. Therefore, in the flexible price benchmark, we can combine intermediate demand (B.13) with labor supply (B.4) to generate an equilibrium labor equation of

$$\frac{W_t}{Q_t} = \frac{\theta - 1}{\theta}(1 - \alpha)A_t L_t^{-\alpha}. \tag{B.14}$$

This can be further combined with HTM consumption (B.11) to solve for potential equilibrium labor and output as

$$\begin{aligned} L_t^* &= \left(\frac{\theta - 1}{\theta}\frac{1}{\chi}\right)^{\frac{1}{1+\xi}}, \\ Y_t^* &= A_t \left(\frac{\theta - 1}{\theta}\frac{1}{\chi}\right)^{\frac{1-\alpha}{1+\xi}}. \end{aligned} \tag{B.15}$$

Going forward we refer to $\log Y_t^* = y_t^*$, and make the following assumption over y_1^*

$$y_1^* = y_0^* + z_1, \quad z_1 \sim N(\mu_z, \sigma_z^2), \tag{B.16}$$

where we assume that there is a permanent productivity shock to y_0^* in $t = 1$.

B.1.2 Perfect Price Rigidity

We simplify our analysis in the main text with the assumption that prices are fully sticky. This implies that $Q_t(j) = Q^*$, and therefore that $Q_t = Q^*$. This assumption transforms the intermediate goods producer profit maximization problem to be

$$\begin{aligned} &\max_{L(j)} Q^* A_t L(j)^{1-\alpha} - W_t L_t(j) - T_t \\ &\text{subject to} \quad A_t L_t^{1-\alpha} \leq Y_t, \end{aligned} \tag{B.17}$$

because these firms are homogeneous, this implies $L_t(j) = L_t$ and $Y_t(j) = Y_t$. Under the assumption that any monetary policy shocks we use in the model are small, firms will optimally meet demand for goods. Therefore, with sticky prices labor and output are determined by

$$L_t = \left(\frac{Q^*(1 - \alpha)A_t}{W_t}\right)^{\frac{1}{\alpha}} \tag{B.18}$$

$$Y_t = A_t \left(\frac{Q^*(1 - \alpha)A_t}{W_t}\right)^{\frac{1-\alpha}{\alpha}}. \tag{B.19}$$

B.2 Financial Markets

In this economy, there are two financial assets.

The first asset is the *market asset* which we refer to as the equity market. This financial asset gives a claim on the share of output accrued to firms which, we show in Appendix B.1, to be αY_t. We denote the measure of the market asset in this economy is given by S which we normalize to be in unitary supply.

The market asset pays dividends in the form of intermediate firm profits as well as capital gains. Therefore, gross returns in each period are defined as

$$R_0 = \frac{\alpha Y_0 + P_0}{P_-}, \quad \text{and} \tag{B.20}$$

$$R_1 = \frac{\alpha Y_1}{P_0}, \tag{B.21}$$

where P_t denotes the price of the asset portfolio in a given period[32].

We also assume that there is a risk-free bond in this economy with return R^f which is in net-zero supply. The return on the risk-free bond is set by the central bank, using a Taylor Rule which we will define subsequently.

B.3 Household Environment

There is a representative household which is endowed with some level of initial wealth A_-. The household consumes out wealth and chooses to invest wealth A_0.

Instead of the typical portfolio choice problem, we do not allow for the household to hold financial assets directly but instead the household delegates its wealth management to two financial intermediaries: a mutual fund (superscript M) and a bank (superscript B). Each financial intermediary offers the household a return. We assume that the return on a mutual fund is risky and the bank offers a certain return[33]. For analytical tractability, we equip the household with Epstein-Zin preferences over consumption with unitary EIS, risk aversion given by parameter γ, and that it discounts the future at rate $\exp(-\rho)$. Therefore the household maximizes utility according to

$$\max_{C_0, A_0, \omega_0^M} \log C_0 + \exp(-\rho) \log \left(\mathbb{E}\left[C_1^{1-\gamma} \right] \right)^{\frac{1}{1-\gamma}} \tag{B.22}$$

$$\text{subject to} \quad C_0 + A_0 = A_- \left(\omega_-^M \left(R_0^M - R^B \right) + R^B \right), \tag{B.23}$$

$$C_1 = A_0 \left(\omega_0^M \left(R_1^M - R^B \right) + R^B \right), \tag{B.24}$$

$$\omega_0^M \geq 0,$$

where R_t^M denotes the return on the mutual fund in a given period, and ω_t^M gives the household wealth weight on the financial intermediary at the end of the period. The return on the bank R^B does not change between periods. Also note that we impose a short-selling constraint to

[32] Therefore P_- is the price of the asset in the period prior to $t = 0$, which pins down the return in $t = 0$.

[33] We think of holdings at a bank to represent a one-period certificate of deposit or savings account.

remove eliminate the improbable scenario that a household borrows money to invest into a bank holdings.

Optimization for this problem is standard. We solve for period 0 consumption as

$$C_0 = \frac{1}{1+\exp(-\rho)} A_- \left(\omega_-^M \left(R_0^M - R^B\right) + R^B\right) \tag{B.25}$$

B.4 Financial Intermediary Environment

Our model features two financial intermediaries who return value to the household and earn profits heterogeneously by investing in financial assets on behalf of the household.

Mutual Funds

Mutual funds invest in the market asset and the risk-free bond on behalf of the household, and do so using a fixed portfolio weight, λ, on the market asset.

Banks

Banks differ from mutual funds in two critical respects within the model: they can earn profit and they offer a fixed return to the household. Banks receive $\left(1-\omega_0^M\right) A_0$ of household wealth in period 0. Banks maximize their wealth according to

$$\max_{\theta^B} \left(\mathbb{E}\left[\left((1-\omega_0^M) A_0 \left(\theta^B \left(R_1 - R^F\right) + R^F\right)^{1-\gamma^B}\right)\right]\right), \tag{B.26}$$

where γ^B refers to the bank's relative risk aversion and θ^B is the bank's portfolio weight on the market asset. In each period the bank must pay out $A_{t-1}\left(1-\omega_{t-1}^M\right) R^B$ to the household, and thus earns profits which they consume,

$$C_t^B = \left(\theta^B \left(R_1 - R^F\right) + R^F - R^B\right)\left(1-\omega_{t-1}^M\right) A_{t-1}.$$

We again approximate the bank portfolio weight on the market asset as

$$\theta^B \approx \frac{1}{\gamma^B} \frac{\mathbb{E}_z[r_1] - r^f + \frac{1}{2}\sigma_z^2}{\sigma_z^2}. \tag{B.27}$$

B.5 Asset Pricing

As shown in Appendix B.1, financial markets receive a claim on output of αY_t each period. Given household and bank consumption, the goods market equilibrium is defined as

$$\alpha Y_t = C_t + C_t^B. \tag{B.28}$$

To provide clarity on the main mechanisms and implications of the model, we make a number

of clarifying assumptions and characterize an equilibrium. First, we choose the initial condition that coming into $t = 0$, the household has its entire wealth invested in mutual funds, $\omega_-^M = 1$. This simplifies analysis of period 0 as the bank then consumes zero profits initially. Using (B.28) with this condition implies the goods market equilibrium condition in $t = 0$ as

$$\alpha Y_0 = C_0^H.$$

Next, we use this goods market equilibrium condition in $t = 0$ and combine it with the optimal consumption policy (B.25) and the asset market clearing condition (12), to derive the *output-asset pricing* equation (in log terms),

$$y_0 = p_0 + \rho - \log \alpha.$$

Using the consumption policy we can also derive the log return in period 0 as

$$r_0 = \kappa + p_0 - p_-, \tag{B.29}$$

where $\kappa = \log(\alpha \exp(\rho) + 1)$.

Because the market asset is a unitary measure and bonds are in net zero supply, the identity $A_0 = P_0$ holds. Using asset market clearing in $t = 0$, (12), and combining with the household portfolio optimization (11), and the bank portfolio weight (B.27) we derive an aggregate *risk-balance equation*, equation (14) in the main text:

$$\frac{y_0^* + \mu_z + \log \alpha - p_0 + \frac{1}{2}\sigma_z^2 - r^f}{\sigma_z} = \gamma(\omega_0^M)\sigma_z, \tag{B.30}$$

$$\text{where} \quad \gamma(\omega_0^M) = \frac{1}{\gamma^B} \frac{1 - \lambda\omega_0^M}{1 - \omega_0^M}. \tag{B.31}$$

The term $\gamma(\omega_0^M)$ is the effective risk-aversion in the economy which depends on the weight the household places on the banking intermediary relative to its wealth weight in the mutual fund. This risk-balance condition prices the market asset.

B.6 Approximation of Period 0 Mutual Fund Returns

We write log returns of the market asset in $t = 0$ as

$$\begin{aligned} \log R_0 = r_0 &= \log\left(\frac{\alpha Y_0 + P_0}{P_-}\right) \\ &= \log\left(\frac{\alpha Y_0}{P_0} + 1\right) + \log\left(\frac{P_0}{P_-}\right) \end{aligned}$$

Define $X = \frac{\alpha Y_0}{P_0}$. Then we can rewrite $r_0 = \log(X+1) + p_0 - p_-$. In $t = 0$, when the household owns all of the market asset due to market clearing, and using the household consumption policy (B.25) we derive

$$\frac{\alpha Y_0}{P_0} = \exp(\rho).$$

Therefore, we can substitute $\exp(\rho)$ for $\frac{\alpha Y_0}{P_0}$ above which yields

$$r_0 = \log(1 + \exp(\rho)) + p_0 - p_-,$$

we define $\kappa = \log(1 + \exp(\rho))$, which gives (B.29).

To allow for analytical tractability we take a second order Taylor approximation of the mutual fund return in $t = 0$, following Campbell and Viceira (2002). The mutual fund return is approximately log-normal as it is a convex combination of a log-normal variable (the market asset), and a constant (risk-free bond). We define $R_0^M = \lambda R_0 + (1 - \lambda) R^f$. We perform the following approximation

$$\begin{aligned} \frac{1 + R_0^M}{1 + R^f} &= 1 + \lambda \left(\frac{1 + R_0}{1 + R^f} - 1 \right) \\ \log \left(\frac{1 + R_0^M}{1 + R^F} \right) &:= r_0^M - r^F \\ &= \log(1 + \lambda \left(\exp(r_0 - r^f) - 1 \right)) \end{aligned}$$

We then take a 2^{nd} order Taylor approximation of $r_0 - r^f \approx 0$ of the above expression. This yields

$$r_0^M - r^f \approx \lambda \left(r_0 - r^f \right) + \frac{1}{2} \lambda (1 - \lambda) \sigma_z^2, \tag{B.32}$$

an approximation we will use throughout the analytical analysis of the model including in the derivation of the household wealth weights as the expectation of (B.32) is log-normal.

B.7 Derivation of Central Bank Target

In this subsection we derive the target rate the central bank attempts to set to ensure that $y_0 = y_0^*$. We begin by noting that from (13), $p_0^* = y_0^* + \log \alpha - \rho$. We then can write the optimal period 0 return as

$$\begin{aligned} & r_0^* = \kappa + y_0^* + \log \alpha - \rho - p_- \\ & \text{where} \quad \kappa = \log(1 + \exp(\rho)), \end{aligned} \tag{B.33}$$

Therefore, the optimal mutual fund return in $t = 0$ is approximately

$$r_0^{M,*} \approx \lambda \left(\kappa + y_0^* + \log \alpha - \rho - p_- - r^{f,*} \right) + r^{f,*} + \frac{1}{2}\lambda(1-\lambda)\sigma_z^2$$

We then use these identities for r_0^*, $r_0^{M,*}$ and the identity for p_0^* in the aggregate risk-balance equation (14) to derive

$$\mu_z + \rho + \frac{1}{2}\sigma_z^2 - r^{f,*} = \sigma_z^2 \underbrace{\frac{1-\lambda\omega_0^{M,*}}{1-\omega_0^{M,*}}}_{\Phi},$$

$$\text{where } \Phi = \frac{1-\lambda\omega_0^{M,*}}{1-\omega_0^{M,*}} = \frac{\gamma^B \left(1 - \frac{\lambda}{\gamma} \frac{\varphi\left[\lambda(\kappa + y_0^* - p_- - r^{f,*}) + r^{f,*} + \frac{1}{2}\lambda(1-\lambda)\sigma_z^2\right] - r^B + \frac{1}{2}\sigma_\varepsilon{}^2}{\sigma_\varepsilon^2} \right)}{1 - \frac{1}{\gamma} \frac{\varphi\left[\lambda(\kappa + y_0^* - p_- - r^{f,*}) + r^{f,*} + \frac{1}{2}\lambda(1-\lambda)\sigma_z^2\right] - r^B + \frac{1}{2}\sigma_\varepsilon{}^2}{\sigma_\varepsilon^2}}$$

which finally implies that the optimal risk-free rate is given

$$r^{f,*} = \mu_z + \rho + \frac{1}{2}\sigma_z^2 - \Phi\sigma_z^2. \tag{B.34}$$

The term y_0^* appears in $\sigma_z^2\Phi$, potential output is given by (B.15). Note that $r^{f,*}$ is an implicit function of parameters. The central bank attempts objective is to set this rate to target $y_0 = y_0^*$.

B.8 Proofs

Proposition 1. *Consider a local monetary perturbation, η. For $r_0^* < \zeta$*

1. *$\frac{\partial \omega_0^M}{\partial \eta} \leq 0$, the household reduces its wealth weight on the mutual fund as a result of a contractionary shock and,*
2. *$\frac{\partial (1-\omega_0^M)\theta^B}{\partial \eta} \geq 0$, the bank absorbs the outflows of the market asset.*

Where $\zeta = \frac{\gamma\sigma_\varepsilon^2 \left(1 - \left(\varphi\lambda(\lambda-1)\frac{\gamma^B\sigma_z^2}{\gamma\sigma_\varepsilon^2} \right)^{\frac{1}{2}} \right) + r^B - \frac{1}{2}\sigma_\varepsilon^2}{\varphi}$.

Proof. We start with characterizing the comparative statics of the bank's portfolio weight on the market asset with respect to the monetary shock,

$$\frac{\partial \theta^B}{\partial \eta} = \frac{1}{\gamma^B\sigma_z^2} \left(-\frac{\partial p_0}{\partial \eta} - 1 \right),$$

and the change in the household's wealth weight on the mutual fund when not facing the short-

selling constraint,

$$\frac{\partial \omega_0^M}{\partial \eta} = \frac{1}{\gamma \sigma_\varepsilon^2}\left[\varphi\left(\lambda\left(\frac{\partial p_0}{\partial \eta} - 1\right) + 1\right)\right].$$

It is clear that a sufficient condition for $\frac{\partial \theta^B}{\partial \eta} > 0$ and $\frac{\partial \omega_0^M}{\partial \eta} < 0$ is $\frac{\partial p_0}{\partial \eta} < -1$. We now show that with $\lambda > 1$ this condition holds, proving Proposition 1 in the unconstrained case.

We rewrite the risk-balance condition (14) as

$$H : y_0^* + \mu_z + \log\alpha - p_0 + \frac{1}{2}\sigma_z^2 - r^{f*} - \eta - \sigma_z^2 \gamma^B \frac{1 - \lambda\omega_0^M}{1 - \omega_0^M} = 0, \tag{B.35}$$

and use the implicit function theorem to derive

$$\begin{aligned}
\frac{\partial p_0}{\partial \eta} &= -\frac{\partial H/\partial \eta}{\partial H/\partial p_0} \\
&= \frac{\overbrace{1 + \sigma_z^2\gamma^B\left(\frac{\lambda\widetilde{\frac{\partial \omega_0^M}{\partial \eta}}(1-\omega_0^M) + \widetilde{\frac{\partial \omega_0^M}{\partial \eta}}(1-\lambda\omega_0^M)}{(1-\omega_0^M)^2}\right)}^{F}}{\underbrace{-1 - \sigma_z^2\gamma^B\left(\frac{-\lambda\widetilde{\frac{\partial \omega_0^M}{\partial p_0}}(1-\omega_0^M) + \widetilde{\frac{\partial \omega_0^M}{\partial p_0}}(1-\lambda\omega_0^M)}{(1-\omega_0^M)^2}\right)}_{G}},
\end{aligned} \tag{B.36}$$

where $\widetilde{\frac{\partial \omega_0^M}{\partial \eta}} = \frac{\varphi(1-\lambda)}{\gamma\sigma_\varepsilon{}^2}$ and $\widetilde{\frac{\partial \omega_0^M}{\partial p_0}} = \frac{\varphi\lambda}{\gamma\sigma_\varepsilon{}^2}$, are partial derivatives of ω_0^M ignoring the GE effects of price changes. For Proposition 1, we must show $\frac{p_0}{\partial \eta} < -1$. The numerator, F, is strictly positive. For the proposition to hold we must have $G < 0$. It is straightforward to verify if

$$\begin{aligned}
r_0^* &< \frac{\overbrace{\gamma\sigma_\varepsilon^2\left(1 - \left(\varphi\lambda(\lambda-1)\frac{\gamma^B\sigma_z^2}{\gamma\sigma_\varepsilon^2}\right)^{\frac{1}{2}}\right) + r^B - \frac{1}{2}\sigma_\varepsilon^2}^{\zeta}}{\varphi} \\
\text{where} \quad r_0^* &= \lambda(\kappa + p_0^* - p_- - r^{f,*}) + r^{f,*} + \frac{1}{2}\lambda(1-\lambda)\sigma_z^2,
\end{aligned}$$

then $G < 0$. With $G < 0$, it suffices to show $F > -G$ This simplifies to the condition

$$1 - \lambda < \lambda,$$

which is always true with $\lambda > 1$. This verifies the claim of Proposition 1 when $\omega_0^M > 0$.

When $\omega_0^M = 0$ due to the short-selling constraint, the proposition holds weakly as $\frac{\partial \omega_0^M}{\partial \eta} = 0$ and $\frac{\partial p_0}{\partial \eta} = -1$.

□

Proposition 2. *Consider a local monetary perturbation, η. For $r_0^* \in (0, \zeta)$,*

1. $\frac{\partial^2 p_0}{\partial \eta \partial \varphi} \leq 0$*, a more return-sensitive household amplifies price declines in the market asset due to monetary contraction and,*
2. $\frac{\partial^2 \omega_0^M}{\partial \eta \partial \varphi} \leq 0$*.*

Proof. We extend the proof method of Proposition 1. First, consider the constrained region where $\omega_0^M = 0$. In this case, it is straightforward to verify $\frac{\partial p_0}{\partial \eta \partial \varphi} = 0$.

When unconstrained,

$$\frac{\partial^2 \omega_0^M}{\partial \eta \partial \varphi} = \frac{1}{\gamma \sigma_\varepsilon^2} \left[\lambda \frac{\partial p_0}{\partial \eta} - 1 + \varphi \lambda \frac{\partial^2 p_0}{\partial \eta \partial \varphi} \right],$$

therefore conditions under which $\frac{\partial^2 p_0}{\partial \eta \partial \varphi} < 0$ completes the proof. Applying the implicit function theorem twice to (B.35) yields,

$$\frac{\partial^2 p_0}{\partial \eta \partial \varphi} = \frac{H_\eta H_{p_0} - H_\eta H_{\eta\varphi}}{H_{p_0}^2}.$$

We use the result and condition in Proposition 1 and conclude this is equivalent to $\frac{\partial p_0}{\partial \eta} H_{p_0 \varphi} < -H_{\eta\varphi}$. The derivations for $H_{p_0\varphi}$ and $H_{\eta\varphi}$ are as follows,

$$H_{p_0\varphi} = (1-\omega_0^M)^{-2} \lambda(\lambda-1) \frac{\sigma_z^2 \gamma^B}{\sigma_\varepsilon^2 \gamma} \left(1 + \frac{2\varphi}{1-\omega_0^M} \frac{\partial \omega_0^M}{\partial \varphi} \right),$$
$$H_{\eta\varphi} = -(1-\omega_0^M)^{-2} (\lambda-1)^2 \frac{\sigma_z^2 \gamma^B}{\sigma_\varepsilon^2 \gamma} \left(1 + \frac{2\varphi}{1-\omega_0^M} \frac{\partial \omega_0^M}{\partial \varphi} \right),$$

then we show

$$\frac{\partial p_0}{\partial \eta} H_{p_0\varphi} < -H_{\eta\varphi}$$
$$\implies \frac{\partial p_0}{\partial \eta} \left((1-\omega_0^M)^{-2} \lambda(\lambda-1) \frac{\sigma_z^2 \gamma^B}{\sigma_\varepsilon^2 \gamma} \left(1 + \frac{2\varphi}{1-\omega_0^M} \frac{\partial \omega_0^M}{\partial \varphi} \right) \right) <$$
$$(1-\omega_0^M)^{-2} (\lambda-1)^2 \frac{\sigma_z^2 \gamma^B}{\sigma_\varepsilon^2 \gamma} \left(1 + \frac{2\varphi}{1-\omega_0^M} \frac{\partial \omega_0^M}{\partial \varphi} \right),$$

which after dividing by $(1-\lambda)\frac{\sigma_z^2 \gamma^B}{\sigma_\varepsilon^2 \gamma}(1-\omega_0)^{-2} < 0$, simplifies to

$$(1-\lambda) \left(1 + \frac{2\varphi}{1-\omega_0^M} \frac{\partial \omega_0^M}{\partial \varphi} \right) < -\lambda \frac{\partial p_0}{\partial \eta} \left(1 + \frac{2\varphi}{1-\omega_0^M} \frac{\partial \omega_0^M}{\partial \varphi} \right).$$

Now, under $r_0^* < \zeta \implies \omega_0^M < 1$. Therefore, if $\frac{\partial \omega_0^M}{\partial \eta} > 0$, the proof is complete as $-\lambda \frac{\partial p_0}{\partial \eta} >$

$0 > 1 - \lambda$. We derive,

$$\frac{\partial \omega_0^M}{\partial \eta} = \frac{r_0^*}{\gamma \sigma_\varepsilon^2},$$

which is positive as long as $r_0^* > 0$. Thus, with $r_0^* \in (0, \zeta)$ the proof is complete. □

Discussion

Note that Propositions 1 and 2 were proven under local perturbations arguments around the optimal period 0 prices targeted by the central bank. The equilibrium asset price is a quadratic function, and we can derive similar conditions for global versions of Propositions 1 and 2 which are available upon request.

Corollary 1. *A monetary contraction increases the risk premium in the economy.*

Proof. The aggregate risk balance equation (14) must hold in any equilibrium. As established in Proposition 1, a contractionary monetary shock causes ω_0^M to decline. Examining (14), if ω_0^M declines, then the right hand side of the risk balance condition must increase as $\lambda > 1$. To equilibrate this shift in portfolio holdings, the LHS of (14), which is the risk-premium of the economy scaled by the volatility of output[34], increases. □

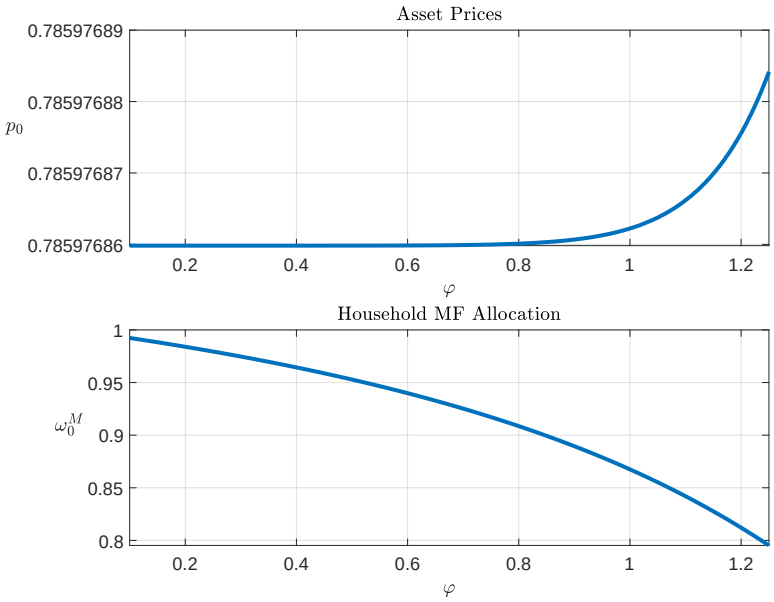
B.9 Numerical Example Details

Table B.1: Numerical Example Calibration Values

Parameter	Value
y_0^*	2
α	0.3
μ_z	0.2
σ_z^2	0.22
σ_ε^2	1.11
r^b	0.05
γ	2.25
γ^B	2.75
κ	0.698
λ	1.2

[34]This is the Sharpe ratio of the market asset.

Figure B.1: Model Values in Levels



C Empirical Appendix

C.1 List of Fund Managers

Table C.1: List of largest fund managers

Banks	Mutual funds	Investment advisors	Life insurance funds	Pension funds	University & Foundation endowments
STATE STREET BANK	THE VANGUARD GROUP	CAPITAL WORLD INVESTORS	AXA FINANCIALS	CALIFORNIA PUBLIC EMPLOYEES	BILL & MELINDA GATES FOUNDATION
NY MELLON BANK	FIDELITY MANAGEMENT & RESEARCH	CAPITAL RESEARCH & MANAGEMENT	EQUITABLE LIFE	NEW YORK STATE COMMON RETIREMENT	HARVARD UNIVERSITY
J P CHASE BANK	BLACKROCK FINANCIAL MANAGEMENT	AE WEALTH MANAGEMENT	CITIGROUP LIFE INSURANCE	LEGAL AND GENERAL GROUP	UNIVERSITY OF CALIFORNIA
BANK OF AMERICA	J P CHASE INVESTMENT MANAGEMENT	GEODE CAPITAL MANAGEMENT	TRAVELERS INC	CANADA PENSION	FORD FOUNDATION
MORGAN STANLEY BANK	WELLINGTON MANAGEMENT	NBIM	PRINCIPAL FINANCIAL	NEW YORK STATE TEACHERS	HOWARD HUGHES MEDICAL INSTITUTE
BARCLAYS BANK	PRICE T ROWE ASSOCIATES	CAMBRIDGE ASSOCIATES	STATE FARM	FLORIDA STATE BOARD	CHARLES STEWART MOTT FOUNDATION
NORTHERN TRUST BANK	GOLDMAN SACHS ASSET MANAGEMENT	BERKSHIRE HATHAWAY	PRUDENTIAL	CALIFORNIA STATE TEACHERS	TEXAS A&M UNIVERSITY
CITIBANK	MORGAN STANLEY ASSET MANAGEMENT	BLACKROCK ADVISORS	NORTHWESTERN MUTUAL	TEXAS TEACHERS	PRINCETON UNIVERSITY
DEUTSCHE BANK	FRANKLIN RESOURCES	CLEARBRIDGE ADVISORS	METLIFE	WISCONSIN INVESTMENT BOARD	YALE UNIVERSITY
PNC BANK	JANUS CAPITAL	ADAGE CAPITAL MANAGEMENT	MASSMUTUAL	NATIONAL PENSION SERVICE (SOUTH KOREA)	UPENN

C.2 Summary Statistics

Table C.2 presents summary statistics of key variables by financial intermediary class: number of institutions within class, % of market held within the S-34, AUM, equity flows, fund manager return, and investor performance-sensitivity. Construction of equity flows and investor performance-sensitivity is discussed in the following section. Equity flows capture the proportion of a fund manager's equity portfolio that gets sold or bought quarter-on-quarter.[35] For a sense of magnitude, a value of equity flows of 0.129 implies 12.9% of the portfolio experiences churn. Investor performance-sensitivity is a measure of flows induced by a fund manager's α, with a positive value indicating high inflows in response to a high α.

We report that mutual funds and investment advisors capture around two-thirds of the market in the two decades 1990-2010, and around four-fifths of the market since 2010. Investment banks market around a fifth of the market in the first two decades, and fourteen percent in the last decade. Together, these two segments capture above ninety percent of the market.

Next, while the median mutual fund and investor advisor was of a similar size as the typical bank by AUM in the earlier part of the sample, banks greatly outpaced the growth of other intermediaries over time. This growth occurred as the number of banks fell, implying bank consolidation. The opposite is true for mutual fund and investor advisors. Both intermediary classes experiences similar churn in equity portfolios, in the mean and in the right tail. However, mutual funds and investment advisors have higher performance-sensitivity, particularly excluding the 2000-2009 decade. Interestingly, banks are the only large financial intermediary to have negative performance-sensitivity, with a particularly high magnitude in the recent decade. A negative relationship implies inflows (outflows) after a recent poor (good) return of the equity portfolio. We discuss this further in the subsequent section, and argue that it is a representation of the insensitivity of banks' trading behavior to their performance due to their market-making function.

[35] We present its absolute value to eliminate opposing signs for buy and sell side activity, and present a measure that captures the extent of churn in a fund manager's equity holdings. The flow measure is purged of any valuation effects and hence represents pure quantity changes.

Table C.2: Summary statistics by financial intermediary class

Period	Number of Institutions	% of market held	AUM ($ million)		Equity flows ($\lvert\Delta Q\rvert$)		Fund manager return		Performance-sensitivity ($\tilde{\varphi}$)	
			Median	90th percentile	Mean	90th percentile	Mean	90th percentile	Mean	90th percentile
Mutual funds & Investment advisors										
1990-1999	1820	64.6	168	2134	0.129	0.275	0.881	1.090	-0.707	1.328
2000-2009	3689	66.4	214	3066	0.132	0.292	0.860	1.091	1.125	3.759
2010-2019	6188	78.7	292	4125	0.111	0.233	0.918	1.084	3.529	19.573
Banks										
1990-1999	376	22	172	2963	0.129	0.257	0.934	1.086	-1.171	0.928
2000-2009	279	23.6	247	10279	0.122	0.241	0.892	1.079	1.647	6.080
2010-2019	283	14	463	16436	0.102	0.206	0.959	1.089	-2.622	14.053
Pension & Life insurance funds										
1990-1999	173	12.8	313	4166	0.142	0.307	0.904	1.086	-0.905	1.126
2000-2009	156	9.4	959	17966	0.123	0.280	0.883	1.102	1.150	6.738
2010-2019	155	5.9	2171	30931	0.102	0.226	0.931	1.093	15.379	76.836
Other fund managers										
1990-1999	50	0.9	83	920	0.072	0.211	0.812	1.095	-0.136	0.599
2000-2009	152	0.8	100	1374	0.097	0.260	0.824	1.105	-0.093	1.553
2010-2019	207	1.4	127	3798	0.048	0.134	0.833	1.145	-5.932	18.789

C.3 Active management by non-S34 sectors

We classify non-S34 holdings for each stock as the difference between the total market capitalization for each stock less the market capitalization managed by S34 managers. In 2019, S-34 managers collectively manage around 70% of the US stock market, with the remaining 30% attributed to non-S34 sectors. Koijen and Yogo (2019) present these sectors as household holdings, but we can generalize this to other smaller managers, RoW, and households.

Indexing for valuation effects for every stock and collapsing by the past quarter weight of the stock in the overall market, we create a measure of aggregate flow for the non-S34 sectors, Active_t. We regress Active_t against MPS_t to test for the aggregate flow response by all other sectors outside the S-34. We find that, after a contractionary monetary surprise, equity flows into S-34 managers by around 3.8%.

Table C.3: Non-S34 share of equities in response to a monetary surprise

	Dependent variable: Active_t
	Aggregate economy
	(1)
MPS	-0.038*
	(0.021)
Observations	128
Adjusted R^2	0.017
$\mathbb{E}$(Y)	51.71%
$\mathbb{E}$(Y, post-GFC)	25.01%

Note:

Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors are in parentheses.

*p<0.1; **p<0.05; ***p<0.01

C.4 MPS Measure

We report statistics on two measures of quarterly monetary policy surprises (MPS) in Table C.4. These surprises are interpreted to be in units of basis points and are aggregated from Bauer and Swanson (2023). Our baseline measure simply aggregates all orthogonal MPS's in a quarter as defined in Bauer and Swanson (2023). We also perform robustness exercises using "MPS Weighted" which weights each MPS event by the length of time that event was the most recent shock within a quarter. Our baseline MPS measure on average features a shock of 0 basis points in a quarter and the distribution of surprises is symmetric. The standard deviation of our baseline measure is 7 basis points.

Table C.4: Summary Statistics for MPS (1988-2019)

	Mean	Standard Deviation	10th Percentile	Median	90th Percentile
MPS	-0.00	0.07	-0.09	0.00	0.08
MPS Weighted	0.00	0.07	-0.07	-0.00	0.10

Note:
Quarterly aggregated MPS shocks from (Bauer and Swanson, 2023). The row "MPS" refers to a simple aggregated measure of MPS that occur in a quarter. The "MPS Weighted" row refers to an aggregated measure where surprises are weighted by the length of time a shock was from the start of quarter.

C.5 Equity flows for unweighted MPS

Table C.5: Equity flow response to a monetary surprise

	Dependent variable: $\Delta Q_{m,t}$
	Aggregate economy
	(1)
MPS $\times$ MF & IA	-0.255***
	(0.064)
MPS $\times$ Banks	0.235*
	(0.126)
MPS $\times$ PF & LI	0.104
	(0.201)
Manager FE	Y
Observations	284,005
Adjusted R^2	0.162
$\mathbb{E}$(Y)	0.7%

Note:

Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses. AUM share of Mutual Funds & Investment Advisors is 74.6%, of Banks is 17.1%, and of Pension and Insurance Funds is 7.1%.

*p<0.1; **p<0.05; ***p<0.01

C.6 Flow performance sensitivity for other classes

Table C.6: Flow-performance sensitivity

	Dependent variable: $\text{Flows}_{m,t}$		
	Pension & Insurance funds	University & foundation endowments	Other funds
	(1)	(2)	(3)
Performance (α)	-0.664	-3.788	1.831
	(0.668)	(4.410)	(3.034)
Manager FE	Y	Y	Y
Time FE	Y	Y	Y
Observations	14,615	1,131	3,043
Adjusted R^2	0.175	0.107	0.066
$\mathbb{E}$(Y)	\$117M	\$29M	\$61M
AUM share	6.8%	0.1%	1.1%

Note:

Coefficients are scaled by the mean of the dependent variable. Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors are in parentheses.

*p<0.1; **p<0.05; ***p<0.01

C.7 Flow performance sensitivity by raw returns

Table C.7: Flow-performance sensitivity

	Dependent variable: $\text{Flows}_{m,t}$					
	Full sample	Mutual funds & Investment advisors	Banks	Pension & Insurance funds	University & foundation endowments	Other funds
	(1)	(2)	(3)	(4)	(5)	(6)
Performance (R)	0.050***	0.053***	0.011	0.060	-0.320	0.031
	(0.001)	(0.015)	(0.103)	(0.073)	(0.590)	(0.827)
Manager FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Observations	344,847	290,923	30,298	17,400	1,322	4,904
Adjusted R^2	0.145	0.152	0.168	0.100	0.054	0.034
$\mathbb{E}$(Y)	\$79M	\$78M	\$86M	\$103M	\$30M	\$48M
AUM share	100%	75.4%	16.6%	6.8%	0.1%	1.2%

Note:

Coefficients are scaled by the mean of the dependent variable. Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors are in parentheses.

*p<0.1; **p<0.05; ***p<0.01

C.8 Equity flows and investor sensitivity for unweighted MPS

Table C.8: Equity flow response to a monetary surprise

	Dependent variable: $\Delta Q_{m,t}$	
	Aggregate economy	Aggregate economy
	(1)	(2)
MPS $\times$ $\tilde{\varphi}$ $\times$ MF & IA	-0.418***	-0.365***
	(0.098)	(0.100)
MPS $\times$ MF & IA	-0.189**	2.308
	(0.090)	(1.474)
MPS $\times$ $\tilde{\varphi}$ $\times$ Banks	0.028	0.016
	(0.028)	(0.033)
MPS $\times$ Banks	0.365*	2.921**
	(0.217)	(1.485)
MPS $\times$ $\tilde{\varphi}$ $\times$ PF & LI	-0.211	-0.207
	(0.232)	(0.224)
MPS $\times$ PF & LI	-0.075	2.508*
	(0.205)	(1.486)
Manager FE	Y	Y
Time FE	N	Y
Observations	134,636	134,636
Adjusted R^2	0.182	0.231
$\mathbb{E}$(Y)	0.7%	0.7%

Note:

Explanatory variables are scaled to one standard deviation. Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses. AUM share of Mutual Funds & Investment Advisors is 74.6%, of Banks is 17.1%, and of Pension and Insurance Funds is 7.1%.

*p<0.1; **p<0.05; ***p<0.01

C.9 Equity flows in response to equity market shocks

Table C.9: Aggregate transmission of monetary policy shocks to equity markets

	Dependent variable: R_t			
	(1)	(2)	(3)	(4)
	All stocks index	S& P 500 index	Funds sample	Funds with $\tilde{\varphi}$
MPS_t	-0.212**	-0.199**	-0.180*	-0.178*
	(0.101)	(0.096)	(0.105)	(0.105)
MPS_{t-1}	0.011	0.002	0.031	0.030
	(0.099)	(0.094)	(0.102)	(0.103)
MPS_{t-2}	-0.002	-0.015	0.037	0.039
	(0.100)	(0.095)	(0.103)	(0.103)
MPS_{t-3}	-0.046	-0.050	-0.003	-0.002
	(0.098)	(0.094)	(0.102)	(0.102)
MPS_{t-4}	-0.151	-0.146	-0.125	-0.125
	(0.101)	(0.096)	(0.104)	(0.105)
Observations	124	124	124	124
Adjusted R^2	0.006	0.006	-0.007	-0.008

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Table C.10: Flow elasticity to price shocks

	Dependent variable: $\Delta\omega_{m,t}$			
	(1)	(2)	(3)	(4)
	All stocks index	S& P 500 index	Funds sample	Funds with $\tilde{\varphi}$
$\widehat{R} \times$ MF & IA	0.223***	0.228***	0.192***	0.190***
	(0.059)	(0.059)	(0.058)	(0.058)
$\widehat{R} \times$ Banks	-0.340	-0.339	-0.341	-0.335
	(0.222)	(0.224)	(0.217)	(0.216)
$\widehat{R} \times$ PF & LI	-0.144	-0.132	-0.185	-0.187
	(0.152)	(0.155)	(0.141)	(0.141)
Manager FE	Y	Y	Y	Y
Observations	267,574	267,574	267,574	267,574
Adjusted R^2	0.162	0.162	0.161	0.161

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses.

Table C.11: Flow elasticity to price shocks

	Dependent variable: $\Delta\omega_{m,t}$			
	(1)	(2)	(3)	(4)
	All stocks index	S& P 500 index	Funds sample	Funds with $\tilde{\varphi}$
$\widehat{R} \times \tilde{\varphi} \times$ MF & IA	0.257***	0.255***	0.234***	0.234***
	(0.061)	(0.062)	(0.056)	(0.055)
$\widehat{R} \times$ MF & IA	0.157**	0.163**	0.127**	0.125*
	(0.067)	(0.069)	(0.064)	(0.064)
$\widehat{R} \times \tilde{\varphi} \times$ Banks	0.032	0.032	0.028	0.029
	(0.045)	(0.044)	(0.049)	(0.049)
$\widehat{R} \times$ Banks	-0.637*	-0.644*	-0.600*	-0.589*
	(0.343)	(0.349)	(0.327)	(0.324)
$\widehat{R} \times \tilde{\varphi} \times$ PF & LI	0.021	0.030	-0.008	-0.007
	(0.119)	(0.122)	(0.109)	(0.108)
$\widehat{R} \times$ PF & LI	0.052	0.070	-0.028	-0.032
	(0.146)	(0.149)	(0.144)	(0.144)
Manager FE	Y	Y	Y	Y
Observations	128,418	128,418	128,418	128,418
Adjusted R^2	0.186	0.186	0.185	0.185

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses.

C.10 Portfolio rebalancing versus net worth shock for unweighted MPS

Table C.12: Portfolio rebalancing and outflows for mutual funds

	(1) Δ Equity Share (%)	(2) Δ Bond Share (%)	(3) Δ Other Share (%)	(4) Δ TNA (%)
MPS	1.843	6.407	2.651	-1.622***
	(4.205)	(4.437)	(6.283)	(0.210)
Manager FE	Y	Y	Y	Y
Observations	23,853	23,853	23,853	30,788
Adjusted R^2	-0.006	-0.006	-0.008	0.044

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

Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses.

Table C.13: Portfolio rebalancing and outflows for mutual funds

	(1) Δ Equity Share (%)	(2) Δ Bond Share (%)	(3) Δ Other Share (%)	(4) Δ TNA (%)
MPS × $\tilde{\varphi}$	5.927	-3.474	-5.417	-0.583**
	(8.134)	(5.157)	(10.919)	(0.286)
MPS	10.616	0.171	-9.664	-1.283***
	(7.002)	(6.062)	(9.466)	(0.253)
Manager FE	Y	Y	Y	Y
Observations	9,294	9,294	9,294	11,654
Adjusted R^2	-0.010	-0.020	-0.008	0.012

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

Heteroskedasticity-robust standard errors clustered by fund managers are in parentheses.

C.11 Portfolio rebalancing versus net worth shock at the fund level

Table C.14: Portfolio rebalancing and outflows for mutual funds

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Equity Share (%)	Δ Other Share (%)	Δ TNA (%)	Δ Equity Share (%)	Δ Other Share (%)	Δ TNA (%)
MPS × Expense Ratio				-0.152	0.803	0.530***
				(1.366)	(1.392)	(0.058)
MPS	1.156	-1.527	-1.188***	1.509	-1.713*	-1.031***
	(1.004)	(1.003)	(0.045)	(0.959)	(0.952)	(0.053)
Fund FE	Y	Y	Y	Y	Y	Y
Observations	1,351,581	1,351,581	1,591,364	1,120,852	1,120,852	1,331,181
Adjusted R^2	-0.023	-0.023	0.048	-0.021	-0.021	0.045

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

Heteroskedasticity-robust standard errors clustered by funds are in parentheses.

C.12 Portfolio rebalancing versus net worth shock at the fund level for unweighted MPS

Table C.15: Portfolio rebalancing and outflows for mutual funds

	(1) Δ Equity Share (%)	(2) Δ Other Share (%)	(3) Δ TNA (%)	(4) Δ Equity Share (%)	(5) Δ Other Share (%)	(6) Δ TNA (%)
MPS × Expense Ratio				-1.514	2.176	0.347***
				(1.372)	(1.401)	(0.056)
MPS	-0.749	0.360	-1.773***	-0.808	0.569	-1.627***
	(1.171)	(1.162)	(0.053)	(1.192)	(1.179)	(0.057)
Fund FE	Y	Y	Y	Y	Y	Y
Observations	1,351,581	1,351,581	1,591,364	1,120,852	1,120,852	1,331,181
Adjusted R^2	-0.023	-0.023	0.054	-0.021	-0.021	0.051

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

Heteroskedasticity-robust standard errors clustered by funds are in parentheses.

C.13 Local projection for unweighted MPS

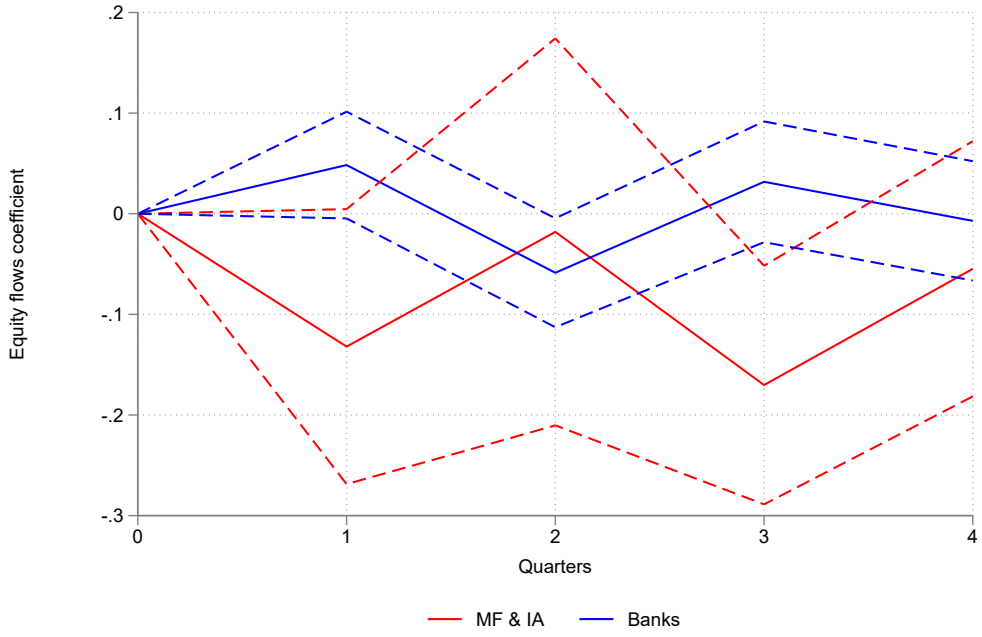


Figure C.1: Local projection of equity flows

Note: This figure plots coefficients from (5) that capture the four-quarter equity flows induced by a contractionary monetary policy surprise for mutual funds and banks.

C.14 Price response to unweighted MPS

Table C.16: Price elasticity to monetary policy shocks

	(1)	(2)	(3)	(4)
	Return_{t+1}	Return_{t+1}	Return_{t+1}	Return_{t+1}
MPS $\times$ $\tilde{\varphi}$	-0.163***	-0.157***	-0.412**	-0.442**
	(0.038)	(0.038)	(0.169)	(0.211)
Stock FE	Y	Y	Y	Y
Time FE	N	Y	N	Y
Weighted	N	N	Y	Y
Observations	650,422	650,422	625,860	625,860
Adjusted R^2	0.025	0.169	0.035	0.314

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Heteroskedasticity-robust standard errors clustered by CUSIP are in parentheses.

Table C.17: Price elasticity to monetary policy shocks (with FF6)

	(1)	(2)
	Return_{t+1}	Return_{t+1}
MPS $\times \tilde{\varphi}$	-0.165***	-0.182***
	(0.042)	(0.043)
MPS $\times \beta^{\text{MKT}}$	0.025	-0.088*
	(0.052)	(0.050)
MPS $\times \beta^{\text{SMB}}$	-0.005	-0.236***
	(0.057)	(0.054)
MPS $\times \beta^{\text{HML}}$	0.049	0.056
	(0.064)	(0.062)
MPS $\times \beta^{\text{RWM}}$	0.245***	0.285***
	(0.050)	(0.048)
MPS $\times \beta^{\text{CMA}}$	0.175***	0.122**
	(0.064)	(0.062)
MPS $\times \beta^{\text{MOM}}$	0.198***	0.164***
	(0.053)	(0.050)
Stock FE	Y	Y
Time FE	N	Y
Observations	475,799	475,799
Adjusted R^2	0.020	0.177

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Heteroskedasticity-robust standard errors clustered by CUSIP are in parentheses.