MONETARY POLICY AND REACHING FOR INCOME*

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Abstract

We study the impact of monetary policy on investors' portfolio choices and asset prices. Using data on individual portfolio holdings and on mutual fund flows, we find that a low-interest-rate monetary policy increases investors' demand for high-dividend stocks and drives up their prices. The increase in demand is more pronounced among investors who fund consumption using dividend income. To explain these empirical findings, we develop an asset pricing model in which investors have quasi-hyperbolic time preferences and use dividend income as a commitment device to curb their tendency to over-consume. When accommodative monetary policy lowers interest rates, it reduces the income stream from bonds and induces investors who want to keep a desired level of consumption to "reach for income" by tilting their portfolio toward high-dividend stocks. Our finding suggests that low-interest-rate monetary policy may influence the risk premium of income-generating assets, lead to under-diversification of investors' portfolios, and cause redistributive effects across firms that differ in their dividend policy.

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1 Introduction

A common stock's total return can be broken down into two components: dividends and capital gains. In frictionless capital markets, Miller and Modigliani (1961) show that rational investors should be indifferent between these two sources of return. Thus, a firm's dividend policy should be irrelevant. However, this core tenet of academic finance is at odds with a large body of popular retail investment advice that advocates a "rule of thumb" of living off an income stream while keeping the principal untapped.[1] Investors who follow such a rule of thumb will naturally exhibit a preference for assets that pay dividends.

In this paper, we investigate the implications of investors' tendency to live off income for portfolio choices and asset prices. We hypothesize that, as monetary policy becomes more accommodative, investors who live off their portfolio income may not be able to sustain their consumption because income from bank deposits and short-term bonds falls with interest rates. As a result, investors may move into higher income assets such as high-dividend stocks. Moreover, the resulting demand pressure from income-seeking investors may drive up the prices of these assets. We refer to the conjecture that monetary policy affects the preference for current income as the "reaching-for-income" hypothesis.[2]

Using data on individual portfolio holdings and mutual fund flows, we document evidence supporting the reaching-for-income hypothesis. Specifically, using individual portfolio holdings from a large discount broker covering 19,394 accounts over a period ranging from 1991 to 1996, we find that a 1% decrease in the Fed Funds rate leads to about a 1% increase in the holdings of high-dividend-paying stocks over the next six months. The increase in demand for high-dividend-paying assets is much more pronounced for retirees who tend to live off dividend income for consumption. Similarly, using data on mutual fund flows from 1991 to 2016, we document rotations of fund flows from bond funds to equity funds following a decrease in the Fed Funds rates. The inflows to equity are concentrated in funds with high income yields: a 1% decrease in the Fed Funds rates leads

[1] Living off income is a popular retail investment advice. For example, in a November 2016 *Forbes* article called "How To Make $500,000 Last Forever" Brett Owens writes: "The only dependable way to retire and stay retired is to boost your payouts so that you never have to touch your capital."

[2] In a December 2016 *Fidelity Viewpoints* article, "A New Era For Dividend Stocks," Morrow et al. (2016) emphasize the link between interest rates and demand for dividend-paying stocks as follows: "As bond interest rates fell to 50-year nominal lows in recent years, many investors looked beyond the bond market for income producing investments. This caused an increase in the value of dividends on a stand alone basis, apart from their role in equity valuations." See `https://www.fidelity.com/viewpoints/investing-ideas/dividend-stocks-rates-rise` (accessed on December 28, 2017).

to a 5.18% increase in the assets under management of high-income mutual funds over a period of three years.

This increase in demand for high-dividend stocks impacts the prices of these assets in ways that do not appear to be fully anticipated by the market: high-dividend-yield stocks exhibit positive risk-adjusted returns following periods of monetary easing and negative or negligible abnormal returns following a period of monetary policy tightening, consistent with investors reacting with a lag to these policy changes. We examine the performance of a dynamic long-short strategy that buys high-dividend stocks and shorts low-dividend stocks following periods of monetary loosening (i.e., following negative Fed Fund rate shocks) and reverses the positions following episodes of monetary tightening. Over the 1987–2015 period, this strategy generates an annualized Sharpe ratio of about 0.18, comparable to that of the "High-Minus-Low" portfolio designed to exploit the value premium in the cross-section.[3]

These empirical findings raise several theoretical questions. According to standard portfolio choice theory, absent taxes or other transaction costs, investors should be indifferent between capital gains and cash dividends and only care about total returns. Similarly, the standard life-cycle theory also predicts that investors should make their consumption-saving decisions based their permanent income rather than current income. Given this benchmark, why do investors live off their current income stream? More importantly, what is the implication for monetary policy if investors do behave differently from the standard portfolio choice and life-cycle theory?

To answer these questions, we first provide a microfoundation for the consumption rule of "living off income." We show that this consumption rule can be an optimal commitment device for an investor with quasi-hyperbolic preferences to limit the tendency to over-consume.[4] We then embed the consumption rule of "living off income" into an asset pricing model. We show that in the presence of this consumption rule, the optimal portfolio exhibits patterns that are consistent with the empirical findings documented above. Specifically, the income yield of an asset matters for portfolio choice and the demand for

[3]In the same time period, the Sharpe ratios of the "High-Minus-Low" and the "Small-Minus-Big" portfolios are 0.23 and 0.12 respectively.

[4]While we motivate the "living off income" rule of thumb as a commitment device for an agent with hyperbolic preferences, there are other frictions or biases that could lead to this rule. We discuss some of these other possibilities toward the end of Section 4.1, but note here that the underlying mechanism that drives the "living off income" rule is not critical for our findings; all that is critical is that some investors follow such a rule, for some reason.

income-generating assets varies with the level of interest rates. Finally, we show that when agents "reach-for-income," monetary policy has real effects on the risk premium in an otherwise frictionless economy. Specifically, when monetary policy lowers the income from bonds, the demand pressure from reaching-for-income investors leads to higher valuation and a lower risk premium for high-dividend stocks.

This paper contributes to four strands of literature. The first strand studies the financial channels of monetary transmission (Nagel, 2016; Drechsler, Savov, and Schnabl, 2017a,b; Xiao, 2018; Drechsler, Savov, and Schnabl, 2018). This literature shows that monetary policy affects asset prices and the financial system in ways not explained by the New Keynesian paradigm. Specifically, this paper is closely related to the studies on the "reaching-for-yield" hypothesis, according to which a low-interest-rate policy induces investors to move into risky assets in a bid to boost total returns (Rajan 2006; Hanson and Stein 2015; Bekaert et al. 2013; Becker and Ivashina 2015; Gertler and Karadi 2015; Hau and Lai 2016; Choi and Kronlund 2017; Di Maggio and Kacperczyk 2017; Lian et al. 2017). In contrast, in our paper we examine the "reaching-for-income" hypothesis. This hypothesis is that a low-interest-rate policy increases the demand for assets with high current income. The implications of the reaching-for-income hypothesis differ from those of reaching for yield insofar as investors have a special preference for dividend yields above and beyond their contribution to total returns. Our empirical results suggest that this is indeed the case. Moreover, we show that reaching for income may have implications for the cross-section of asset prices and ultimately, the allocation of capital between firms with different dividend policies.

Although reaching for income is a distinct phenomenon from reaching for yield, in some cases it may have similar implications for the riskiness of a portfolio: when accommmodative monetary policy lowers bond yields below the dividend yield of the stock market, reaching-for-income investors may substitute from bonds to stocks, thus increasing overall portfolio risk. Therefore, investors' tendency to reach for income could provide an additional channel for the reaching-for-yield phenomenon.

The second strand of literature to which this paper contributes examines the demand for dividends in an economy. Miller and Modigliani (1961) show that dividend policy is irrelevant for equity values in a perfect capital market with rational investors. In light of this benchmark, Black (1976) argues that the observed practice of investors exhibiting a strong preference for dividends is puzzling. The voluminous body of literature that

attempts to explain why dividends matter can be organized in two broad groups. The first group relaxes the perfect capital markets assumption by introducing asymmetric information (Bhattacharya 1979; John and Williams 1985; Miller and Rock 1985) or agency problems between corporate insiders and outside shareholders (Easterbrook 1984; Jensen 1986; Fluck 1998, 1999; Myers 1998; Gomes 2001; and Zwiebel 1996). The second group relaxes the assumption that investors are fully rational. Shefrin and Statman (1984) suggest that self-control problems, loss aversion, or regret aversion may generate a demand for dividends. In our model, we formalize the self-control motive suggested by Shefrin and Statman (1984), and show that if investors have time-inconsistent preferences, and they constrain themselves to consume only out of dividends, they can increase their ex ante utility. Empirically, we provide new evidence that may help to differentiate among theories of the demand for dividends. Specifically, by showing that demand for dividends is time-varying over monetary cycles and linked to the consumption and saving decisions of retail investors, we provide evidence consistent with the hypothesis that the preference for dividends may reflect the presence of self-control motives in households' portfolio choices.

In doing so, we also contribute to a large body of empirical literature that examines how investors' responses to dividend policy differ from the rational benchmark. In particular, Baker and Wurgler (2004a) find that there is strong variation over time in the demand for dividends. Although they do not take a strong stand on the source of the variation in the demand for dividends, Baker and Wurgler (2004a) show that firms appear to "cater" to this variation by changing the level of dividends that they distribute. Consistent with this hypothesis, Jiang and Sun (2015) show that high-dividend yield firms have longer duration, in the sense that their prices move up more strongly in response to interest rate declines than do the prices of low-dividend yield firms. This interesting result is inconsistent with the hypothesis that high-dividend yield firms should have shorter durations because they have lower anticipated dividend growth. Hartzmark and Solomon (2017) demonstrate that investors appear to make buy/sell decisions based on price changes as opposed to cum-dividend returns. They present strong evidence showing that many investors behave as if they believe dividends are "free" in the sense that paying dividends would not lead to a reduction in prices. Like us, they show that demand for dividends is systematically higher in periods of low interest rates, but attribute this to the "free-dividend fallacy." We provide a distinct mechanism based on the commitment value of dividends for time-inconsistent investors. We show that investors demand more dividends in periods of low interest rates because the value of dividends as a commitment device goes up as income

from bonds becomes insufficient to sustain the optimal level of consumption. We also provide empirical evidence consistent with this hypothesis.

The third strand of literature to which our paper relates studies households' consumption and saving decisions over the life-cycle. Standard life-cycle theories suggest that agents should not distinguish between capital and income when making spending choices (Statman 2017). In contrast to the standard life-cycle theory, Baker, Nagel, and Wurgler (2007) and Kaustia and Rantapuska (2012) find that investors usually only spend their dividends but rarely dip into capital. We contribute to this literature by showing theoretically that such behavior is an optimal response to the over-consumption problem. In doing so, we add to the study of the self-control problem in the behavioral life-cycle literature (McCarthy 2011; Carlson et al. 2015). Our paper also relates to Graham and Kumar (2006), which finds that older investors with lower labor income hold stocks with higher dividend yields than younger investors with higher labor income. We find that older investors not only hold more dividend-paying stocks on average, they are also more likely to reach for income when interest rates fall.

The fourth strand of literature to which we contribute studies the implications of behavioral biases on asset prices, and more specifically, the role of time-inconsistent preferences. The assumption of exponential discounting has been challenged by mounting experimental evidence (Chung and Herrnstein 1967; Ainslie 1975). These studies suggest instead that subjective discount functions are approximately hyperbolic, thus implying time-inconsistency. Shefrin and Statman (1984) show that agents with non-exponential discount functions prefer to constrain their own future choices (see also O'Donoghue and Rabin (1999)), and Laibson (1997) illustrates how a partially illiquid asset may be used as a commitment device. In our model, investors use portfolio income as a commitment device. Luttmer and Mariotti (2003) study an exchange economy with time-inconsistent agents and show that subjective rates of time preference affect the equilibrium risk-free rate but not the instantaneous risk-return trade-off. In our setting, we show that the self-control motive introduces an additional trade-off between high and low income that leads to optimal portfolios that differ from those of time-consistent investors.

The rest of the paper is organized as follows. In Section 2, we provide empirical evidence that low-interest-rate monetary policy induces investors to "reach for income." In Section 3, we show that investor reaching for income behavior is reflected in asset prices. In Section 4, we develop an asset pricing model to interpret the empirical findings. Sec-

tion 5 discusses the implications of reaching for income for portfolio under-diversification, capital reallocation, and risk-taking. Section 6 concludes. Appendix A contains proofs of propositions and Appendix B contains a detailed description of the data used in our empirical analysis.

2 Empirical evidence of reaching for income

In this section we provide empirical evidence on the effect of monetary policy on the demand for dividend-paying stocks. Section 2.1 describes our data. Section 2.2 provides evidence from individual portfolio holding data and Section 2.3 provides evidence based on mutual fund flows data.

2.1 Data

Our analysis is based on two main datasets.[5] The first dataset consists of individual portfolio holdings gathered from a large discount broker. This dataset has been previously used by Barber and Odean (2000) and includes monthly observations on portfolio holdings for 78,000 households between 1991 and 1996. For each household, we observe the number of assets and asset type held in its portfolio. We restrict our analysis to common stock holdings and focus on a smaller subset of 19,394 households for whom we have demographic information. The average household in this dataset holds approximately $34,000 in common stock. Table 1 reports summary statistics for the investor portfolio dataset. We merge the portfolio holding dataset to the CRSP stock database by the Committee on Uniform Security Identification Procedures (CUSIP) number. This allows us to associate prices and dividend payments to the assets in each individual portfolio. The dividend yield of a stock is calculated by dividing the dollar value of dividends per share of stock by the share price before the dividend is paid. If a stock pays multiple dividends within a year, the annual dividend yield is the sum of the dividend yield over the whole year. The average dividend yield of the stocks in the merged sample is 2.1%. The 90th percentile dividend yield is 5.7%. In our sample, 23.7% of stock positions belong to account holders who are retirees, 42.6% are married, 75.3% hold at least a bank card, and 58% are male.

[5] Appendix B contains a detailed description of the variables used in our analysis.

We label a stock as a "high income yield" stock if it is in the top decile of the dividend yield distribution in a given month. We define the time-t "change in holding of a stock," $\Delta Holding_{i,j,t}$, as the six-month change in stock i's position in account j scaled by the average of the current and the 6-month lagged holding of stock i in the same account j:

$$\Delta\text{Holding}_{i,j,t} = \frac{Q_{i,j,t} - Q_{i,j,t-6}}{(Q_{i,j,t} + Q_{i,j,t-6})/2}, \tag{1}$$

where $Q_{i,j,t}$ represents the number of stocks i held in account j at time t.

The second dataset consists of monthly data on U.S. mutual funds from the Center for Research in Security Prices (CRSP). Our sample includes all equity mutual funds from January 1991 to December 2016 covering a total of 23,166 fund share classes. The summary statistics of this sample are reported in Table 2. Net flows is defined as the net growth in fund assets adjusted for price changes. Formally, it is calculated as:

$$Flow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} \times (1 + R_{i,t})}{TNA_{i,t-1}}, \tag{2}$$

where $TNA_{i,t}$ is fund i's total net assets at time t, $R_{i,t}$ is the fund's return over the prior month.

We measure the income of a mutual fund by the *income yield*, defined as the annual dividend income distribution divided by the value of a mutual fund's share. The average income yield in our data is 1.3% for the equity funds sample and 3.8% for the bond funds sample. The 90th percentile income yield is 2.8% for the equity funds sample and 6.2% for the bond funds sample.

Finally, we measure the stance of monetary policy using the Fed Funds rate (FFR) data available from the Federal Reserve Economic Data (FRED) website. An important channel through which monetary policy affects investors' income is through the level of interest on bank deposits. To construct measures of local deposit rates paid by banks, we combine the *Call Report*, the quarterly regulatory filings on bank balance sheets, with the FDIC *Summary of Deposits*, the annual survey of branch office deposits for all FDIC-insured institutions. Specifically, we construct a measure of deposit rates of each bank by dividing bank interest payments on deposits by total deposits held at the end of each quarter. We average across all the banks in a metropolitan statistical area (MSA) to obtain an MSA-level measure of deposit rates. Each bank's deposit rate is weighted by the amount of deposits of this bank's branches in the MSA.

2.2 Evidence from individual portfolio holding data

2.2.1 "Living off income"

We begin our analysis by showing that, based on evidence gathered from individual stock holding data, some investors do appear to follow the rule of "living off income." We follow Baker et al. (2007) and construct a measure of net withdrawal from brokerage accounts as a proxy of consumption. Specifically, for each account j and month t, we calculate the net withdrawal $W_{j,t}$ as the change in account balance, $A_{j,t}$, adjusted for capital gain, $G_{j,t}$, and dividends, $D_{j,t}$:

$$W_{j,t} = A_{j,t-1} + G_{j,t} + D_{j,t} - A_{j,t}. \tag{3}$$

Figure 1 shows a scatter plot of monthly net withdrawal against contemporaneous dividend income (Panel A) and capital gains (Panel B) for each household of our dataset. The horizontal axis reports the dividend income/capital gains and the vertical axis reports the net withdrawal. Panel A shows that dividend income data cluster around two clear sets. The first set of observations lines up along the 45-degree line. These observations represent investors who withdraw their portfolio dividend income almost one-for-one, likely for consumption reasons. The second set of observations lines up along the horizontal line corresponding to zero withdrawals. These points represent investors who do not withdraw dividends, but instead reinvest them in their portfolios.

Panel B shows the scatter plot of net withdrawal against contemporaneous capital gains. In contrast to Panel A, we find no evidence that investors regularly withdraw their capital gain. If anything, a higher capital gain is associated with *lower* withdrawal. This is consistent with Baker et al. (2007) and Kaustia and Rantapuska (2012) who show that individual investors treat dividend income and capital gains differently for consumption decisions.

To better understand which type of investors are likely to live off income, we relate the dividend-withdrawing behavior to demographic information. Specifically, we first define a "dividend-withdrawal month" as a month when the withdrawal amount is between 90% and 110% of an investor's contemporaneous dividend income.[6] We then classify an individual

[6] We leave a margin of error of 10% because withdrawal and dividends may be measured with error. In the data, 19% of the household-month observations are "dividend withdrawal events".

as a "withdrawer" if the frequency of "dividend-withdrawal month" is above the median among all investors, and "non-withdrawers" otherwise. Finally, we estimate a logistic regression of the "withdrawers" indicator on a set of demographic variables such as a retiree dummy, labor income, home-owner dummy, married dummy, bank card owner dummy, and vehicle owner dummy.

Table 3 reports the estimation results. We find that investors who have retired or have lower labor income are more likely to be dividend withdrawers. This finding does not seem to be attributable to a wealth effect, as proxies of wealth such as home ownership and vehicle ownership are not associated with a higher likelihood of being a withdrawer. A more likely interpretation of these results is that, consistent with Baker et al. (2007), individuals view labor income and dividends as close substitutes but treat dividend income and capital gains very differently.

2.2.2 Reaching for Income

If investors indeed follow the rule of "living off income," monetary policy may affect their portfolio decisions. Specifically, when low-interest-rate monetary policy reduces the interest income from deposits and bonds, these investors may want to "reach for income" by buying high dividend stocks to compensate for the low interest income received on deposits and bonds.

We first show that the relative current income of bonds and stocks vary over monetary cycles. Figure 2 plots the income yield of the aggregate U.S. stock market and that of two commonly-held debt instruments—3-month certificates of deposit and 10-year Treasury bonds—from 1954 to 2016. The income yield of stocks are measured by the dividend-price ratio. We also report the level of Fed Funds rates as a measure of the stance on monetary policy. The figure shows that the income yield of debt instruments strongly co-moves with the Fed Funds rates, while that of equity does not. During periods of monetary easing, equity becomes relative more attractive as a source of current income. In particular, while the ultra-easy monetary policy of the most recent decade has lowered bond yields towards zero, income yields of equity have stayed around 3%.[7]

[7] The lack of co-movement between equity income yields and nominal debt instrument yields is partly due to the fact that equity is a real asset.

Given that low-interest-rate monetary policy reduces the interest income from deposits and bonds, some investors may "reach for income" by buying more high-dividend stocks. To test this hypothesis, we use the individual stock holding data and examine whether a reduction in the Fed Funds rates is associated with an increase in the holding of high-dividend stocks. Specifically, we regress the change in holdings, $\Delta Holding_{i,j,t}$, of stock i in account j over a 6-month period as defined in (1), on: (i) the three-year changes in the Fed Funds rates, ΔFFR_t; (ii) a high-dividend dummy $HighDiv_{i,j,t}$ that takes the value of one if a stock is in the top income yield decile for a given month; (iii) an interaction term $\Delta FFR_t \times HighDiv_{i,j,t}$; and (iv) a set of control variables $X_{i,j,t}$ that account for stock characteristics and demographic variables. The stock characteristics include: a high-repurchase dummy, market beta, book-to-market ratio, the past 1-year and 3-year returns, log market capitalization, profit margin, and return on equity (ROE). The demographic variables include home ownership, marital status, and gender of the holder of account j. Formally, we estimate the following regression:

$$\Delta\text{Holding}_{i,j,t} = \beta_1 \Delta\text{FFR}_t + \beta_2 \text{High Div}_{i,t} + \beta_3 \Delta\text{FFR}_t \times \text{High Div}_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t}. \quad (4)$$

Column 1 of Table 4 presents the result for the entire sample. The coefficient of the interaction term, β_3, is negative and significant. This implies that the demand for dividends appears to change over monetary cycles: a 1% decrease in the Fed Funds rates is associated with a 0.946% increase in the holding of high-dividend stocks.

Columns 2 and 3 of Table 4 separate the sample into retirees and non-retirees, respectively, and re-estimate regression (4). The results show that the impact of monetary policy on dividend-stock holdings in the retiree subsample is twice as large as that of the non-retiree sample: the interaction coefficient β_3 is -1.568 in the retiree sample and -0.669 in the non-retiree sample, with the difference statistically significant at the 1% level. This is consistent with the idea that retirees follow the investment rule of "living off dividends." When low-interest-rate monetary policy reduces the income from deposits and bonds, retirees are more likely to reach for income and buy high-dividend stocks.

Cash dividends and share repurchases are two main ways companies can distribute earnings to investors. Unlike cash dividends, which boost investors' current income, share repurchases benefit most investors through capital gains. Therefore, under the reaching for income hypothesis, one would expect different results when considering share repurchases as opposed to cash dividends. To test this conjecture, in the regressions of Table 4 we

include a dummy variable, *High Repurchase*, which equals 1 if a stock lies in the top decile of the distribution of share repurchases, as well as its interaction with the three-year change in the Fed Funds rates. We find that low interest rates do not increase the demand for high-repurchase stocks. If anything, low interest rates seem to *reduce* the demand for high-repurchase stocks possibly due to a substitution effect toward high-dividend stocks. This result suggests that investors do seem to treat cash dividends differently from share repurchase.

2.2.3 Identifying monetary policy impacts through local bank deposit rates

A common challenge in studying the effect of monetary policy is the difficulty in disentangling monetary policy changes from other confounding macro factors affecting the common policy rate that applies to an entire economy. To address this challenge, we exploit cross-region variations in bank deposit rates, which represent an important transmission channel of monetary policy. Drechsler et al. (2017a) show that, although there is only one monetary policy for the whole country, the transmission to local deposit rates differs across regions. Specifically, deposit rates in regions with a more competitive banking sector are more sensitive to changes in the Fed Funds rates. Therefore, monetary policy has a different impact on the local deposit rate, depending on the market power of local banks. Given the importance of local deposits rates as a source of current income for investors, we can sharpen our empirical identification by exploiting the cross-region variations in bank deposit rates.

To do so, we construct a measure of local deposit rates using the weighted average of deposits rates of banks with branches in each Metropolitan Statistical Area (MSA). We map investors to local MSAs based on their zip codes. We then regress the changes in holdings of stock i by household j in MSA m at time t, $\Delta\text{Holding}_{i,j,m,t}$, on: (i) the three-year changes in local deposit rates, $\Delta DepRates_{m,t}$; (ii) a high-dividend dummy $HighDiv_{i,t}$ that takes the value of one if stock i is in the top income yield decile for a given month t; (iii) an interaction term $\Delta DepRates_{m,t} \times HighDiv_{i,t}$; (iv) an interaction between changes in the Fed Funds rates and the high dividend dummy $\Delta FFR_t \times HighDiv_{i,t}$; (v) a set of control variables $X_{i,j,m,t}$ that control for stock characteristics and demographic variables; and (vi) time fixed effects and MSA fixed effects. Column 1 of Table 5 reports the results

from estimating the following model:

$$\begin{aligned}\Delta\text{Holding}_{i,j,m,t} &= \beta_1\Delta\text{DepRates}_{m,t} + \beta_2\text{High Div}_{i,t} + \beta_3\Delta FFR_t \times \text{High Div}_{i,t} + \\ &\quad \beta_4\Delta\text{DepRates}_{m,t} \times \text{High Div}_{i,t} + \gamma' X_{i,j,m,t} + \varepsilon_{i,j,m,t}. \qquad (5)\end{aligned}$$

The coefficient β_4 of the interaction term $\Delta DepRates_{m,t} \times HighDiv_{i,t}$ is negative and significant, indicating that demand for dividends is negatively related to local deposit rates. The magnitude is more than twice as large as that of the interaction term $\Delta FFR_t \times HighDiv_{i,t}$ estimated in Table 4. Furthermore, the coefficient β_3 in (5) is still negative but, unlike the estimate in Table 4, becomes statistically insignificant. This result suggests that local bank deposit rates provide a more accurate measure of available sources of income for local investors than the Fed Funds rates.

To assess whether withdrawers are more likely to reach for income when interest rates fall, we estimate the same regression model of equation (5) separately for withdrawers and non-withdrawers. Columns 2 and 3 in Table 5 report the result. We find that the reaching-for-income phenomenon is entirely driven by the withdrawer sample. For the non-withdrawer sample, neither the local deposit rates nor the Fed Funds rates significantly affect the holding of high-dividend paying stocks.

2.3 Evidence from mutual fund flows data

To gain a better understanding of the magnitude of the reaching-for-income hypothesis, in this section we test the hypothesis using data on mutual fund flows.

2.3.1 Mutual fund flows and monetary policy

We study the effect of monetary policy on mutual fund flows using two separate approaches. First, we consider the fund flow dynamics in response to changes in Fed Fund rates. Second, we analyze the response of flow to interest rates in panel regressions. The former approach focuses mainly on the time dimension, while the latter focuses mainly on the cross-section dimension.

Fund flow dynamics. As monetary policy changes the relative income yields between equity and bonds, we may expect income-seeking investors to rebalance their portfolios

across different types of mutual funds. To test this conjecture, we estimate the "impulse response" of mutual fund flows to the current and lagged changes in the Fed Funds rates, ΔFFR. Specifically, we estimate the following regression:

$$Flows_{i,t} = \beta_1 \Delta FFR_{t,t-1} + \beta_2 \Delta FFR_{t-1,t-2} + \ldots + \beta_{10} \Delta FFR_{t-9,t-10} + \gamma' X_{i,t} + \varepsilon_{i,t}, \quad (6)$$

where $\Delta FFR_{t,t-1}$ denotes the change in Fed Fund rates from time $t-1$ to t and $X_{i,t}$ denotes a set of control variables that may be important drivers of fund flows.[8] The cumulative fund flows up to n years to a 1% change in the Fed Funds rates is $\sum_{k=1}^{n} \beta_k$.

We estimate model (6) separately for equity, bond, and balanced funds. Within each type of funds, we further classify funds in the top decile of income yield as "high-income funds" and the remaining ones as "low-income funds." Figure 3 reports cumulative fund flows in response to a 1% reduction in the Fed Funds rates over different time horizons. Each panel in the figure represents a different type of fund. In each panel, the red solid line represents the cumulative fund flows for high-income funds while the blue dashed line represents low-income funds. Comparing across fund types, we find that a reduction in the Fed Funds rates is associated with inflows to equity funds (Panel A) and outflows from bond funds (Panel B). Balanced funds (Panel C) experience both inflows and outflows depending on the level of income yields. This finding is consistent with the evidence reported in Figure 2: equity becomes a more attractive source of income when interest rates fall. Within each fund type, we note that high-income funds receive larger inflows or experience smaller outflows following a reduction in the Fed Funds rates. In terms of magnitude, following a 1% reduction in the Fed Funds rates, high-income equity funds receive an inflow of 5% of assets under management (AUM) by the fifth year than low-income equity funds.

We also see that investors respond to monetary policy changes in a slow and persistent manner. Two reasons may lead to the observed persistence of investors' responses to monetary policy changes. First, investors are likely to adjust their portfolios only periodically, thus generating a delayed response to changes in monetary policy. Second, investors may be holding long-term bonds that were issued before a change in monetary policy. Income yields therefore may change slowly as long-term bonds gradually mature and are replaced by newly issued bonds.

[8] The control variables are the fund returns in the past year, the fund return volatility, the log assets under management, fund expenses, and a time trend.

Panel regressions. To complement the evidence from the dynamics of fund flows illustrated in Figure 3, we estimate the following panel regression:

$$\text{Flows}_{i,t} = \beta_1 \text{High Income}_{i,t} + \beta_2 \Delta\text{FFR}_t \times \text{High Income}_{i,t} + \tau_i + \tau_t + \gamma' X_{i,t} + \varepsilon_{i,t}, \quad (7)$$

in which we relate the monthly fund flows into fund i, $Flows_{i,t}$, to: (i) a high-income dummy, *High Income*$_{i,t}$, taking the value of one if fund i has an income yield in the top decile in a given month; (ii) an interaction term between the high-income dummy and the three-year changes in the Fed Funds rates, $\Delta FFR_t \times$ *High Income*$_{i,t}$;[9] (iii) fund and time fixed effects, τ_i, τ_t, and (iv) a set of control variables $X_{i,t}$ that may be important drivers of fund flows.[10] We are interested in the coefficient of the interaction term, β_2, which, following a 1% change in the Fed Funds rates, measures the additional fund flows that high-income funds receive relative to low-income funds. If low-interest rate monetary policy indeed leads investors to reach for income, we should expect a negative value for the coefficient β_2.

Table 6 reports the regression results. Columns 1 and 2 include the whole sample of equity and bond funds respectively. The coefficient β_1 of the High Income dummy is positive and significant, indicating that high-income funds on average attract more flows. Specifically, if an equity fund has an income yield in the top decile among all the funds in a given month, it receives 0.284% more flows in the same month. This finding is consistent with the idea that investors exhibit a preference for current income.

Most importantly, the coefficient of the interaction term, β_2, in regression (7) is negative and significant, which means that high-income funds receive more inflows when interest rates fall. This finding indicates that investors do reach for income in periods of low interest rates. The economic magnitude is large as well: a 1% decrease in the Fed Funds rate leads to a 5.18% (0.144% per month $\times$ 36 months) cumulative increase in assets under management for high-dividend equity funds over a period of three years, compared to low-income equity funds. This magnitude is consistent with the findings in Figure 3.

[9] From Figure 3 we see that investors respond to monetary policy changes in a slow and persistent manner. Therefore, we consider a three-year horizon in the construction of the variable ΔFFR, as it seems to capture the most salient effects of monetary policy change on portfolio flows. Our results are robust to alternative horizons in the construction of ΔFFR.

[10] These control variables are: fund returns, volatility, the interaction between volatility and the three-year change in the Fed Funds rates, assets under management, expenses, income tax, and the interaction between income tax and a high-income dummy.

Note that these findings are obtained after controlling for characteristics of the fund such as its return and volatility, fund size, expenses, and changes in taxes. Controlling for volatility and its interaction with the changes of the Fed Funds rates is particularly important to allay the concern that our results are driven by investors' desire to reach for yield by investing in riskier assets when interest rates are lower.

Columns 3–6 in Table 6 split the sample of equity and bond funds by investor type, that is, retail versus institutions. The results show that the coefficient of the interaction term β_2 is statistically significant only for the subset of retail investors, indicating that only such investors have a tendency to reach for income when the Fed Funds rates decline. This effect is not present among institutional investors. The difference between the estimates for retail and institutional investors is significantly different from zero at the 5% significance level for the equity fund sample.

2.3.2 Discussion

The above results can help differentiate among theories that have been proposed to explain the "dividend puzzle" (Black 1976), that is, the observation that investors do exhibit a strong preference for dividends despite the irrelevance of dividend policy in perfect capital markets with rational agents (Miller and Modigliani 1961). Two broad groups of theories have been proposed to explain this puzzle. The first group of theories relaxes the assumption of perfect capital markets and introduces institutional frictions such as asymmetric information (Bhattacharya 1979; John and Williams 1985; Miller and Rock 1985) and agency problems between corporate insiders and outside shareholders (Easterbrook 1984; Jensen 1986; Fluck 1998, 1999; Myers 1998; Gomes 2001; and Zwiebel 1996). The second group of theories relaxes the investor rationality assumption and argues that investors' behavioral reasons, such as self-control motives, loss aversion, or regret aversion, can generate the observed demand for dividends (Shefrin and Statman 1984; Thaler 1999).

If institutional frictions were the source of the demand for dividends, then one would expect institutional investors to exhibit a similar, if not stronger, preference for dividends. We do not find evidence of this in our data. As shown in columns 2 and 3 of Table 6, institutional investors do not reach for income, in contrast to retail investors. To the extent that retail investors are likely to be more subject to behavioral biases than institutional investors, our results lend support to the second group of theories that explain the dividend puzzle as a departure from investor rationality.

Furthermore, our findings help to differentiate among different behavioral theories proposed as explanations for the dividend puzzle. In particular, the fact that investors reach for income when monetary policy is accommodative seems to corroborate the prediction of theories that rely on self-control. For example, if investors follow the conventional rule of "living off dividends" as a way to control a tendency to over-consume, a natural consequence would be that a low-interest-rate monetary policy would increase the demand for dividend-paying assets by lowering the income from bonds. In Section 4, we build a simple model with hyperbolic discounting to formalize this intuition. In contrast, it is difficult to conceive that monetary policy would affect investor loss or regret aversion in such a way as to generate the observed pattern of an increased demand for dividend-paying assets in low-interest-rate periods.

2.3.3 Robustness

Table 7 presents a set of robustness checks to the baseline regression in Table 6. Specifically, we consider: (i) an alternative definition of monetery policy changes, and (ii) alternative ways to characterize high-dividend funds.

In our baseline results reported in Table 6, we only consider changes in short-term interest rates. A possible concern with this choice is that monetary policy not only affects short-term rates but also influences long-term rates through the expectation of future policy. As such, a decrease in the long-term interest rates may also induce investors to reach for income. To account for this possibility, we re-estimate regression (7) by including an interaction term between the changes of the term spread and the high-income dummy. The term spread is measured as the difference between the ten-year Treasury yield and the Fed Funds rates. We report the results in columns 1 and 2 of Table 7. We find that a decrease in the term spread also leads to additional flows into high-income funds with a magnitude similar to that of the change in the short-term rates.

Columns 3 to 4 of Table 7 consider different ways to characterize high-income funds. In our baseline regression in Table 6, we split the sample into two groups, high- versus low-income funds. Columns 3 and 4 of Table 7 split the sample into ten deciles. Using this alternative classification, we find results that are consistent with those of columns 1 and 2.

Columns 5 and 6 of Table 7 classify mutual funds into high- and low-income funds based on fund names. In the data, about 10% of equity funds have "dividends," "income," or "yield" in their names. Most of these funds seek to generate a high income to cater to income-seeking investors.[11] Using the information inferred from fund names, we classify a fund as a high-income fund if its name contains "dividends," "income," or "yield". For bond funds, we use "high dividends," "high income," or "high yield" to identify high-income funds.[12] Under this classification, we find that a reduction in the Fed Funds rates is associated with significantly larger flows into funds whose name alludes to a high-income focus.

3 Asset pricing implications

The tendency of investors to reach for income may imply a role for monetary policy in the determination of equilibrium asset prices. We hypothesize that by increasing the demand for dividends, low-interest rate monetary policy may drive up the valuation of dividend-paying stocks relative to that of non-dividend-paying stocks.

We first follow Baker and Wurgler (2004b) to construct an empirical measure of *dividend premium*, defined as the difference between the (equal-weighted averages of the) log market-to-book ratios of dividend-paying stocks and non-dividend-paying stocks in each year. We relate this dividend premium measure to the stance of monetary policy.

Figure 4 reports the relationship between the annual changes in the dividend premium and the annual changes in the Fed Funds rates from 1963 to 2016. As the figure shows, a decrease in the Fed Funds rates is associated with an increase in the relative valuation of dividend-paying stocks versus non-dividend paying stocks. This is consistent with an increase in demand for dividends at times when the Fed Funds rates fall.

To formally test whether high-dividend stocks may outperform low-dividend stocks when interest rates are declining, we divide the sample period from 1963 to 2016 into rising and declining interest rate environments based on the three-year change in the Fed

[11] For instance, a Pittsburgh-based asset management company, Federated, manages a fund called Federated Strategic Value Dividend Fund. As indicated by the fund name, this fund "seeks a higher dividend yield than that of the broad equity market."(From the 2017 Prospectus of Federated Strategic Value Dividend Fund)

[12] Because many bond funds contain the generic string "fixed income," a single word "income" would not be sufficient to identify high-income funds.

Fund rates leading up to month t, ΔFFR_t. For each sub-sample we compute excess returns (alphas) from the five-factor model of Fama and French (2016). It is well known (see Fama and French 1993) that dividend decile portfolios do not exhibit risk-adjusted average excess returns. However, Table 8 shows that *conditional* on the monetary policy stance, dividend-sorted portfolios do exhibit significant risk-adjusted excess returns. Specifically, during times of decreasing Fed Funds rates, high-dividend portfolios have positive and significant alphas while low-dividend portfolios have negative and significant alphas. During times of increasing Fed Funds rates, the opposite pattern occurs.

To assess the robustness of these findings, we construct abnormal returns of each dividend decile portfolio based on the CAPM and the Fama-French 3-factor, 4-factor, and 5-factor models.[13] We then estimate the following regression model:

$$\alpha_{i,t} = \beta_1 \Delta\text{FFR}_t + \beta_2 \Delta\text{FFR}_t \times \text{DivDecile}_i + \zeta_i + \varepsilon_{i,t}, \tag{8}$$

where $\alpha_{i,t}$ is the abnormal return of portfolio i in month t. DivDecile_i is the decile of each portfolio and ζ_i represents decile fixed-effects. Table 9 reports the results. The interaction coefficient β_2 is negative and significant for all asset pricing models we consider, providing consistent evidence that declining interest rates are associated with positive excess returns for high-dividend portfolios.

These patterns in alphas suggest a simple trading strategy that longs high-dividend stocks and shorts low-dividend stocks when rates are declining, and reverses the position when rates are rising. Figure 5 shows the cumulative returns for this strategy from 1956 to 2015. Over the 1987–2015 period, this strategy earned a monthly Fama-French 5-factor alpha of 44 basis points, and generated an annual Sharpe ratio of about 0.23, a value comparable to that of a strategy that exploits the value premium in the cross-section. In contrast, this strategy does not perform as well in the period before the Great Disinflation of the 1980s and 1990s, possibly because bond yields were much higher than stock dividend yields, thus muting investors' incentive to reach for income.

Finally, to assess the persistence of the impact of monetary policy on excess returns we construct the impulse response of excess returns to Fed Funds rates. Specifically, we regress the monthly excess returns $\alpha_{i,t}$ of each decile portfolio i on the lagged annual

[13] The result is robust to allowing factor loadings to be a function of the Fed Funds rates. The result is presented in the Online Appendix.

changes in the Fed Funds rates over the past ten years:

$$\alpha_{i,t} = \beta_{i,1}\Delta\text{FFR}_{t,t-1} + \beta_{i,2}\Delta\text{FFR}_{t-1,t-2} + ... + \beta_{i,10}\Delta\text{FFR}_{t-9,t-10} + \varepsilon_{i,t}. \tag{9}$$

Figure 6 plots the estimated coefficients $\beta_{i,t}$ as a function of t for the two lowest and the two highest dividend decile portfolios. The figure shows that monetary policy has a persistent impact on excess returns. This is likely due to the persistence of mutual fund inflows and of the stock-buying pressure from individual investors. Comparing the impulse response of excess returns in Figure 6 to the impulse response of mutual fund flows in Figure 3, we find that excess returns switch from positive to negative around year 3, about two years before the time in which fund flows to high-dividend equity funds peak in Figure 3. This finding suggests that some investors might still flow into high-dividend funds even when high-dividend stocks are overpriced and the expected excess returns in the future are likely to be negative.

In summary, the empirical analysis of the previous two sections shows that monetary policy affects investors' choice between high- and low-dividend stocks and that the changes in demand for dividends significantly impact asset prices. These results are surprising in light of the irrelevance of dividend policy and raise important questions regarding both the functioning of markets and agent rationality. Why do investors have a preference for dividends? Why does monetary policy affect this preference? In the next section we propose a model of "reaching for income" to potentially address these questions.

4 A model of "reaching for income"

In this section we analyze the theoretical foundations and implications for the reaching-for-income hypothesis. In Section 4.1 we propose a possible microfoundation of the living-off-income rule, based on the notion of time-inconsistency of agents' preferences. In Section 4.2 we show that, in an economy in which a fraction of agents follow the living-off-income rule, monetary policy, by influencing the interest income from bonds, can affect the equilibrium risk premium of high dividend-paying assets.

4.1 A microfoundation of reaching-for-income behavior

Let us consider an asset market consisting of N assets. In this section we take the asset returns as given and denote by R_t the $N \times 1$ vector of asset returns. In Section 4.2 we determine these returns endogenously in an a general equilibrium with heterogeneous agents. Let θ_t be a $N \times 1$ vector of portfolio weights invested in each of the risky assets. We consider an agent with quasi-hyperbolic discounting preference who solves the following lifetime consumption and portfolio problem (Harris and Laibson 2001)

$$\max_{\{C_\tau, \theta_\tau\}_{\tau=t}^{T-1}} u(C_t) + \mathbb{E}_t \sum_{\tau=t}^{T} \beta \delta^{\tau+1-t} u(C_{\tau+1}) \tag{10}$$

subject to the dynamic budget constraint

$$W_{t+1} = (W_t - C_t) R_{p,t+1}(\theta_t), \quad \theta_t^\top \mathbf{1} = 1, \tag{11}$$

where $R_{p,t+1}(\theta_t)$ denotes the return of portfolio θ_t at time $t+1$, that is, $R_{p,t+1}(\theta_t) = \theta_t^\top R_{t+1}$.

In (10), the parameter β captures the intensity of the agent's psesent bias, that is, the extent to which the agent values immediate rewards at the expense of long-term intentions. When $\beta < 1$, the agent's preferences are time-inconsistent. At any time t the discount rate between *any* two periods from $t+1$ onward is δ, but the discount rate from t to $t+1$ is $\beta\delta < \delta$. This implies that the agent consistently plans to be patient in the future (when the discount rate is δ) but as the future arrives, he changes his mind and becomes impatient, discounting the immediate future at a rate $\beta\delta$. This in turn implies that the agent plans to save in the future but, as the future arrives, he systematically reneges on his promise and consumes more than he would have done if he were able to commit to his original plan.[14]

In the presence of time-inconsistent preferences, commitment may become valuable to the agent. A prevalent commitment device in this situation is to use current income to discipline consumption, as suggested by the popular advice "live off income, do not dip into the principal." Financial advisors usually suggest investors direct the interest and dividend income into a bank account for daily consumption while keep their principal in a

[14]Smaller value of β implies a more severe present bias while $\beta = 1$ corresponds to the time-consistent case.

brokerage account that is inconvenient for immediate or impulsive spending."[15] Motivated by this practice, we allow the agent in our model to *choose* to adopt the consumption rule of "living off income":[16]

$$0 \leq C_{t+1} \leq I_{t+1}(\theta_t), \quad t = 0, \ldots, T-2, \tag{12}$$

where $I_{t+1}(\theta_t)$ is the income generated by portfolio θ_t at time $t+1$, that is, the sum of dividends and interest. The constraint (12) imposes that future consumption C_{t+1} cannot exceed the income $I_{t+1}(\theta_t)$ generated by the portfolio inherited from time t. Therefore, the current "self" can constrain the future "self" by choosing a portfolio θ_t which delivers at time $t+1$ a level of income that constrains future consumption.

At the same time, however, the consumption rule limits the flexibility of the agent to adjust consumption to ex-post portfolio returns. When the agent wants to consume more because of high portfolio returns, portfolio income inefficiently caps consumption. In other words, the agent faces a trade-off between commitment and flexibility.

The following proposition characterizes the solution of the problem (10)–(12) for an investor with CRRA preferences.

Proposition 1. *Let us consider an investor with CRRA preferences, $u(C) = C^{1-\gamma}/(1-\gamma)$, with $\gamma > 1$ is the coefficient of relative risk aversion, and an asset market consisting of N assets with return vector R_t and dividend-yield vector Y_t. Let $i_t \equiv I_t/W_t$ denote the income to wealth ratio at time t. Then the optimal portfolio, θ_t^*, and consumption, C_t^*, that solve the problem (10)–(12) for $t = 0, \ldots, T-1$ are given by*

$$\theta_t^* = \arg\max_{\theta_t} B_t(\theta_t) \tag{13}$$

$$C_t^* = \xi_t^*(i_t)\, W_t, \tag{14}$$

[15] As an example, consider the following quote that appeared in a popular financial advice website *The Balance*: "One way you can avoid the temptation to dip into your seed corn is to use what I call a central collection and disbursement account. Doing so results in the dividends, interest, profits, rents, licensing income, or other gains you see being deposited into a bank account dedicated to disbursements, not the brokerage accounts or retirement trusts that hold your investments [....] It erects a barrier between you and your principal." (Kennon 2016)

[16] Note that the constraint does not bind in the last period $t = T$ because, in a finite horizon problem without bequest, the agent has to consume his entire wealth.

where $B_t(\theta_t)$ is given by

$$\frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_t\left[\frac{R_{p,t+1}^{1-\gamma}(\theta_t)}{1-\gamma}\kappa_{V,t+1}(i_{t+1})^{1-\gamma}\right], \tag{15}$$

with $R_{p,t+1}(\theta_t) = \theta_t^\top R_{t+1}$ the portfolio return, i_{t+1} the next period income to wealth ratio is given by

$$i_{t+1} = \frac{Y_{p,t+1}(\theta_t)}{R_{p,t+1}(\theta_t)}, \quad t = 0, \ldots, T-1, \tag{16}$$

with $Y_{p,t+1}(\theta_t) = \theta_t^\top Y_{t+1}$ the portfolio dividend yield, and $\kappa_{V,t+1}(i_{t+1})$ the agent's continuation value from time $t+1$ onwards, given by

$$\kappa_{V,t+1}(i_{t+1}) = \begin{cases} \left((\xi_{t+1}^*)^{1-\gamma} + \delta(1-\xi_{t+1}^*)^{1-\gamma} B_{t+1}(\theta_{t+1}^*)^{1-\gamma}\right)^{\frac{1}{1-\gamma}}, & \text{for } t = 0, \ldots, T-2 \\ 1, & \text{for } t = T-1 \end{cases}. \tag{17}$$

The consumption wealth ratio $\xi_t^*(i_t)$ is given by

$$\xi_t^*(i_t) = \min\left\{i_t, \frac{x_t}{1+x_t}\right\}, \text{ where } x_t \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_t(\theta_t^*)^{\frac{\gamma-1}{\gamma}} > 0. \tag{18}$$

The agent's value function at time t, $J_t(W_t, i_t)$, is

$$J_t(W_t, i_t) = W_t^{1-\gamma}\frac{\kappa_{J,t}(i_t)^{1-\gamma}}{1-\gamma}, \tag{19}$$

where $\kappa_{J,t}(i_t)$ represents the certainty equivalent wealth given by

$$\kappa_{J,t}(i_t) = \left((\xi_t^*)^{1-\gamma} + \beta\delta(1-\xi_t^*)^{1-\gamma} B_t(\theta_t^*)^{1-\gamma}\right)^{\frac{1}{1-\gamma}}. \tag{20}$$

As the proposition illustrates, the solution of the problem is recursive and proceeds backward, starting with the boundary condition (17) for the continuation value $\kappa_{V,T} = 1$. Comparing the continuation value from $t+1$ onwards, equation (17), and time-t certainty equivalent wealth (20), we note that at each time t, the agent's discount factor for times $t+1$ and onward is equal to δ while the discount rate between time t and $t+1$ is equal to $\beta\delta$. Therefore, the consumption wealth ratio chosen by the agent at time $t+1$, ξ_{t+1}^*, will be higher than what the agent would have preferred at time t. This is the manifestation of time-inconsistency: the agent plans to save in the future, but as the future arrives,

the agent consumes more than planned. Anticipating that the time-$t+1$ self will become impatient at time $t+1$, the time-t self tries to affect the choice set of his future self through his current portfolio choice at time-t and the imposition of the self-control constraint (12).

To illustrate the solution derived in Proposition 1, we implement the model for the case of two risky assets and a risk-free asset. We assume that the two risky assets have identical binomial return distributions in each period, but differ in their dividend yields. We denote by H the risky asset with the higher dividend yield and by L the risky asset with the low dividend yield.[17]

The imposition of the self control constraints, while allowing the current-self to discipline the consumption temptation of his future-self, comes at a cost of limiting his flexibility. Figure 7 illustrates the trade-off between commitment and flexibility. We report time-1 consumption as a function of time-1 wealth for an agent with time-inconsistent preferences in the two-period example. The black line, C_1^{fc}, is the first-best case consumption from the standpoint of the time-0 self obtained by setting $\beta = 1$ in the time-1 portfolio choice problem. The blue line, C_1^{unc}, is the consumption that will be chosen by time-1 self. Note that $C_1^{\text{unc}} > C_1^{\text{fc}}$ always, indicating that, in the unconstrained case, the agent consumes more than the time-0 planned optimal consumption. The red line, C_1^{con}, is the consumption of an agent who commits to consume not more than the portfolio income. The income from the portfolio is the dashed-dotted line, I_1, set to unity in the figure. Intuitively, the self-control constraint reduces the over-consumption problem in low-wealth states, but limits the flexibility of choosing high consumption in high-wealth states. The trade-off between the benefit and cost of the self-control constraint depends on the severity of the over-consumption problem and the value of flexibility.

Figure 8 shows the time-0 certainty equivalent wealth, κ_J from equation (20). We assume that the agent faces a *current* self-control constraint at time 0, and consider three possible cases for the time-1 consumption: (i) unconstrained, κ_J^{unc}; (ii) constrained, κ_J^{con}; and (iii) first-best case, κ_J^{fc}. For each case we report the certainty equivalent wealth as the value of the present bias parameter β varies. Low value of β corresponds to a high level of distortion in consumption induced by time inconsistency, while $\beta = 1$ represents

[17]Specifically, we assume that the return on asset $i = H, L$ in each period is either $R_i^u = e^{\mu_i + \frac{1}{2}\sigma_i^2 + \sigma_i}$ or $R_i^d = e^{\mu_i + \frac{1}{2}\sigma_i^2 - \sigma_i}$ with equal probability 1/2, and that the joint probability of (R_H, R_L) is $1/4(1+\rho)$ for $(R_H, R_L) = (R_H^u, R_L^u)$ and $(R_H, R_L) = (R_H^d, R_L^d)$ and $1/4(1-\rho)$ for $(R_H, R_L) = (R_H^u, R_L^d)$ and $(R_H, R_L) = (R_H^d, R_L^u)$. This ensures that the return correlation is equal to ρ. We assume that $\mu_H = \mu_L$ and $\sigma_H = \sigma_L$. We take the gross risk-free rate $R^f = 1 + r^f$ and the dividend yields $Y_H > Y_L$ to be constant over time.

the time-consistent case. The black line, κ_J^{fc}, shows the first-best-case certainty equivalent wealth. When time-inconsistency is severe (low β), the constrained certainty equivalent wealth, κ_J^{con}, is *higher* than the unconstrained one, κ_J^{unc}, while the opposite is true if the time-inconsistency is less severe (β close to one). This implies that it is optimal for an agent to commit to a self-control constraint if he has a strong tendency to over-consume due to high present-time bias, that is, low β.

Figure 9 repeats the analysis of Figure 8 and reports certainty equivalent wealth as a function of stock return volatility. Intuitively, flexibility is more valuable when volatility is high and therefore a constraint is more harmful. Consistent with this intuition, the certainty equivalent wealth in the presence of a self-control constraint is higher than the unconstrained case for low levels of return volatility but lower than the unconstrained case for high levels of return volatility.

In summary, the analysis in this section provides a potential microfoundation of the consumption rule of "living off income" by showing that this rule can be an *optimal* commitment device for an agent with a hyperbolic discounting preference. Other frictions or behavioral biases may also lead to such a consumption rule. For example, prior to 1975, the NYSE set large minimum trade commissions that were almost always binding (Jones, 2002).[18] The rule of living off income is a plausible response to such high transaction costs. While transaction costs are now too low to provide a plausible explanation for the "living off income" rule of thumb, we cannot exclude that such a rule became established in the fixed-commission period, and that investors continue to follow it despite being sub-optimal.[19] Another related explanation for living-off-income is the "mental effort" involved in liquidating asset positions. Our empirical analysis on individual trading data shows that infrequent traders do not exhibit a stronger tendency to reach for income than frequent traders, a result inconsistent with the mental effort explanation.[20] Combining our empirical evidence with the discussion of financial advisors such as Kennon (2016) and Owens (2016), it appears that disciplining consumption is arguably a more plausible reason underpinning the rule of "living off dividends."

[18]Specifically, Jones reports that, between March 3, 1959 and December 5, 1968, trades of less than \$400 paid a minimum commission of \$3 plus 2% of the amount traded. For trades between \$400 and \$2,400, the minimum commission was \$7 plus 1% of the amount traded. Jones also reports that commission rebates were strictly prohibited by the exchange.

[19]We thank Terry Odean for pointing this out to us.

[20]The result is presented in the Online Appendix.

Regardless of the fundamental reasons underlying the consumption rule of "live off dividends," the analysis of the next section shows that as long as some investors follow such a rule, monetary policy will have an impact on portfolio allocations and the risk premium, even in an economy in which prices are fully flexible.

4.2 Implications of living off income for monetary policy

In this section, we analyze the equilibrium implication for monetary policy in an economy in which a fraction of investors follow the consumption rule of living off income.

We consider an endowment economy populated by two types of agents: agents of the first type make their consumption and savings decisions based on their permanent income, while agents of the second type have a hyperbolic discounting preference and follow the consumption rule of "living off current income" as discussed in Section 4.1. Time is discrete and runs over two periods, $t = 0, 1, 2$.

Monetary policy. We model monetary policy as determining the *nominal* risk-free rates in the economy, $r_t^{\$,f} = r_t^f + \pi_t$ where r_t^f denotes the net real rate and π_t inflation. To keep the model simple, we do not model the optimization problem of the monetary authority, and, as in Stein (2012), we abstract away price stickiness and assume instead that prices are fully flexible. In this setting, monetary policy de facto changes the evolution of the price level, or more precisely, the inflation rate π_t. Notice that monetary policy does not affect the real endowment process in our model. Therefore, in the absence of any nominal friction, monetary policy is completely neutral. However, as we show below, the presence of a fraction of agents following the "living off income" rule introduces a nominal friction in the model that renders money non-neutral. As a consequence, monetary policy has a real effect on the equilibrium risk premium.

Endowment. The economy consists of two risky endowment trees, $j = L, H$. The agent can trade financial assets that represent claims on the endowment trees. Asset L is the low-dividend risky asset and asset H is the high-dividend risky asset. We assume that risky dividends follow a multiplicative binomial process over the horizon, that is, the dividend growth can take values u^j or d^j at each time with

$$u^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 + \sigma_j}, \quad \text{and} \quad d^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 - \sigma_j} \quad j = L, H. \tag{21}$$

The high-dividend asset has a higher current dividend level and thus a lower dividend growth rate than the low-dividend assets, that is, $\mu_H < \mu_L$. We assume that dividend growth of the two assets have a correlation equal to ρ and the following joint probability distribution

$$\Pr(u^L, u^H) = \Pr(d^L, d^H) = \frac{1}{4}(1+\rho), \quad \text{and} \quad \Pr(u^L, d^H) = \Pr(d^L, u^H) = \frac{1}{4}(1-\rho). \tag{22}$$

This guarantees that the correlation between the dividend growth of asset H and L is indeed equal to ρ. Denoting by P_t^j the price of asset $j \in \{H, L\}$ at time t, we have that the one period return $\tilde{R}_{j,t_1}$ is given by

$$\tilde{R}_{j,t+1} = \frac{D_{t+1}^j + P_{t+1}^j}{P_t^j}, \quad j = H, L. \tag{23}$$

In addition to the two risky endowment trees, there is also a short-term risk-free bond for each period that pays a pre-determined dividend at maturity, $D_t^f = 1$, for $t = 0, 1, 2$. The risk-free rate for the horizon ending at time $t = 1, 2$ is defined as $R_t^f = 1 + r_t^f = D_t^f / P_{t-1}^f$.

At time 0 agents are endowed with a share of each of the assets and choose consumption and portfolio composition to maximize their lifetime expected utility. Specifically, at each date $t = 0, 1$ agents optimally choose their consumption and allocate their savings in a portfolio composed of the three dividend-generating assets. At time $t = 2$ agents consume all the dividends produced by the assets they hold.

Preferences. We assume that both agents have the same attitude toward atemporal risk, captured by CRRA preferences. However, their time-discounting attitude differ. Agent A has quasi-hyperbolic discounting as discussed in Section 4, while agent B has exponential discounting. Specifically, each agent $h = A, B$ solves the following problem

$$\max \mathbb{E}_0 \left[u(C_{h,0}) + \beta_h \delta_h u(C_{h,1}) + \beta_h \delta_h^2 u(C_{h,2}) \right], \quad \beta_A < 1, \beta_B = 1, \tag{24}$$

subject to a budget constraint for $t = 0, 1$

$$C_{h,t} = W_{h,t} - n_{h,t}^f P_t^f - n_{h,t}^L P_t^L - n_{h,t}^H P_t^H \tag{25}$$

$$W_{h,t+1} = n_{h,t}^f D_{t+1}^f + n_{h,t}^L (D_{t+1}^L + P_{t+1}^L) + n_{h,t}^H (D_{t+1}^H + P_{t+1}^H), \tag{26}$$

with $n^j_{h,t}$, $j \in \{H, L, f\}$ denoting, respectively, agent h's demand for asset H, asset L, and short-term Treasuries. The initial endowment of Treasuries ,S^f_{-1}, risky assets, S^L and S^H, and its distribution across agents, determines the initial wealth of agents:

$$W_{h,0} = \omega_h(S^f_{-1}D^f_0 + S^L(D^L_0 + P^L_0) + S^H(D^H_0 + P^H_0)), \tag{27}$$

where ω_h denotes agent h's share of total wealth.

In (24), $\beta_A < 1$, while $\beta_B = 1$, denoting that agent A suffers from present bias, as discussed in Section 4. Agent A responds to this bias by imposing a self-control constraint on the *nominal* amount of next-period consumption, that is the nominal consumption $C^{\$}_{A,t}$ is bounded by the net income available at time $t, 0, 1$, that is

$$C^{\$}_{A,t} \leq n^f_{A,t-1}\left(\Pi_t - P^{\$,f}_{t-1}\right) + n^L_{A,t-1}D^{\$,L}_t + n^H_{A,t-1}D^{\$,H}_t, \tag{28}$$

where $C^{\$}_{A,t} = C_{A,t}\Pi_t$ is the consumption in terms of time t dollars and Π_t is the time-t price level. Because the bond has a real dividend of 1 at time t, the nominal dividend of the bond is Π_t at time t. $P^{\$,f}_{t-1}$ is the nominal price of the short-term bond at time $t-1$. $\Pi_t - P^{\$,f}_{t-1}$ is the nominal interest income. Note that the self-control constraint is automatically satisfied at time $t = 2$ because each agent has to consume the total asset dividends at the terminal date.

The following proposition illustrates that a change in the nominal risk-free rate on the income constraint (28) affects the agents *real* consumption/savings ratio.

Proposition 2. *Let Π_t denote the time-t price level. Then self-control constraint (28) on nominal consumption is equivalent to a constraint on the ratio of real consumption to real savings, that is,*

$$\frac{C_{A,t}}{W_{A,t-1} - C_{A,t-1}} \leq \theta^f_{A,t-1}r^{\$,f}_t + \theta^l_{A,t-1}dp^L_t + \theta^H_{A,t-1}dp^H_t, \tag{29}$$

where $\theta^j_{h,t}$, $j \in \{H, L, f\}$ is the portfolio holding in asset j:

$$\theta^j_{A,t} = \frac{n^j_{A,t}P^j_t}{W_{A,t} - C_{A,t}}, \tag{30}$$

$dp^j_t = \frac{D^j_t}{P^j_{t-1}}$ is the dividend yield of asset $j = H, L$, and $r^{\$}_t$ is the nominal risk-free rate at time t.

The expression of the constraint (29) in the proposition shows that an increase in the nominal interest rate $r_t^{\$,f}$ at time t relaxes the income constraint. The source of nominal friction in the model comes from the fact that agents think about bond income in nominal terms rather than in real terms. Hence, the presence of investors who follow the nominal consumption rule (28) is the reason why monetary policy has a real effect in our otherwise frictionless economy.

Equilibrium. Given an endowment process of treasuries S^f and risky assets S^L and S^H, an equilibrium is characterized by a set of prices $\{P_{f,t}, P_{H,t}, P_{L,t}\}$ and allocation (consumption and portfolio rules) such that both agents maximize expected utility (24) subject to (25), (26), and (28) and markets clear

$$n_{A,t}^f + n_{B,t}^f = S_t^f \tag{31}$$

$$n_{A,t}^L + n_{B,t}^L = S^L \tag{32}$$

$$n_{A,t}^H + n_{B,t}^H = S^H. \tag{33}$$

Portfolio composition. To understand the effect of the self-control constraint on asset demand, we first first derive the optimal portfolio of both agents taking returns as given. Figure 10 illustrates the agents' portfolio holdings of the high- and low-dividend stocks at time $t = 0$ for each level of nominal interest rates.[21] Notice that, for the unconstrained agent A, the holdings of both assets are unaffected by the level of the nominal interest rate, that is $\theta_H^{\text{unc}} = \theta_L^{\text{unc}}$.[22] In contrast, the constrained agent exhibits clear reaching-for-income behavior, holding a much larger fraction of the high-dividend-paying assets, $\theta_H^{\text{con}} > \theta_L^{\text{con}}$. Furthermore, the sensitivity of the holding of the high-dividend asset is larger than that of the low-dividend asset. As the nominal risk-free rate $r^{\$,f}$ decreases, the agent shifts his portfolio more aggressively toward the high-dividend-paying asset.

Equilibrium risk premia. The demand patterns induced by the presence of the self-control constraint have implications for equilibrium asset prices in this economy. In the spirit of Baker and Wurgler (2004b), we define the equilibrium *dividend premium* as the the ratio of the risk premium—the expected excess return over the risk-free rate—of the low-dividend yield stock and that of the high-dividend yield stock. Intuitively, this measure captures the relative valuation high- versus low-dividend yield assets in the economy.

[21] We assume that the return distribution is as described in Section 4.1, footnote 17.

[22] In general equilibrium, the unconstrained agent's portfolio is also affected by monetary policy because the asset prices adjust in equilibrium.

Figure 11 plots the relationship between the equilibrium dividend premium and the nominal risk-free rate at time $t = 0$. The red line is the dividend premium as a function of the risk-free rates when the time-inconsistent agent is subject to a self-control constraint, while the blue line is the dividend premium when there is no self-control constraint. Note that risk premia are inversely related to prices. In equilibrium, a lower risk-free rate represents lower income yield from the bond. When the risk-free rate is low, the reaching-for-income behavior of the time-inconsistent agent bids up the price of the high dividend yield asset (H) relative to that of the low-dividend yield asset (L) thus implying a higher dividend premium. These findings are qualitatively consistent with our empirical finding in Figure 4.[23]

To show the effect of the consumption rule, we also solve an unconstrained version of the equilibrium in which no agents follow the consumption rule of "living off income." As shown in Figure 11, the equilibrium dividend premium in such an economy is unaffected by the level of the nominal risk free rate. In the unconstrained equilibrium, monetary policy is completely neutral.

Note that, in our model, monetary policy affects the *risk premium* of assets. This is in contrast to standard New Keynesian models in which monetary policy works by influencing the *real* risk-free rates. This feature of our model is consistent with a growing body of evidence that documents the impact of monetary policy shocks on asset prices through the risk premium channel (Bernanke and Kuttner 2005, Gertler and Karadi 2015; Hanson and Stein 2015). Unlike the standard New Keynesian model, in which the main friction is price stickiness, in our model, prices are fully flexible and the key friction is the presence of a non-negligible fraction of agents that consume out of their nominal income. This mechanism places our model within the class of models that studies the financial channel of monetary policy transmission.[24]

[23]Notice, however, that the variations in the dividend premium from our model are very small. This is an artifact of the two-period model we consider. In a two-period model, the dividend yield is high because in each period the dividend represents a large fraction of the price. Therefore, the variation in the bond interest rates has a small effect on the relative risk premium of the two stocks. A better calibration can be achieved in a model with bequest motives or infinitely lived agents in which the dividend yields of stocks can be made comparable to the income yield from bonds.

[24]See Drechsler et al. (2017b) for a survey.

5 Discussion

Our analysis highlights a new channel through which monetary policy impacts the financial sector of an economy. In what follows we discuss the relevance of these effects for portfolio diversification, capital allocation, and investors' risk-taking behavior.

Portfolio under-diversification. Accommodative monetary policy may induce under-diversification of investors' portfolios. As Figures 10 shows, a fully diversified portfolio in our model would have equal weights in both the high- and low-dividend stocks. However, as accommodative monetary policy depresses the risk-free rates, "reaching-for-income" investors demand more high-dividend stocks and sell low-dividend stocks. The overall portfolio standard deviation increases sharply, as illustrated in Figure 12. In the data, stocks that pay a high dividend usually concentrate in certain sectors such as utilities and telecommunications. Reaching for income would lead to excessive exposure to these sectors. Furthermore, firms' high-dividend yields might be a consequence of financial distress that, by depressing prices, inflates dividend yields. Reaching for income may then over-expose investors' portfolios to distress-related events.

Risk-taking. When accommodative monetary policy lowers bond yields below those of the stock market, "reaching-for-income" investors may substitute stocks for bonds, which increases their overall portfolio risk. As Figures 10 illustrates, when the risk-free rate is below a certain threshold, a further cut in interest rates would increase the weight of *both* high- and low- dividend stocks. This is because bonds are unattractive in terms of their current income, and investors are substituting into both high- and low-dividend stocks. This increases the overall portfolio risks in a non-linear fashion. In equilibrium, higher demand bids up asset prices, which may lead to a risk premium that is too low to compensate for the associated risks.

As low interest rates drive up prices of high-dividend assets, dividend yields fall and become less attractive to these "reaching-for-income" investors. These investors may reach to alternative asset classes such as junk bonds, preferred securities, and real estate investment trusts (REITs). Many of these instruments may attract income-oriented investors who ignore the contribution of these tools to overall portfolio risk.

Capital reallocation. In Section 3, we show that monetary policy affects the cross-section of dividend-sorted portfolios. This has implications for the allocation of capital across firms with different dividend payout policies. If accommodative monetary policy

lowers the cost of capital of high-dividend paying companies, it may have redistributive effects in the economy. In times of monetary policy easing, high-dividend paying companies will find it cheaper to raise capital than low-dividend paying companies.

Catering. In Section 3, we show that low-interest rate monetary policy leads to higher valuation of dividend-paying stocks. Catering to such demand, firms may initiate dividends to boost their share prices. We find suggestive evidence of this in the data. Figure 13 plots the level of the Fed Funds rates (right axis) and the fraction of firms that initiate cash dividends in the following year (left axis). Panel A considers cash dividends while Panel B refers to share repurchases. From Panel A we note that more firms initiate cash dividends when the Fed Funds rates are lower. In contrast, Panel B shows that the likelihood of initiating share repurchases does not exhibit the same correlation with the Fed Funds rates. The different pattern between cash dividends and share repurchases is consistent with the hypothesis that low-interest rates increase the demand for current income rather than capital gains. In aggregate, however, the catering behavior of firms does not seem to be able to satisfy all of the excess demand as asset prices of dividend-paying firms still rise. A possible reason is that it may be costly for some firms to change their dividend payout policy, e.g., Lintner (1956).

To summarize, we argue that through investors' tendency to "reach for income," monetary policy may lead to unintended consequences on the financial sector such as portfolio under-diversification, capital reallocation, and excessive risk-taking.

6 Conclusion

This study documents empirical evidence that accommodative monetary policy induces investors to reach for income: we find that a 1% decrease in the Fed Funds rate would lead to a cumulative 5.18% inflow over three years to mutual funds with high income yields over a three-year period, and a 0.946% increase in holdings of high-dividend-paying stocks over a six-month period. The investors who reach for income are mainly investors who live off dividend income for consumption. By exploiting regional variations in bank deposit rates, we show that such effects are not driven by latent macroeconomic variables that correlate with monetary policy.

Through its influence on the demand of high-dividend stocks, monetary policy affects the prices of these assets. High-dividend stocks exhibit positive risk-adjusted returns in periods of accommodative monetary policy, and negative or negligible abnormal returns in periods of tightening monetary policy. A trading strategy that longs high-dividend stocks when rates are falling and shorts them when rates are rising earns an annual Sharpe ratio of about 0.18.

We propose an asset pricing model to explain these empirical results. We show that the consumption rule of "living off income" naturally arises as a commitment device to control over-consumption. Monetary policy, by influencing the interest income from bonds, will impact the demand of dividend-paying stocks in a way that is consistent with what we observed in the data.

Overall, our results add to a growing body of research showing that the monetary authority exerts a profound impact on the financial sector through its intervention on the risk-free rate. In particular, we show that an accommodative monetary policy induces some investors to overweight high-dividend stocks, which may result in under-diversified portfolios. Furthermore, through the reaching-for-income channel, monetary policy may also affect the cross-section of asset prices and ultimately, capital allocation and risk-taking behavior in the aggregate. While our study does not advocate that monetary policy should change its course because of these potential distortions, our results highlight that it is important for policy makers to be aware of the effects we document and devise measures to contain their consequences.

A Appendix: Proofs of Propositions

Proof of Proposition 1:

We solve the problem (10)–(28) backwards starting at time $t = T - 1$. The agent has one period left and, because of quasi-hyperbolic discounting in (10), his short-term discount rate is $\beta\delta$. The state variables are represented by the agent's wealth W_{T-1} and income I_{T-1}. We denote by $J_{T-1}(W_{T-1}, I_{T-1})$ the agent value function

$$J_1(W_{T-1}, I_{T-1}) = \max_{\{0 \leq C_{T-1} \leq I_{T-1}, \theta_{T-1}\}} \left\{ \frac{C_{T-1}^{1-\gamma}}{1-\gamma} + \beta\delta \mathbb{E}_{T-1} \left[\frac{W_T^{1-\gamma}}{1-\gamma} \right] \right\}, \tag{A1}$$

where

$$W_T = (W_{T-1} - C_{T-1}) R_{p,T}(\theta_{T-1}). \tag{A2}$$

Let $\xi_1 \equiv C_{T-1}/W_{T-1}$ and $i_{T-1} \equiv I_{T-1}/W_{T-1}$. Then we can re-express problem (A1)–(A2) as follows:

$$J_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \max_{\{0 \leq \xi_{T-1} \leq i_{T-1}, \theta_{T-1}\}} \left\{ \frac{\xi_{T-1}^{1-\gamma}}{1-\gamma} + \beta\delta (1 - \xi_{T-1})^{1-\gamma} \frac{B_{T-1}(\theta_{T-1})^{1-\gamma}}{1-\gamma} \right\}. \tag{A3}$$

where we define the quantity $B_{T-1}(\theta_{T-1})$ such that

$$\frac{B_{T-1}(\theta_{T-1})^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_{T-1} \left[\frac{R_{p,T}^{1-\gamma}(\theta_{T-1})}{1-\gamma} \right]. \tag{A4}$$

Note that $B_{T-1}(\theta_{T-1}) > 0$ for all values of γ. In the optimization (A3), the optimal portfolio θ_{T-1}^* is independent of the consumption choice ξ_{T-1} and is given by

$$\theta_{T-1}^* = \arg\max \mathbb{E}_{T-1} \left[\frac{R_{p,T}^{1-\gamma}(\theta_1)}{1-\gamma} \right]. \tag{A5}$$

From (A4), the optimization in (A5) is equivalent to

$$\theta_{T-1}^* = \arg\max B_{T-1}(\theta_{T-1}). \tag{A6}$$

Taking the first-order condition with respect to ξ_{T-1} in (A3) we obtain that the unconstrained consumption ξ_{T-1}^{unc} is given by

$$(\xi_{T-1}^{\text{unc}})^{-\gamma} = \beta\delta(1-\xi_{T-1}^{\text{unc}})^{-\gamma} B_{T-1}^{1-\gamma}, \tag{A7}$$

or

$$\xi_{T-1}^{\text{unc}} = \frac{x_{T-1}}{1+x_{T-1}}, \quad \text{where} \quad x_{T-1} \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_{T-1}(\theta_{T-1}^{*})^{\frac{\gamma-1}{\gamma}} > 0. \tag{A8}$$

Imposing the self-control constraint $\xi_{T-1} \leq i_{T-1}$ we obtain

$$\xi_{T-1}^{*} = \min\left\{ i_{T-1}, \frac{x_{T-1}}{1+x_{T-1}} \right\}. \tag{A9}$$

From (A3), the value function $J_{T-1}(W_{T-1}, i_{T-1})$ is then

$$J_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \frac{\left(\kappa_{J,T-1}(i_{T-1})\right)^{1-\gamma}}{1-\gamma}, \tag{A10}$$

where $\kappa_{J,T-1}(i_{T-1})$ is the certainty equivalent

$$\kappa_{J,T-1}(i_{T-1}) = \left((\xi_{T-1}^{*})^{1-\gamma} + \beta\delta(1-\xi_{T-1}^{*})^{1-\gamma} B_{T-1}(\theta_{T-1}^{*})^{1-\gamma} \right)^{\frac{1}{1-\gamma}}. \tag{A11}$$

At time $t = T-2$ the value function is

$$J_{T-2}(W_{T-2}, I_{T-2}) = \max_{\{0 \leq C_{T-2} \leq I_{T-2}, \theta_{T-2}\}} \left\{ \frac{C_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta\, \mathbb{E}_{T-2}\left[\frac{C_{T-1}^{1-\gamma}}{1-\gamma} + \delta \frac{W_{T}^{1-\gamma}}{1-\gamma} \right] \right\}. \tag{A12}$$

Under the optimal consumption and portfolio policy, the term in the above expression is the continuation value from time $t = T-1$ onward. From the above analysis, we infer that the continuation value is of the form (A1) where $\beta\delta$ is replaced by δ. Hence, using (A10) we can express the continuation value as

$$V_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \frac{\left(\kappa_{V,T-1}(i_{T-1})\right)^{1-\gamma}}{1-\gamma}, \tag{A13}$$

where

$$\kappa_{V,T-1}(i_{T-1}) = \left((\xi_{T-1}^{*})^{1-\gamma} + \delta(1-\xi_{T-1}^{*})^{1-\gamma} B_{T-1}(\theta_{T-1}^{*})^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \tag{A14}$$

We can then express the problem (A12) recursively as follows:

$$J_{T-2}(W_{T-2}, I_{T-2}) = \max_{\{0 \le C_{T-2} \le I_{T-2}, \theta_{T-2}\}} \left\{ \frac{C_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta\, \mathbb{E}_{T-2}\left[V_{T-1}(W_{T-1}, i_{T-1}(\theta_{T-2}))\right] \right\}, \tag{A15}$$

where

$$W_{T-1} = (W_{T-2} - C_{T-2}) R_{p,T-1}(\theta_{T-2}), \tag{A16}$$

and

$$i_{T-1}(\theta_{T-2}) = \frac{I_{T-1}}{W_{T-1}} = \frac{(W_{T-2} - C_{T-2}) Y_{p,T-1}(\theta_{T-2})}{(W_0 - C_0) R_{p,T-1}(\theta_{T-2})} = \frac{Y_{p,T-1}(\theta_{T-2})}{R_{p,T-1}(\theta_{T-2})}. \tag{A17}$$

Using the definition of $V_{T-1}(W_{T-1}, i_{T-1})$ in (A13)–(17) we obtain

$$J_{T-2}(W_{T-2}, i_{T-2}) = W_{T-2}^{1-\gamma} \max_{\{0 \le \xi_{T-2} \le i_{T-2}, \theta_{T-2}\}} \left\{ \frac{\xi_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta (1-\xi_{T-2})^{1-\gamma} \frac{B_{T-2}(\theta_{T-2})^{1-\gamma}}{1-\gamma} \right\}, \tag{A18}$$

where

$$\frac{B_{T-2}(\theta_{T-2})^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_{T-2}\left[\frac{R_{p,T-1}^{1-\gamma}(\theta_{T-2})}{1-\gamma} \kappa_{V,T-1}(i_{T-1}(\theta_{T-2}))^{1-\gamma} \right], \tag{A19}$$

and $i_{T-1}(\theta_{T-2})$ is given in (A17). In the optimization (A18) the optimal portfolio θ^*_{T-2} is independent on the consumption choice ξ_{T-2} and is given by

$$\theta^*_{T-2} = \arg\max B_{T-2}(\theta_{T-2}). \tag{A20}$$

Taking the first-order condition with respect to ξ_{T-2} in (A18) and following the same steps used at time $t = T-1$ above, we obtain that the unconstrained consumption ξ^{unc}_{T-2} is given by

$$\xi^*_{T-2} = \min\left\{ i_{T-2}, \frac{x_{T-2}}{1+x_{T-2}} \right\} \quad \text{where} \quad x_{T-2} \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_{T-2}(\theta^*_{T-2})^{\frac{\gamma-1}{\gamma}} > 0. \tag{A21}$$

From (A18), the value function $J_{T-2}(W_{T-2}, i_{T-2})$ is then

$$J_{T-2}(W_{T-2}, i_{T-2}) = W_{T-2}^{1-\gamma} \frac{\left(\kappa_{J,T-2}(i_{T-2})\right)^{1-\gamma}}{1-\gamma}, \tag{A22}$$

where

$$\kappa_{J,T-2}(i_{T-2}) = \left((\xi^*_{T-2})^{1-\gamma} + \beta\delta(1-\xi^*_{T-2})^{1-\gamma}\, B_{T-2}(\theta^*_{T-2})^{1-\gamma}\right)^{\frac{1}{1-\gamma}}. \tag{A23}$$

Proceeding backwards, we infer that at each time $t = 0, \ldots, T-2$, the problem can be expressed recursively as

$$J_t(W_t, i_t) = W_t^{1-\gamma} \max_{\{0\le\xi_t\le i_t,\theta_t\}} \left\{ \frac{\xi_t^{1-\gamma}}{1-\gamma} + \beta\delta(1-\xi_t)^{1-\gamma}\, \frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \right\}, \tag{A24}$$

with

$$\frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_t \left[\frac{R^{1-\gamma}_{p,t+1}(\theta_{T-2})}{1-\gamma} \kappa_{V,t+1}(i_{t+1}(\theta_t))^{1-\gamma} \right], \tag{A25}$$

where $i_{t+1}(\theta_t) = R_{p,t+1}/Y_{p,t+1}$ and the continuation value $\kappa_{V,t+1}(i_{t+1}(\theta_t))$ is

$$\kappa_{V,t+1}(i_{t+1}) = \left((\xi^*_{t+1})^{1-\gamma} + \delta(1-\xi^*_{t+1})^{1-\gamma}\, B_{t+1}(\theta^*_{t+1})^{1-\gamma}\right)^{\frac{1}{1-\gamma}}, \tag{A26}$$

which at time t is known from the solution at time $t+1$. ∎

Proof of Proposition 2:

Using the definition of portfolio weights (30), we can express the nominal constraint (28) as follows

$$\begin{aligned} C_{A,t}\Pi_t &\le \left(W^{\$}_{A,t-1} - C^{\$}_{A,t-1}\right) \left[\theta^f_{A,t-1} \frac{\Pi_t - P^{\$,f}_{t-1}}{P^{\$,f}_{t-1}} + \theta^L_{A,t-1} \frac{D^{\$,L}_t}{P^{\$,L}_{t-1}} + \theta^H_{A,t-1} \frac{D^{\$,H}_t}{P^{\$,H}_{t-1}} \right] && \text{(A27)} \\ &= \left(W^{\$}_{A,t-1} - C^{\$}_{A,t-1}\right) \left[\theta^f_{A,t-1} \left(R^{\$,f}_t - 1\right) + \theta^L_{A,t-1} \frac{D^{\$,L}_t}{P^{\$,L}_{t-1}} + \theta^H_{A,t-1} \frac{D^{\$,H}_t}{P^{\$,H}_{t-1}} \right] && \text{(A28)} \end{aligned}$$

where

$$R^{\$f}_t \equiv \frac{\Pi_t}{P^{\$,f}_{t-1}} = \frac{1}{P^f_{t-1}\frac{\Pi_{t-1}}{\Pi_t}} = R^f_t \frac{\Pi_t}{\Pi_{t-1}}, \tag{A29}$$

where R^f_t denotes the time-t real risk free rate $R^f_t = 1/P^f_{t-1}$.

Transforming the income constraint in real terms using the price levels Π_t and Π_{t-1} and using (A29) we have

$$C_{A,t}\Pi_t \le (W_{A,t-1} - C_{A,t-1})\, \Pi_{t-1} \left[\theta^f_{A,t-1} \left(R^f_t \frac{\Pi_t}{\Pi_{t-1}} - 1 \right) + \theta^L_{A,t-1} \frac{D^L_t \Pi_t}{P^L_{t-1}\Pi_{t-1}} + \theta^H_{A,t-1} \frac{D^H_t \Pi_t}{P^H_{t-1}\Pi_{t-1}} \right],$$

which simplifies to

$$C_{A,t} \leq (W_{A,t-1} - C_{A,t-1}) \left[\theta^f_{A,t-1} \left(R^f_t - \frac{\Pi_{t-1}}{\Pi_t} \right) + \theta^L_{A,t-1} \frac{D^L_t}{P^L_{t-1}} + \theta^H_{A,t-1} \frac{D^H_t}{P^H_{t-1}} \right]. \tag{A30}$$

By definition, inflation π_t is the change in price levels, that is,

$$\frac{\Pi_t}{\Pi_{t-1}} = 1 + \pi_t.$$

When inflation is small, $\frac{\Pi_{t-1}}{\Pi_t} \approx 1 - \pi_t$, and therefore the income yield of bonds in (A30) is the *net* nominal interest rate, that is,

$$R^f_t - \frac{\Pi_{t-1}}{\Pi_t} \approx 1 + r^f_t - (1 - \pi_t) = r^f_t + \pi_t = r^{\$,f}_t.$$

Using this approximation in (A30), we obtain that the nominal income constraint (28) can be written as a function of the nominal interest rate $r^{\$,f}_t$ and risky assets' real dividend yields $dp^j_t = D^j_t / P_{t-1}$, $j = H, L$, that is,

$$\frac{C_t}{W_{t-1} - C_{t-1}} \leq \theta^f_{t-1} r^{\$,f}_t + \theta^l_{t-1} dp^L_t + \theta^h_{t-1} dp^H_t. \tag{A31}$$

∎

B List of Data Variables

Mutual Fund Data	
Variable	**Details of construction**
Flow	Monthly changes in total net assets (TNA) adjusted for fund returns
Dividend Yield	The dividend yield is calculated by dividing the annual dividend income distribution by the NAV of the mutual shares at the time of distribution. If there are multiple distributions within one year, then we sum the yield for each distribution.
High Dividend	A dummy variable that takes the value of 1 if a fund is in the top decile of the dividend yield distribution for a given month, and 0 otherwise
Return	Past one-month gross return
Volatility	Annualized monthly return volatility over the past 12 months.
Size	Assets under management (log)
Expense	Expense ratio
ΔTax	3-year change in the difference in tax on dividends and capital gains. The tax rate on dividends is the maximum individual tax rate retrieved from the FRED database from the St. Louis Fed. The series name is "IITTRHB. " The tax rate on capital gains is retrieved from Treasury Department website.
ΔFFR	3-year change in the Fed Funds rates. The Fed Funds rates are retrieved from the FRED database from the St. Louis Fed. The series name is "FEDFUNDS."

Individual Holding Data	
Variable	**Details of construction**
ΔHolding	Percentage change in quantity of a security held over last 6 months.
Dividend Yield	The dividend yield of a stock is calculated by dividing the dollar value of dividends per share of stock by the share price before the dividend is paid. If a stock pays multiple dividends within a year, the annual dividend yield is the sum of the dividend yield over the whole year.
Repurchase Yield	The repurchase yield of a stock is calculated by dividing the dollar value of repurchase per share of stock by the share price before the repurchase. If a stock has multiple repurchase within a year, the annual repurchase yield is the sum of the repurchase yield over the whole year. The share repurchase measure is constructed following Fama and French (2001).
Home Owner	A dummy variable which takes the value of 1 if an account holder owns a home, and 0 otherwise
Married	A dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise
Male	A dummy variable which takes the value of 1 if an account holder is male, and 0 otherwise
Retirees	Individuals whose age is above 65
Withdrawers	Individuals who have above a median frequency to withdraw their dividend income rather than reinvesting it
ΔDeposit Rates	Local deposit rates are constructed in the following steps. First, we calculate deposit rates of each bank by dividing bank interest payments on deposits by total deposits held at the end of each quarter. Then we take average across all the banks in a metropolitan statistical area (MSA) to calculate the MSA level deposit rates. Each bank's deposit rate is weighted by the amount of deposits of this bank's branches in the MSA.
Income	Labor income of the account holder
Bank Card	A dummy variable which takes the value of 1 if an account holder has a bank card
Vehicles	A dummy variable which takes the value of 1 if an account holder has a vehicle

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Table 1: Summary Statistics of the Stock-Holding Sample

This table reports summary statistics of the individual stock-holding sample from January 1991 to December 1996, covering a total of 19,394 households. The data are from a large discount broker. Δ*Holding* represents the percentage change in the quantity of a security over a period of 6 months; *Dividend Yield* represents the annual dividend yield of the stock. *Repurchase Yield* is the annual repurchase per share divided by price per share. *Retiree* represents a dummy variable that takes the value of 1 if the age of an account holder is above 65 and 0 otherwise; *Labor Income* represents a categorical variable that classifies account holders into 10 income groups; *Home Owner* represents a dummy variable that takes the value of 1 if an account holder owns a home and 0 otherwise; *Married* represents a dummy variable that takes the value of 1 if an account holder is married and 0 otherwise; *Male* represents a dummy variable that takes the value of 1 if an account holder is male and 0 otherwise; *Bank Card* represents a dummy variable that takes the value of 1 if an account holder has at least one bank card and 0 otherwise; *Vehicles* represents the number of vehicles an account holder owns.

	mean	sd	p10	p25	p50	p75	p90
Δ Holding	2.929	22.451	0.000	0.000	0.000	0.000	1.660
Income Yield	0.021	0.024	0.000	0.000	0.013	0.036	0.057
Repurchase Yield	0.005	0.025	0.000	0.000	0.000	0.000	0.012
Market Beta	1.089	0.581	0.399	0.693	1.060	1.432	1.837
Book-to-Market	0.613	0.462	0.163	0.280	0.505	0.813	1.168
Past 1-year Return	0.861	1.241	-0.696	0.173	1.076	1.586	2.263
Past 3-year Return	0.203	0.713	-0.657	-0.117	0.278	0.591	0.978
Market Cap (log)	14.310	2.481	10.734	12.468	14.619	16.356	17.396
Profit Margin	0.289	0.610	0.109	0.213	0.350	0.492	0.651
ROE	0.038	0.337	-0.246	0.014	0.101	0.184	0.282
Retiree	0.237	0.425	0.000	0.000	0.000	0.000	1.000
Labor Income	4.070	3.313	0.000	0.000	5.000	7.000	8.000
Home Owner	0.593	0.491	0.000	0.000	1.000	1.000	1.000
Married	0.426	0.494	0.000	0.000	0.000	1.000	1.000
Male	0.580	0.494	0.000	0.000	1.000	1.000	1.000
Bank Card	0.753	0.431	0.000	1.000	1.000	1.000	1.000
Vehicles	0.495	0.835	0.000	0.000	0.000	1.000	2.000

Table 2: Summary Statistics of the Mutual Fund Sample

This table reports the summary statistics of the mutual fund sample. The data are from the CRSP Survivor-Bias-Free U.S. Mutual Fund database from January 1991 to December 2016, covering a total of 25,463 fund share classes for equity funds and 14,921 fund share classes for bond funds. Each observation is a month-fund share class combination. *Flow* represents net inflows into a fund share class; *Income Yield* represents the annual income yield of the fund; *Return* is monthly fund return; *Volatility* is standard deviation of fund return for the past year; *Size* represents assets under management (log); and *Expense* represents the expense ratio. *Flow*, *Return*, *Volatility*, and *Expense* are in percentages. *Size* is in millions (log).

Panel A: Equity Funds

	mean	sd	p10	p25	p50	p75	p90
Flow	2.566	14.810	-4.545	-1.623	-0.007	2.607	9.523
Income Yield	0.013	0.012	0.002	0.005	0.011	0.019	0.028
Return	0.007	0.051	-0.053	-0.018	0.012	0.036	0.061
Volatility	1.303	0.697	0.618	0.814	1.163	1.641	2.132
Size	3.608	2.733	-0.223	1.887	3.869	5.561	6.923
Expense	1.199	0.588	0.450	0.820	1.150	1.550	2.000

Panel B: Bond Funds

	mean	sd	p10	p25	p50	p75	p90
Flow	1.408	12.515	-6.076	-2.084	-0.212	2.261	8.820
Income Yield	0.038	0.022	0.006	0.025	0.038	0.050	0.062
Return	0.003	0.014	-0.008	0.000	0.003	0.009	0.017
Volatility	0.283	0.294	0.005	0.031	0.243	0.392	0.585
Size	3.918	2.506	0.531	2.404	4.140	5.634	6.920
Expense	0.908	0.516	0.270	0.550	0.800	1.250	1.670

Table 3: Demographics of Withdrawers

This table reports the coefficient estimates from a logistic regression of a withdrawer dummy on a set of demographic variables. The sample includes all the households with demographic information in the LBD data from 1991 to 1996. Columns 1 and 2 include all the individuals, while columns 3 and 4 include only males and females respectively. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered at household and month levels.

	(1) All	(2) All	(3) Male	(4) Female
Retiree	0.258***	0.258***	0.251***	0.271***
	[0.040]	[0.040]	[0.048]	[0.075]
Labor Income	-0.018**	-0.018**	-0.024**	0.025
	[0.008]	[0.008]	[0.011]	[0.018]
Home Owner	0.061	0.061	0.089	0.018
	[0.055]	[0.055]	[0.069]	[0.107]
Married	0.013	0.013	0.045	0.030
	[0.041]	[0.041]	[0.045]	[0.113]
Bank Card	0.005	0.005	-0.019	0.017
	[0.043]	[0.043]	[0.082]	[0.052]
Vehicles	0.026	0.026	0.042**	-0.075
	[0.020]	[0.020]	[0.021]	[0.070]
Occupation F.E.	No	Yes	Yes	Yes
Observations	19,394	19,394	11,442	7,952
Pseudo R-squared	0.002	0.002	0.003	0.002

Table 4: Stock Holdings and Monetary Policy: Retirees vs Non-retirees

This table reports the coefficient estimates from panel regression (4):

$$\Delta\text{Holding}_{i,j,t} = \beta_1 \Delta\text{FFR}_t + \beta_2 \text{High Div}_{i,j,t} + \beta_3 \Delta\text{FFR}_t \times \text{High Div}_{i,j,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t}.$$

where $\Delta Holding_{i,j,t}$ is defined in equation (1) as the change in stock position over the past 6 months scaled by the average position at the beginning and at the end of the period. ΔFFR_t represents the three-year change in Fed Funds rates from year $t-3$ to year t; *High* $Div_{i,j,t}$ is a dummy variable that equals 1 if the income yield of a stock is in the top decile for a given month, and 0 otherwise; and $X_{i,j,t}$ is a set of control variables. The first subset of control variables are stock characteristics including high repurchase dummy and its interaction with the 3-year change in deposit rates, market beta and its interaction with the 3-year change in deposit rates, book-to-market ratio and its interaction with the 3-year change in deposit rates, past 1-year and 3-year returns, log market capitalization, profit margin, and ROE. The second set of characteristics are demographic variables such as home-ownership, marital status, and gender. The sample includes all the stock positions in the LBD data from 1991 to 1996. Column 1 includes all individuals in the sample. Columns 2–3 include retirees and non-retirees respectively. *Retirees* represents individuals whose age is above 65. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered at household and month levels.

	(1) All	(2) Retirees	(3) Non-retirees
Δ FFR	-0.303***	-0.151	-0.356***
	[0.105]	[0.109]	[0.109]
High Dividend	9.491***	9.069***	9.792***
	[1.143]	[1.262]	[1.203]
Δ FFR*High Dividend	-0.946***	-1.568***	-0.669**
	[0.338]	[0.377]	[0.339]
High Repurchase	0.292	0.742	0.158
	[0.490]	[0.733]	[0.541]
Δ FFR*High Repurchase	0.433***	0.334*	0.463***
	[0.126]	[0.196]	[0.139]
Stock Characteristics	Yes	Yes	Yes
Demographics	Yes	Yes	Yes
Observations	1,759,502	418,255	1,341,247
Adj. R-squared	0.015	0.021	0.014

Table 5: Local Deposit Rates and Stock Holdings

This table reports the coefficient estimates from panel regression (5):
$\Delta\text{Holding}_{i,j,t} = \beta_1 \Delta\text{Dep Rates}_{i,t} + \beta_2 \text{High Div}_{i,j,t} + \beta_3 \Delta\text{Dep Rates}_{i,t} \times \text{High Div}_{i,j,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t}$
where $\Delta Holding_{i,j,t}$ is defined in equation (1) as the change in stock position over the past 6 months scaled by the average position at the beginning and and at the end of the period. $\Delta Dep\ Rates_{i,t}$ is the 3-year change in deposit rates from year $t-3$ to year t. $High\ Div_{i,j,t}$ is a dummy variable that equals 1 if the dividend yield of a stock is in the top decile for a given month and 0 otherwise; $X_{i,j,t}$ is a set of control variables. The first subset of control variables are stock characteristics including high repurchase dummy and its the interaction with the 3-year change in deposit rates, market beta and its interaction with the 3-year change in deposit rates, book-to-market ratio and its interaction with the 3-year change in deposit rates, past 1-year and 3-year returns, log market capitalization, profit margin, and ROE. The second set of characteristics are demographic variables such as home-ownership, marital status, and gender. The local deposit rates are average bank deposit rates in each MSA weighted by deposits. The sample includes all the stock positions in the LBD data from 1991 to 1996. Column 1 includes all the individuals. Columns 2–3 include withdrawers and non-withdrawers respectively. *Withdrawers* represents individuals who have above a median frequency of withdrawing their dividend income rather than reinvesting it. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered at household and month levels.

	(1) All	(2) Withdrawers	(3) Non-Withdr.
Δ Deposit Rates	-0.883***	-0.858***	-1.153***
	[0.209]	[0.228]	[0.393]
High Dividend	7.638***	7.533***	9.233***
	[1.090]	[1.127]	[2.305]
Δ FFR*High Dividend	-0.426	-0.401	-0.768
	[0.364]	[0.365]	[0.867]
Δ Deposit Rates*High Dividend	-2.159**	-2.509**	0.694
	[0.934]	[0.950]	[1.928]
High Repurchase	0.304	0.0225	1.387
	[0.530]	[0.517]	[1.360]
Δ Deposit Rates*High Repurchase	1.119***	0.961***	1.694**
	[0.291]	[0.294]	[0.768]
Stock Characteristics	Yes	Yes	Yes
Demographics	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
MSA Fixed Effects	Yes	Yes	Yes
Observations	1,296,462	1,064,446	232,013
Adj. R-squared	0.020	0.026	0.012

Table 6: Mutual Fund Flows, Income Yields, and Monetary Policy

This table reports the coefficient estimates from panel regression (7):

$$\text{Flows}_{i,t} = \beta_1 \text{High Income}_{i,t} + \beta_2 \Delta\text{FFR}_t \times \text{High Income}_{i,t} + \tau_t + \gamma' X_{i,t} + \varepsilon_{i,t},$$

where $Flows_{i,t}$ represents flows into mutual fund i at time t; ΔFFR_t represents the three-year change in Fed Funds rates from year $t-3$ to year t; $High\ Income_{i,t}$ is a dummy variable that equals 1 if the income yield of a fund is in the top decile for a given month, and 0 otherwise; and $X_{i,t}$ is a set of control variables including: *Volatility,* $\Delta FFR \times$ *Volatility,* $\Delta Tax \times$ *High Dividend, Return, Size, Turnover,* and *Expense*. *Return* is fund return over the preceding month; *Volatility* is the standard deviation of fund returns for the past year; ΔTax is the difference between the maximum individual income tax rate and the capital gains tax rate; *Size* represents the assets under management (log); and *Expense* represents the expense ratio. The sample includes all the equity or bond mutual funds in the United States from 1991 to 2016. Each observation is a fund share class-month combination. Columns 1 and 2 include the whole sample. Columns 3 and 4 include only the retail share classes. Columns 5 and 6 include only the institutional share classes. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered at month levels.

	All		Retail		Institution	
	(1)	(2)	(3)	(4)	(5)	(6)
	Equity	Bond	Equity	Bond	Equity	Bond
High Income	0.284***	0.700***	0.640***	0.322***	0.288**	0.717***
	[0.094]	[0.099]	[0.148]	[0.118]	[0.145]	[0.145]
Δ FFR*High Income	-0.144***	-0.050*	-0.146***	-0.090**	-0.066	-0.069
	[0.031]	[0.030]	[0.047]	[0.039]	[0.042]	[0.049]
Volatility	0.453***	-0.770***	0.853***	-0.461	0.386**	-0.462
	[0.154]	[0.254]	[0.242]	[0.381]	[0.177]	[0.399]
Δ FFR*Volatility	0.038	-0.450***	0.134**	-0.289***	0.047	-0.522***
	[0.047]	[0.058]	[0.064]	[0.077]	[0.049]	[0.101]
Δ Tax*High Dividend	-0.120***	-0.035	-0.040	-0.068	-0.002	0.029
	[0.021]	[0.024]	[0.050]	[0.057]	[0.043]	[0.051]
Fund Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1064289	1206575	500377	572685	388581	293847
Adj. R-squared	0.015	0.013	0.019	0.021	0.008	0.006

Table 7: Mutual Fund Flows and Alternative Measures of Income Yields

This table reports the coefficient estimates from panel regression (7):

$$\text{Flows}_{i,t} = \beta_1 \text{High Income}_{i,t} + \beta_2 \Delta\text{FFR}_t \times \text{High Income}_{i,t} + \tau_t + \gamma' X_{i,t} + \varepsilon_{i,t},$$

where $Flows_{i,t}$ represents flows into mutual fund i at time t; ΔFFR_t represents the three-year change in Fed Funds rates from year $t-3$ to year t; and $X_{i,t}$ is a set of control variables including: *Volatility,* $\Delta FFR \times$ *Volatility,* $\Delta Tax \times$ *High Dividend, Return, Size, Turnover,* and *Expense*. *Return* is fund return over the preceding month; *Volatility* is the standard deviation of fund returns for the past year; ΔTax is the difference between the maximum individual income tax rate and the capital gain tax rate; *Size* represents the assets under management (log); and *Expense* represents the expense ratio. The sample includes all the equity or bond mutual funds in the United States from 1991 to 2016. Each observation is a fund share class-month combination. In columns 1 and 2, $High\ Income_{i,t}$ is a dummy variable that equals to 1 if a fund is in the top decile of income yield distribution. In columns 3 and 4 $High\ Income_{i,t}$ is a categorical variable that equals the decile number of a fund in the income yield distribution. In columns 5 and 6, $High\ Income_{i,t}$ is a dummy variable that equals 1 if the name of an equity fund contains "dividend," "income," or "yield"; and if the name of a bond fund contains "high dividend", "high income," or "high yield" and equals to 0 otherwise. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered at month level.

	High-Income Dummy		Income Decile		Fund Name	
	(1)	(2)	(3)	(4)	(5)	(6)
	Equity	Bond	Equity	Bond	Equity	Bond
High Income	-0.044	0.561***	-0.097***	0.089***	-0.228**	0.280**
	[0.116]	[0.125]	[0.018]	[0.021]	[0.098]	[0.139]
Δ FFR*High Income	-0.604***	-0.271**	-0.049***	-0.028	-0.630***	-0.263*
	[0.123]	[0.119]	[0.017]	[0.019]	[0.099]	[0.134]
Δ Term Spread*High Income	-0.585***	-0.285*	-0.060***	-0.034	-0.587***	-0.266
	[0.152]	[0.151]	[0.020]	[0.024]	[0.118]	[0.163]
Volatility	0.455***	-0.780***	0.417***	-1.089***	0.454***	-0.596**
	[0.154]	[0.254]	[0.151]	[0.239]	[0.151]	[0.257]
Δ FFR*Volatility	0.038	-0.453***	0.030	-0.463***	0.027	-0.444***
	[0.047]	[0.058]	[0.046]	[0.059]	[0.046]	[0.059]
Δ Tax*High Dividend	-0.139***	-0.048**	-0.119***	-0.020	-0.117***	0.004
	[0.020]	[0.024]	[0.019]	[0.023]	[0.019]	[0.022]
Fund Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1064289	1206575	1064289	1206575	1064289	1206575
Adj. R-squared	0.015	0.013	0.015	0.013	0.015	0.013

Table 8: Monetary Policy and Excess Returns of Dividend Decile Portfolios

This table reports Fama French 5-factor alphas of equal-weighted portfolios formed on dividend yields conditional on the stance of monetary policy over the sample period of 1963 to 2016. When the 3-year change of Fed Funds rates is positive, we classify it as rising FFR; when negative, we classify it as declining FFR. The first two columns are the portfolio alphas on each state while the third column is the difference. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels. The alpha is in percentage points. The sample period is from July 1963 to June 2016.

	Rising FFR	Declining FFR	Rising-Declining
Decile 1	0.062	-0.211**	0.273**
	[0.089]	[0.091]	[0.127]
Decile 2	0.041	-0.068	0.109
	[0.077]	[0.071]	[0.104]
Decile 3	-0.018	-0.127*	0.109
	[0.071]	[0.068]	[0.099]
Decile 4	-0.039	-0.056	0.017
	[0.074]	[0.069]	[0.101]
Decile 5	-0.075	-0.045	-0.030
	[0.069]	[0.069]	[0.098]
Decile 6	-0.002	0.018	-0.020
	[0.074]	[0.069]	[0.101]
Decile 7	-0.050	0.142**	-0.191**
	[0.071]	[0.066]	[0.097]
Decile 8	-0.005	0.229***	-0.233**
	[0.073]	[0.070]	[0.101]
Decile 9	-0.064	0.187***	-0.251***
	[0.073]	[0.072]	[0.102]
Decile 10	-0.113	0.178	-0.291*
	[0.109]	[0.122]	[0.164]
Decile 10 - Decile 1	-0.175	0.389***	-0.564***
	[0.141]	[0.152]	[0.207]

Table 9: Fed Funds Rates and Excess Returns of Dividend Decile Portfolios

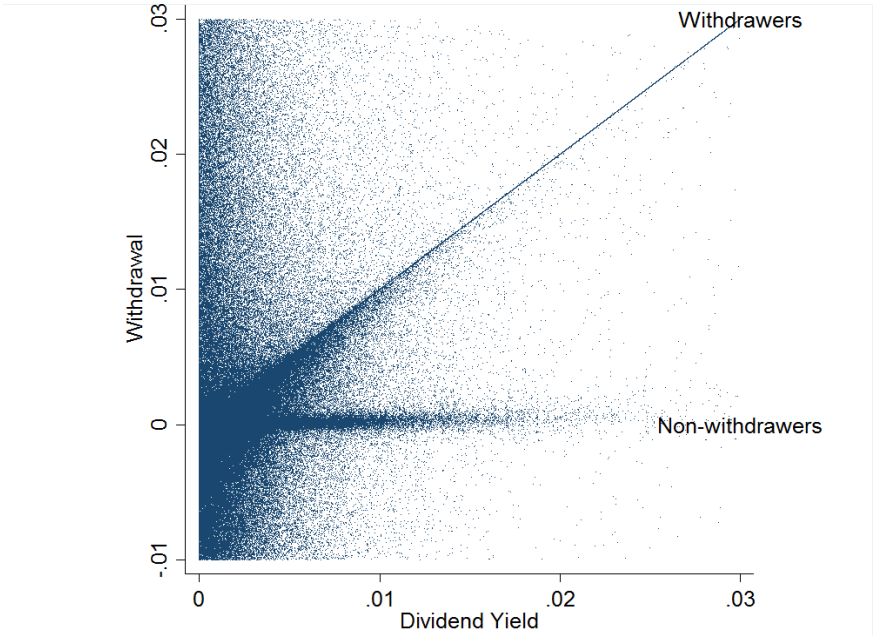
This table reports the coefficient estimates from panel regression (8):

$$\alpha_{i,t} = \beta_1 \Delta\text{FFR}_t + \beta_2 \Delta\text{FFR}_t \times \text{DivDecile}_i + \zeta_i + \varepsilon_{i,t},$$

where $\alpha_{i,t}$ represents the risk-adjusted return on the dividend portfolio i in month t. ΔFFR_t represents the three-year change in Fed Funds rates from year $t-3$ to year t; DivDecile_i is a dummy variable that equals 1 for dividend decile portfolio i and 0 otherwise; and ζ_i is decile fixed effects. Each of the four columns corresponds to alphas from the CAPM, the Fama-French 3-factor model, the Fama-French 4 -factor model, and the Fama-French 5-factor model. The observations are in monthly frequency. The sample period is from July 1963 to June 2016. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5%, and 1% levels.

	(1) CAPM Alpha	(2) FF3 Alpha	(3) FF4 Alpha	(4) FF5 Alpha
Δ FFR	0.003	0.013	0.014	0.033***
	[0.018]	[0.011]	[0.011]	[0.011]
Δ FFR* Dividend Decile	-0.008**	-0.007***	-0.007***	-0.009***
	[0.003]	[0.002]	[0.002]	[0.002]
Decile Fixed Effects	Yes	Yes	Yes	Yes
Observations	6,360	6,360	6,360	6,360
Adj. R^2	0.005	0.006	0.005	0.005

Panel A: Dividend Yield vs. Withdrawal



Panel B: Capital Gains vs. Withdrawal

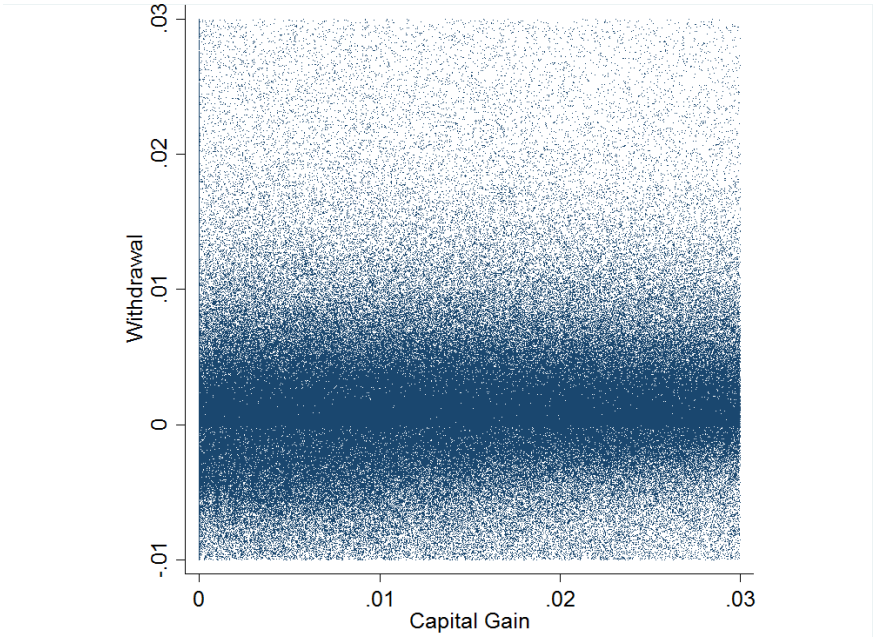


Figure 1: Dividend Income, Capital Gains, and Net Withdrawals

The figure shows a scatter plot of monthly net withdrawals against dividends (Panel A) or capital gains (Panel B) in the same month. Following Baker et al. (2007), withdrawals are defined as households' monthly net withdrawals from their brokerage account scaled by the account value in the previous month. Dividend yields/capital gains are the dollar value of dividend income/capital gain from the portfolio scaled by the account value in the previous month. The graph is truncated at 4% for both axes to drop outliers.

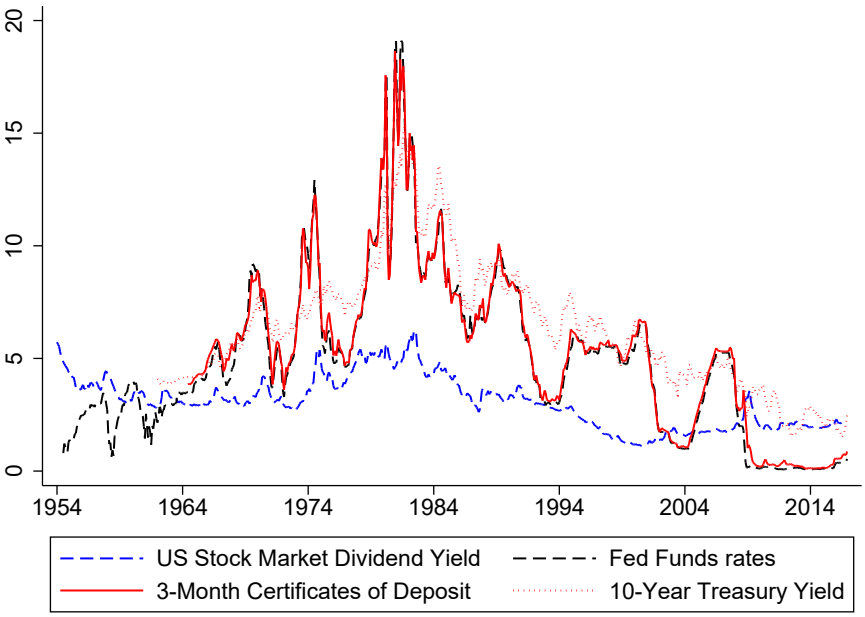


Figure 2: Income Yields of Stocks and Bonds over Monetary Cycles

This figure shows the aggregate U.S. stock market dividend yield and the Fed Funds rates from 1954 to 2016. The aggregate stock market dividend yield is retrieved from Robert Shiller's website. The yield of 3-month certificates of deposit and 10-year Treasury yield is retrieved from the FRED database of the St. Louis Fed.

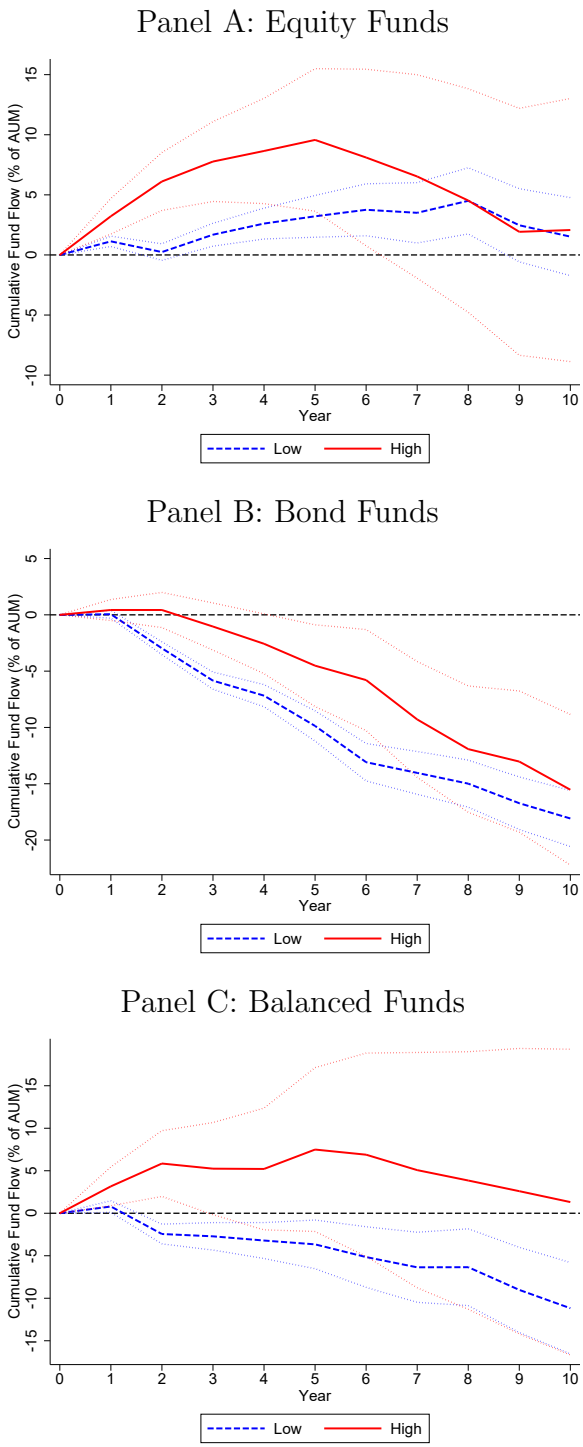


Figure 3: Impulse Response of Fund Flows to Changes in the Fed Fund Rates

The solid lines in each figure plot the impulse response of the mutual fund flows to a negative 1% shock on the Fed Funds rates; the dotted lines represent 95% confidence intervals. The estimation model is given by equation (7). The estimation sample includes the domestic mutual funds in the United States from 1991 to 2016.

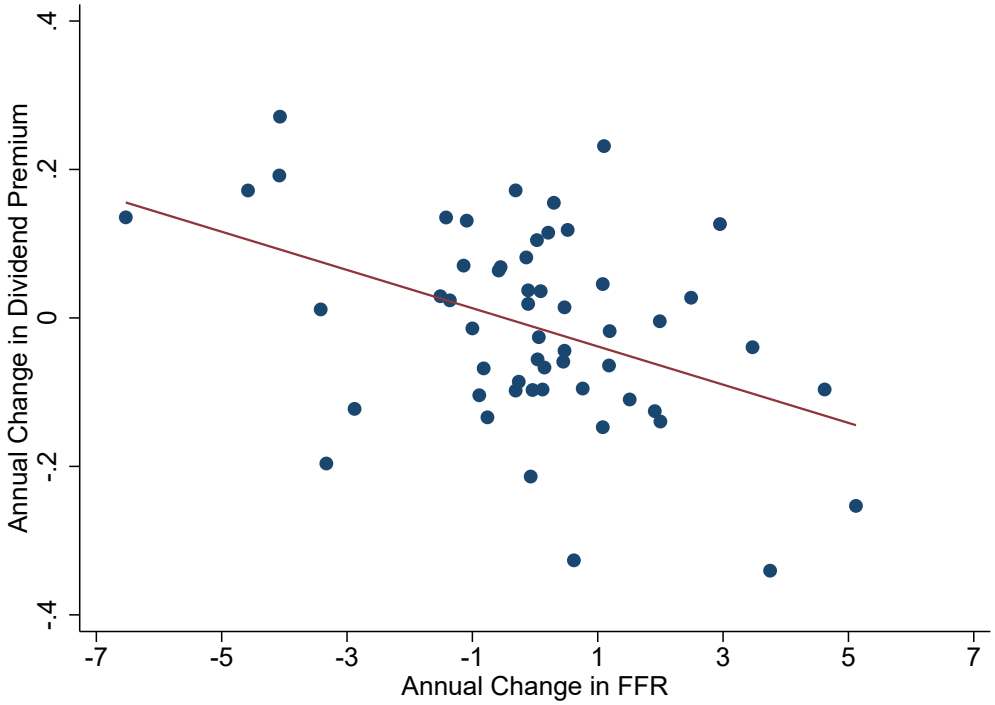


Figure 4: Dividend Premium and Fed Funds Rates

The figure reports the scatter plot of the annual change in the dividend premium against the annual change in the Fed Funds rates. We take equal-weighted averages of the market-to-book ratios separately for dividend payers and nonpayers in each year and compute the dividend premium as the difference in the two average log market-to-book ratios (Baker and Wurgler 2004b). The sample period is from 1963 to 2016.

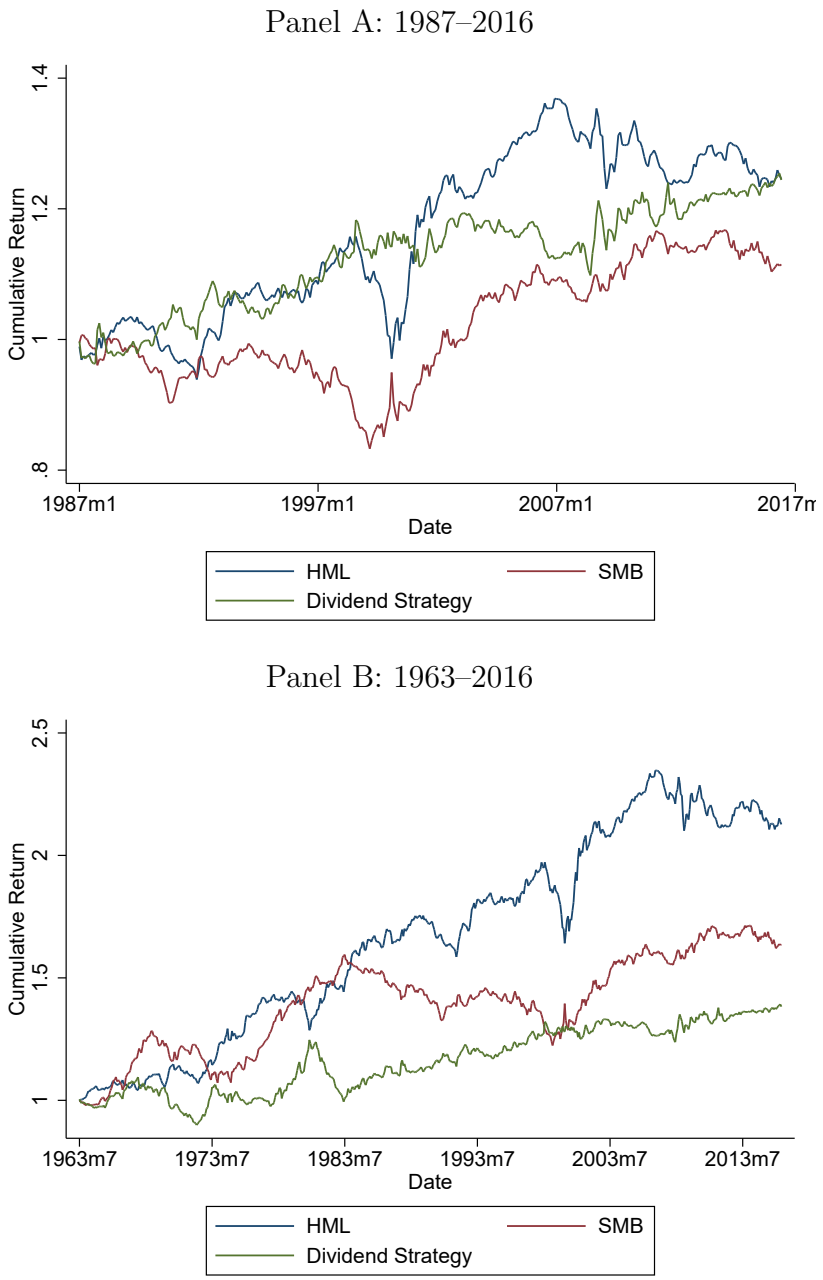


Figure 5: Cumulative Return of the Dividend Strategy

This figure plots the cumulative return of a trading strategy that (i) buys the tenth decile of the dividend portfolio and shorts the first decile after a negative 3-year change in Fed Funds rates, and (ii) buys the first decile of the dividend portfolio and shorts the tenth decile after a positive 3-year change in Fed Funds rates. The cumulative returns are normalized to have the same monthly standard deviation of 1%. The annual Sharpe ratio of the dividend strategy is 0.231.

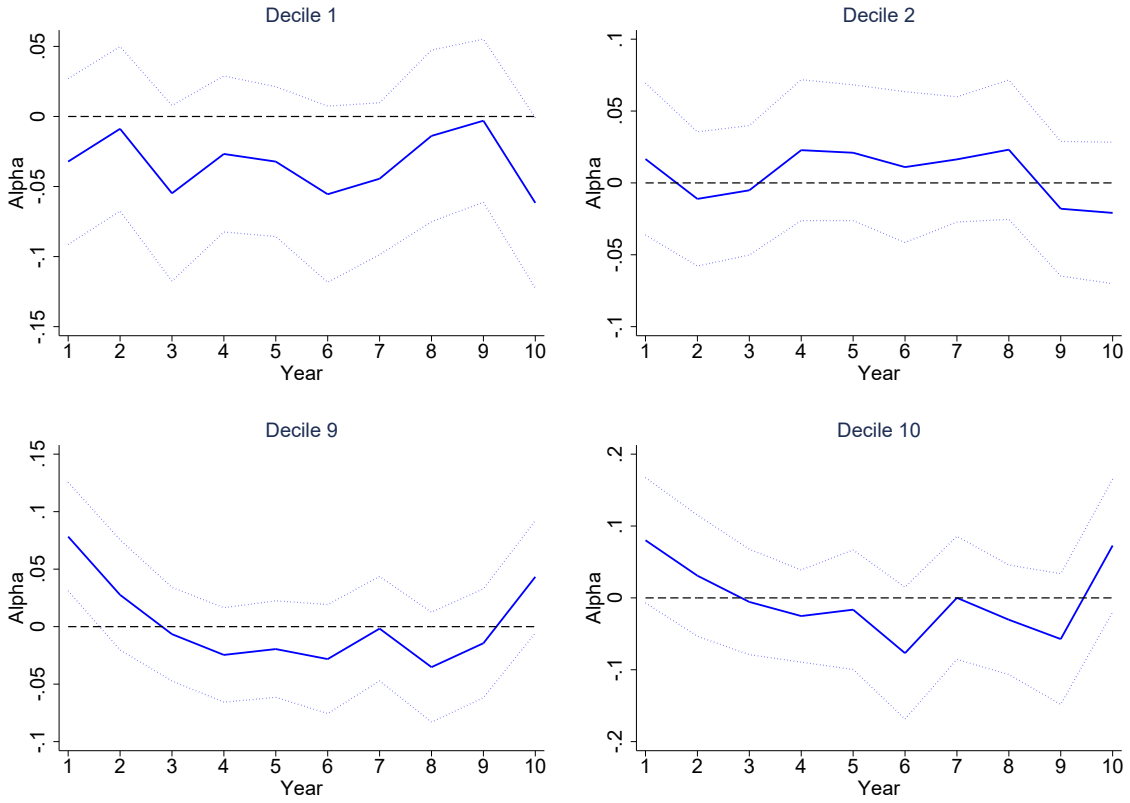


Figure 6: Impulse Response of Alphas to Monetary Policy by Dividend Deciles

This solid lines in each figure plot the impulse response of the Fama-French 5-factor alphas of the two lowest and the two highest dividend decile portfolios to a negative 1% shock on the Fed Funds rate; the dotted lines represent 95% confidence intervals. The sample period is from July 1963 to June 2016.

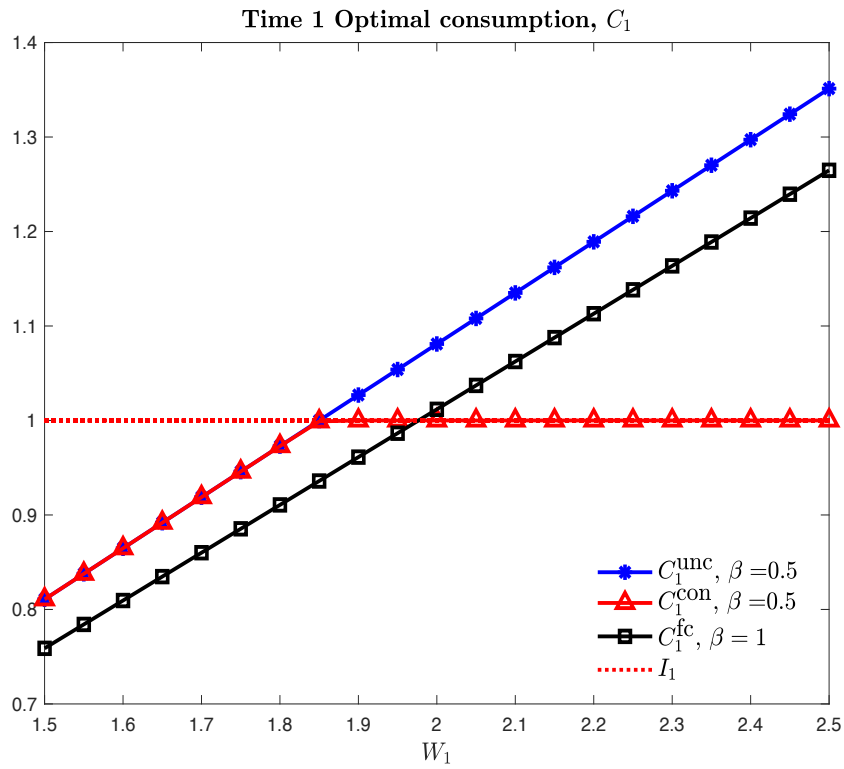


Figure 7: Consumption and Self-Control Constraint

The figure reports the optimal time-1 consumption as a function of the time-1 wealth of the two-period version of the problem described in Proposition 1. C_1^{unc}, C_1^{con}, and C_1^{fc} refers, respectively, to the consumption of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is, $\beta = 1$ in the time-1 portfolio choice problem. $I_1 = 1$ is the income from the portfolio. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, $\beta = 0.5$. We assume that the distribution of asset returns is binomial, as discussed in footnote 17, with parameters $\sigma_L = \sigma_H = 0.4$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.11$, and $R_f = 0.01$. Asset H has a dividend yield of $Y_H = 0.7$ and asset L has a dividend yield of $Y_L = 0.5$.

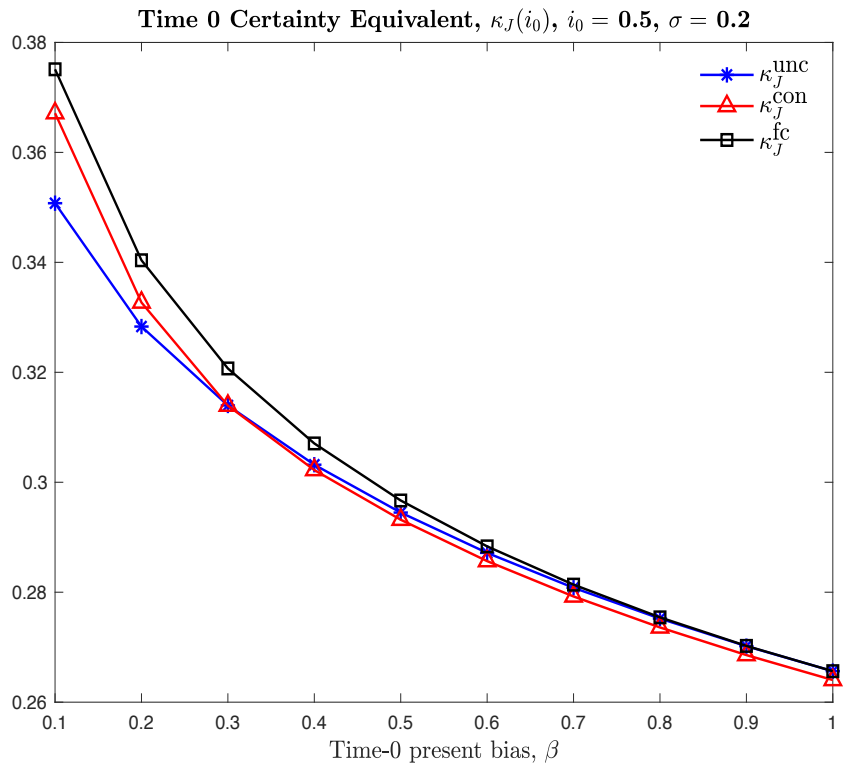


Figure 8: Certainty Equivalent Wealth and Time-Inconsistency

The figure reports the time-0 certainty equivalent wealth as a function of the time-inconsistency parameter, β, for the two-period version of the problem described in Proposition 1. κ_J^{unc}, κ_J^{con}, and κ_J^{fc} refers, respectively, to the time-0 certainty equivalent wealth of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is, $\beta = 1$ in the time-1 portfolio choice problem. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$. We assume that the distribution of asset return is binomial, as discussed in footnote 17, with parameters $\sigma_L = \sigma_H = 0.2$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.11$, and $R_f = 0.01$. Asset H has a dividend yield of $Y_H = 0.7$ and asset L has a dividend yield of $Y_L = 0.5$.

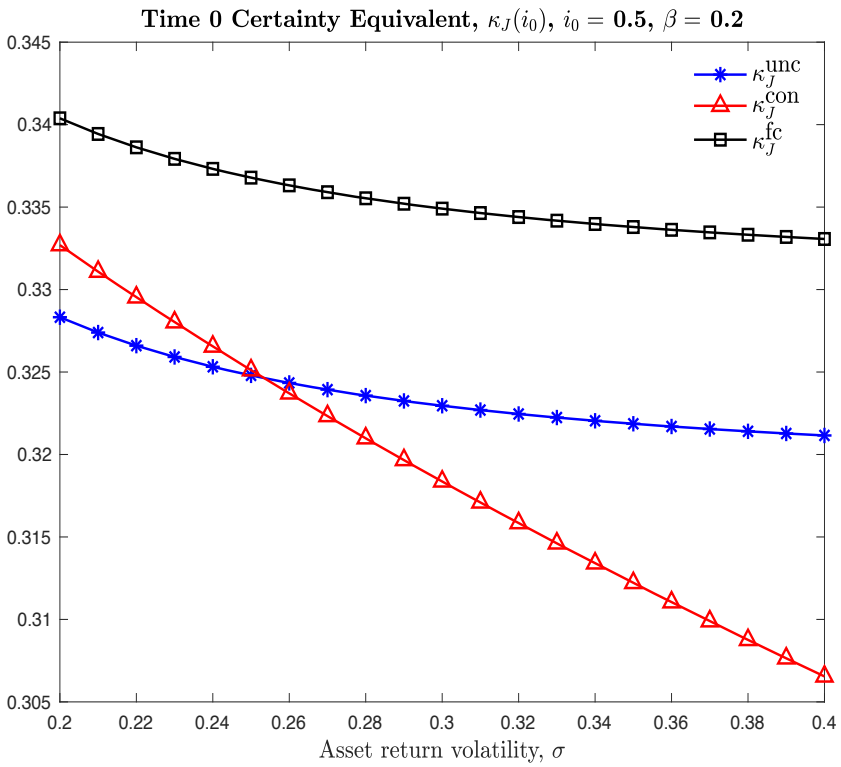


Figure 9: Certainty Equivalent Wealth and Return Volatility

The figure reports the time-0 certainty equivalent wealth as a function of the stock return volatility parameter, $\sigma_L = \sigma_H$, for the two-period version of the problem described in Proposition 1.κ_J^{unc}, κ_J^{con}, and κ_J^{fc} refers, respectively, to the time-0 certainty equivalent wealth of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is, $\beta = 1$ in the time-1 portfolio choice problem. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, $\beta = 0.2$. We assume that assets log returns have identical volatility: $\sigma = \sigma_L = \sigma_H$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.11$, and $R_f = 0.01$. Asset H has a dividend yield of $Y_H = 0.7$ and asset L has a dividend yield of $Y_L = 0.5$.

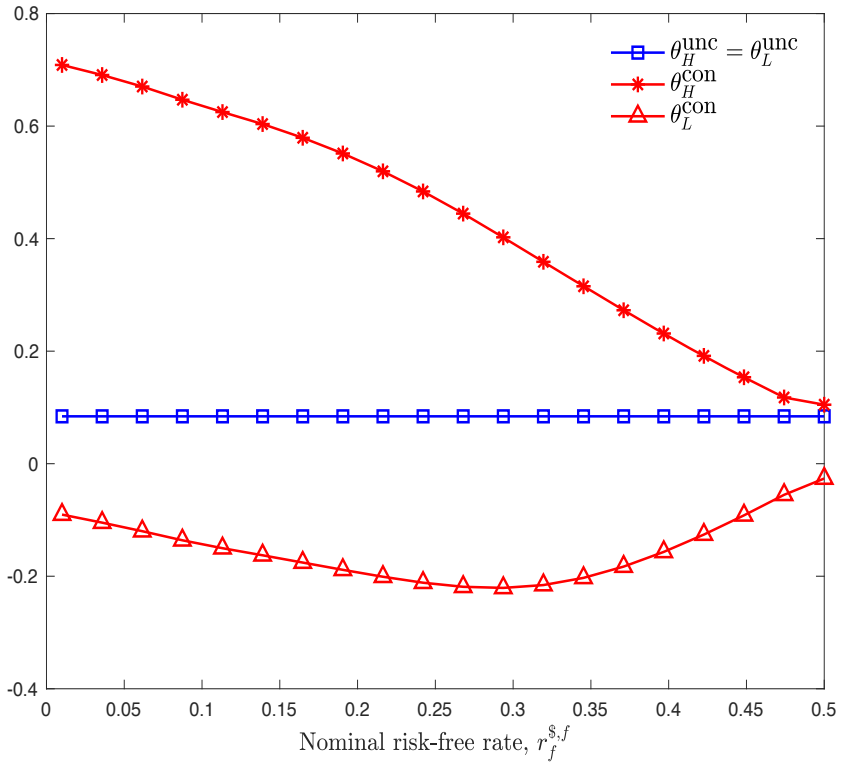


Figure 10: Portfolio Holdings and Self-control Constraint

The figure reports the optimal portfolio holdings at time 0 for the two-period problem described in Section 4.1. The portfolio $(\theta_H^{\text{con}}, \theta_L^{\text{con}})$ refers, respectively, to the holdings of the high- and low-dividend-paying asset in the presence of the self-control constraint (28). The portfolio $(\theta_H^{\text{unc}}, \theta_L^{unc})$ is the corresponding unconstrained solution. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, $\beta = 0.95$. We assume that assets' log returns have identical volatility: $\sigma_L = \sigma_H = 0.5$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.1249$. Asset H has a dividend yield of $Y_H = 0.6$ and asset L has a dividend yield of $Y_L = 0.1$.

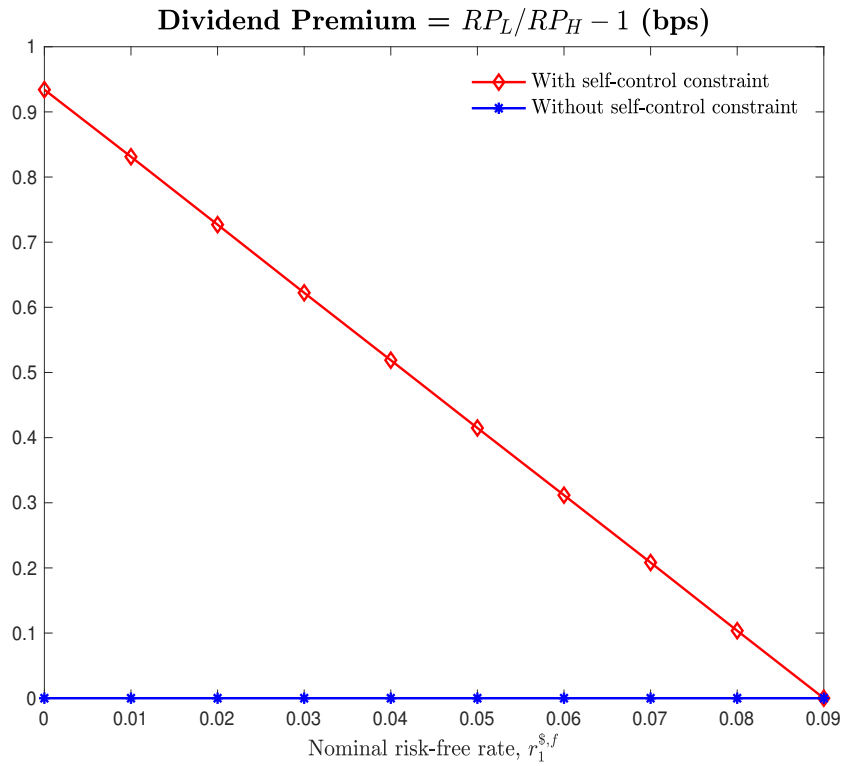


Figure 11: Dividend Premium

The figure reports the dividend premium as a function of the risk-free rates in the general equilibrium model of two agents. Agent A has a time-inconsistent preference while agent B has a time-consistent preference. Each agent has an equal share of initial endowment. Preferences parameter values: $\gamma_A = \gamma_B = 3$, $\delta_A = \delta_B = 0.98$, $\beta_A = 0.9$, $\beta_B = 1.0$. We assume that the dividend growth of both endowment trees have volatility: $\sigma_H = \sigma_L = 0.2$ and correlation $\rho = 0.5$. Asset H (value stock) has an expected dividend growth rate $\mu_H = 0.02$ and asset L (growth stock) has expected dividend growth rate $\mu_L = 0.04$. The dividend premium is defined as the ratio of the risk premium of the growth stock and the value stock minus one. We normalize the dividend premium for the unconstrained economy to zero to facilitate comparison. We express the dividend premium in basis points.

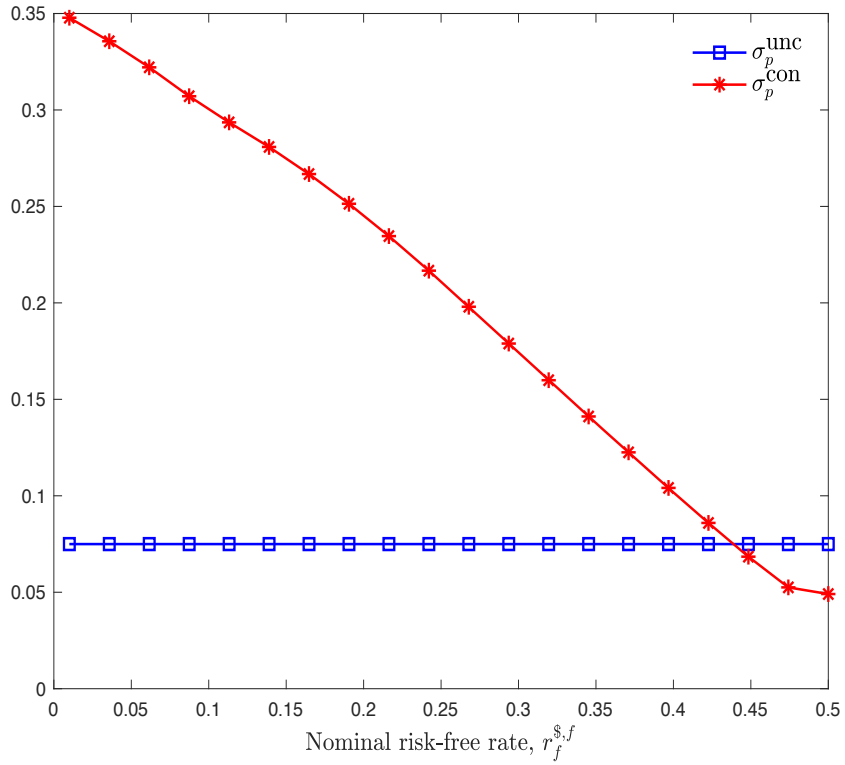


Figure 12: Portfolio Volatility

The figure reports the volatility of the time-0 unconstrained and constrained portfolios, respectively, σ_p^{unc} and σ_p^{con}, for the two-period problem described in Section 4.1. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, $\beta = 0.5$. We assume that assets log returns have identical volatility: $\sigma_L = \sigma_H = 0.22$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.1249$. Asset H has a dividend yield of $Y_H = 0.6$ and asset L has a dividend yield of $Y_L = 0.1$.

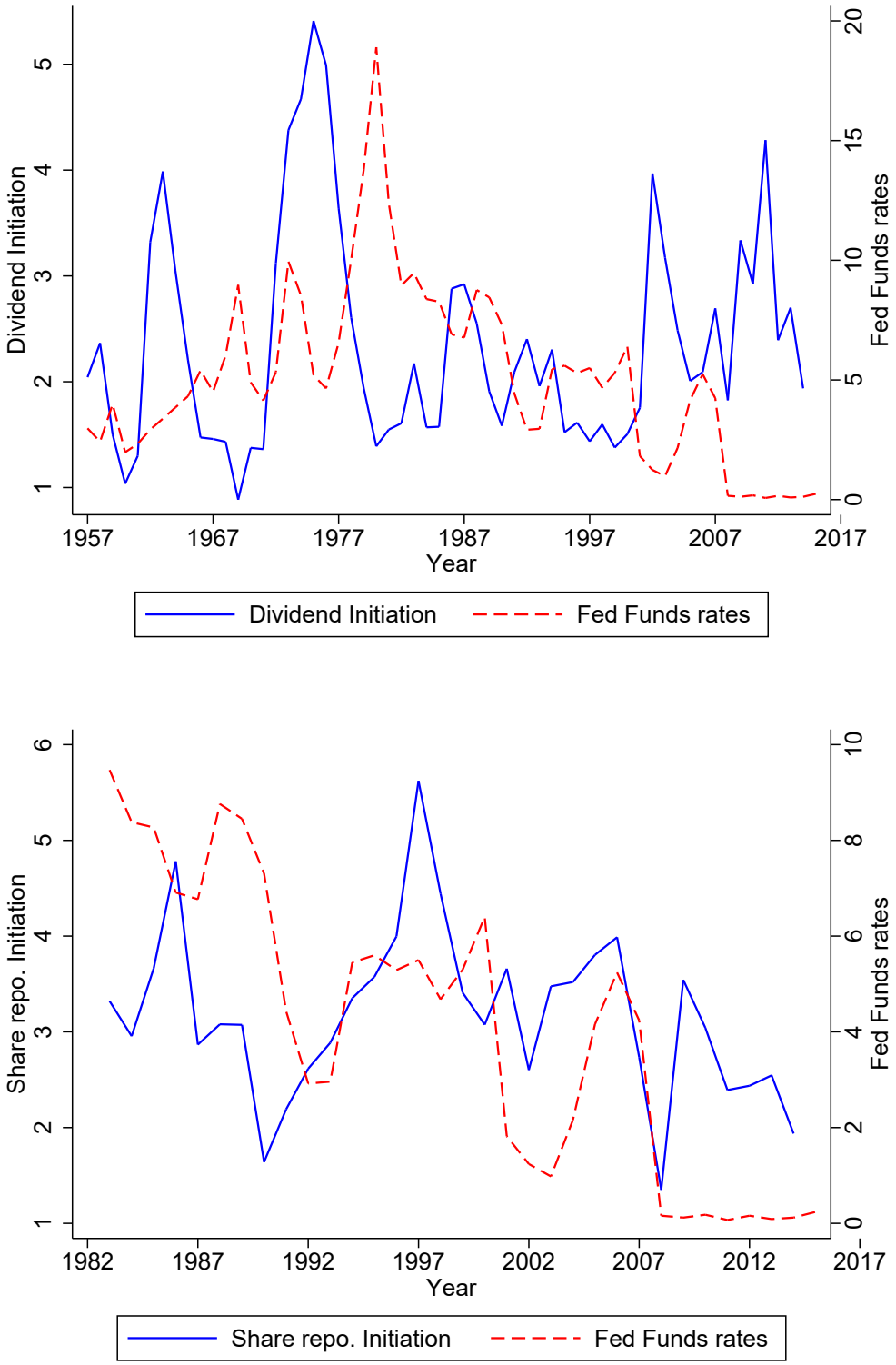


Figure 13: Dividend Initiation and Fed Funds rates

The figure reports the time series plot of the Fed Funds rates and the frequency of dividend and repurchases initiation in next year scaled by total number of firms in the Compustat database. The sample includes all the Compustat firms from 1962 to 2016.