Monetary Policy and Reaching for Income^{*}

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Monetary Policy and Reaching for Income

Abstract

This paper studies the impact of monetary policy on investors' portfolio choice and asset prices. Using data on mutual fund flows and individual trading records, we find that lowinterest-rate monetary policy increases investors' demand for high-dividend stocks and drives up their asset prices. The increase in demand is more pronounced among investors who live off dividend income for consumption. To explain these empirical findings, we develop a portfolio choice model in which investors have quasi-hyperbolic time preferences and use dividend income as a commitment device to curb their tendency to over-consume in the short-run. 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 towards high-dividend stocks. Our finding suggests that low-interest-rate monetary policy may lead to underdiversification of investors' portfolios and may cause redistributive effects across firms that differ in their dividend policy.

JEL Classification Codes: E50, G40, G11 Keywords: reaching for income, monetary policy

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1 Introduction

For decades, central banking has been dominated by the "Jackson Hole consensus" which holds that monetary policy makers should focus on their dual mandate of stabilizing prices and maximizing employment, while financial sector quantities such as asset prices and fund flows should not be their primary concern unless they affect inflation or unemployment (Bernanke and Gertler 2001; Evanoff, Kaufman, and Malliaris 2012; Smets 2014). However, the events surrounding the 2007–2009 financial crisis have shown that monetary policy, through its influence on risk-free rates, may have profound ramifications to the inner workings of the financial sector. Prompted by these events, the academic literature has devoted increasing attention to the link between monetary policy and financial markets.

In this paper, we add to this literature by studying how monetary policy affects investors' portfolio choice and asset prices. In particular, we take special aim at the effect of monetary policy on investors' desire to hold dividend-paying stocks in their portfolios. This investigation is motivated by the observation that investors, and especially retirees, have the tendency to live off current income streams—dividends and interest—from their portfolio, while leaving the principal untapped.¹ If investors have such a preference for current income, we hypothesize that accommodative monetary policy may induce a higher demand of high-dividend stocks to compensate for the low interest income from bonds. We refer this conjecture as the "reaching-for-income" hypothesis.²

Using data on mutual fund flows and individual trading records, we document evidence supporting the reaching-for-income hypothesis. Specifically, using mutual fund flow data from 1991 to 2016, we find that a 1% decrease in the Fed Funds rates leads to a 4.79% increase in the assets under management of high-dividend mutual funds over a period of three years. Similarly, using trading records 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

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

²In a recent *Fidelity Viewpoints*' article "A New Era For Dividend Stocks," Morrow, Rahman, and Vemparala (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 Dec. 28, 2017).

the next six months. The demand increase for high-dividend-paying assets is much more pronounced for retail investors, and in particular retirees, who tend to live off dividend income for consumption.

The 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-paying stocks exhibit positive risk-adjusted returns following periods of accommodating monetary policy, and negative or negligible abnormal returns following a period of monetary policy tightening. We examine the performance of a dynamic long-short strategy that buys high-dividend stocks and shorts low-dividend stocks following periods of accommodating monetary policy (i.e., following negative Fed Fund rate shocks) and reverses the positions following periods of tight monetary policy. Over the 1987–2015 period, this strategy generates an annualized Sharpe ratio of about 0.18, a value 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. In frictionless markets, Miller and Modigliani (1961) further show that, given a firm's investment policy, dividend policies are irrelevant for equity value. Given this benchmark, what can make dividends relevant for investors' portfolio decisions? And, more importantly, why does the demand for dividends seem to vary over different monetary policy regimes?

To answer these questions, we develop a portfolio choice model for an investor with quasi-hyperbolic time preferences. Under these preferences, the investor consistently *plans* to save in the future, but, as the future arrives, he reneges and consistently consumes more than planned. In the presence of this time-inconsistency, commitment is valuable. The "present self" would like to constrain the "future self" not to deviate from a planned action. An effective way to implement such a commitment is to use current income to constrain consumption, as suggested by the popular retail investment advice of "not dipping into the capital." We show that in the presence of such a *self-control* constraint, the optimal portfolio exhibits patterns that are consistent with the empirical findings documented above. Intuitively, monetary policy affects the demand for dividend-paying assets by altering the income stream from bonds. When accommodative monetary policy lowers the income from bonds to level insufficient to sustain a desired level of consumption,

 $^{^{3}}$ 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.

the investor "reaches for income" by substituting away from bonds and low-dividendpaying assets into high-dividend-paying assets. This demand pressure is consistent with our empirical findings documenting that high-dividend stocks experience positive realized abnormal returns in periods of declining interest rates.

This paper contributes to four strands of literature. The first strand studies the "reaching-for-yield" hypothesis, according to which a low-interest-rate policy increases the demand for risky assets in a bid to boost total returns (Rajan 2006; Hanson, Shleifer, Stein, and Vishny 2015; Greenwood and Hanson 2013; Gertler and Karadi 2015; Bekaert, Hoerova, and Duca 2013). 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 accommodating 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 studies 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 tried to explain why dividends matter can be organized in two broad groups. The first group relaxes the assumption of a perfect capital market 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, using dividends as a constraint for future consumption is optimal in that it can improve the investor's 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, in particular, by showing that that such demand is linked to the consumption and saving decision of retail investors, we provide evidence consistent with the hypothesis that the preference for dividends is linked to 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) finds that there is strong variation over time in the demand for dividends, based on four proxies. They do not take a strong stand on the source of this variation. They proceed to show that firms "cater" to this variation in the demand for dividends by changing the level of dividends that they pay. Consistent with the hypothesis, Jiang and Sun (2015) show that high-dividend yield firms have a higher duration, in the sense that their prices move up more strongly in response to interest rate declines than the prices of low-dividend yield firms. This interesting result is inconsistent with the hypothesis that high-dividend yield firms should have lower duration because they have lower anticipated dividend growth. Hartzmark and Solomon (2017) demonstrates that investors appear to make buy/sell decisions based on price changes as opposed to cumdividend 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 timeinconsistent 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 capital from 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 self-control problem in the behavioral life-cycle literature (McCarthy 2011; Carlson, Kim, Lusardi, and Camerer 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-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 risk-free rates 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 4, we interpret the empirical findings through the lens of a portfolio choice model with a time-inconsistent agent who uses income as a commitment device. We show that monetary policy influences the demand for dividends through the self-control motive. In Section 5, we discuss the implications of reaching for income for portfolio under-diversification, capital reallocation, and risk-taking. Section 6 concludes. Appendix A contains proofs.

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 based on mutual fund flows data and Section 2.3 provides evidence from individual portfolio holding data.

2.1 Data

We use two main datasets. The first dataset consists of monthly data on U.S. mutual funds from the Center for Research in Security Prices (CRSP). Our sample includes all the 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 1. Net flows is defined as the net growth in fund assets adjusted for price changes. Formally, it is calculated as:

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

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.

Mutual fund dividend yield is a measure of the income return of a mutual fund. It is calculated by dividing the annual dividend income distribution payment by the value of a mutual funds shares. We exclude distributions related to capital gains and share splits. The average dividend yield of sample funds is 1.3%. The 90 percentile dividend yield is 2.8%. The summary statistics regarding total monthly returns, annual return volatility, fund size, expense ratio, and turnover ratio are also presented.

The second 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 it holds 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 2 reports summary statistics for the investor portfolio dataset. The average dividend yield of sample stocks is 2.1%. The 90 percentile dividend yield is 5.3%.

statistics regarding demographic information of account holders such as retiree dummy, home ownership, marital status, bank card ownership, vehicle ownership, and gender are also presented.

We merge prices and stock dividend payments from the CRSP database to the portfolio holdings dataset by CUSIP. We label each stock as "high dividend yield" if it is in the top decile of the dividend yield distribution in a given month. We define the time t "holding change 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*:

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

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

We measure the stance of monetary policy using the Fed Funds rates from FRED Economic Data of the Federal Reserve Bank at St. Louis. An important channel through which monetary policy affect investors income is through the level of interest on bank deposits. To construct measures of local deposit rates paid by banks we use data from the Federal Reserve Bank of Chicago *Call Report* and from the FDIC *Summary of Deposits*. 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. 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.

2.2 Evidence from mutual fund flows data

According to Berk and Van Binsbergen (2016), mutual fund flows are useful to infer investors' preferences: an increase appetite for a particular asset characteristic should be reflected in an increase in flow to the mutual funds holding assets with similar characteristics. Following this logic, we study how monetary policy affects the flows to mutual funds that differ in their income yield. Specifically, we are interested in understanding whether low-interest-rate monetary policy increases the inflows to funds with high dividends. To address this question, we regress the monthly fund flows into fund *i*, $Flows_{i,t}$, on: (i) the three-year changes in the Fed Funds rates, ΔFFR_t ; (ii) a high-dividend dummy, $HighDiv_{i,t}$, that takes the value of one if fund *i* has an income yield in the top decile for a given month; (iii) an interaction term, $\Delta FFR_t \times HighDiv_{i,t}$; and (iv) a set of control variables $X_{i,t}$ —fund returns, volatility, asset under management, expenses, and turnover—that may be important drivers of fund flows. Specifically, we estimate the following regression:

$$Flows_{i,t} = \beta_1 \Delta FFR_t + \beta_2 High \ Div_{i,t} + \beta_3 \Delta FFR_t \times High \ Div_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t}.$$
 (3)

Table 3 reports regression results. The coefficient β_2 of the high-dividend dummy is positive and significant, indicating that high-dividend funds on average attract more flows. Specifically, if a fund has an income yield in the top decile among all the funds in a given month, it receives 0.228% more flows in the same month. This finding is consistent with investors exhibiting a preference for current income.

Interestingly, the coefficient β_3 of the interaction term in regression (3) is negative and significant, which means that high-dividend 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 4.78% (0.133% per month × 36 months) cumulative increase in asset under management for high-dividend funds over a period of three years.

Columns 2 and 3 in Table 3 split the sample into retail and institutional investors, respectively. The results show that the coefficients β_2 and β_3 are statistically significant only for the subset of retail investors, indicating that only retail investors have a tendency to reach for income when the Fed Funds rates decline. This effect is not present among institutional investors.

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

In the above analysis, we use as explanatory variable the three-year change in the Fed Fund rates, ΔFFR_t . This is because investors' response to a change in monetary policy is likely to be persistent. Two reasons may lead to such persistence. First, investors are likely to adjust their portfolios only periodically, thus generating a delayed response to changes in monetary policy. Second, investors may hold long-term bonds that were issued before the monetary policy change. Income yields change slowly as long-term bonds gradually mature and are replaced by newly issued bonds. To examine the persistence of investors' response to monetary policy changes, we regress fund flows on the current and lagged annual changes in the Fed Funds rates for up to ten years. Formally, we estimate the following regression for funds in each income-yield decile, d = 1, ..., 10:

$$Flows_{i,d,t} = \beta_{d,1} \Delta FFR_{t,t-1} + \beta_{d,2} \Delta FFR_{t-1,t-2} + \ldots + \beta_{d,10} \Delta FFR_{t-9,t-10} + \gamma' X_{i,d,t} + \varepsilon_{i,d,t}.$$
(4)

Figure 1 plots the regression coefficients $-\beta_{1,t}$ (Panel A) and $-\beta_{10,t}$ (Panel B), t = 1, ..., 10, corresponding to the lowest and highest income yield decile, respectively. The coefficients can be interpreted as the impulse response to a negative 1% shock to the Fed Funds rates. We find that inflows to the highest dividend decile mutual funds do exhibit a persistent response to changes of the Fed Funds rate up to three years. In comparison, there are no such effects in the lowest-decile mutual funds.

The results in this section 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 with perfect capital markets and 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 argue 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 are the source of the demand for dividends, then one should expect institutional investors to exhibit similar, if not stronger, preference for dividend. We do not find evidence of this in our data. As shown in columns 2 and 3 of Table 3, 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 supports to the second group of theories that explain the dividend puzzle as a departure from investor rationality.

Furthermore, our finding that monetary policy affects investors' demand for dividends helps to differentiate among the different behavioral theories proposed as explanation of the dividend puzzle. In particular, the fact that investor reach for income when monetary policy is accommodative seem to corroborate the prediction of theories that rely on selfcontrol. 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 is that a low-interestrate monetary policy increases would increase the demand for dividends by lowering the income from bonds. In Section 4 we build a simple portfolio choice 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 increase demand for dividend at times in which interest rates are low.

2.3 Evidence from individual portfolio holding data

In order to sharpen our understanding of the mechanism through which monetary policy affects investors demand for dividend-paying stocks it would be useful to observe investors' demographic information. This will allow us to test whether, consistent with conventional wisdom and popular investment advice, retirees have a stronger demand for dividendpaying assets. Unfortunately, the mutual fund flow data used in the previous section does not have investors' demographic information. To overcome this hurdle, we rely on a second dataset of individual trading records which contains transaction-level information together with detailed information about retail investors' demographic characteristics and geographic location. This dataset was used originally by Barber and Odean (2000) and, subsequently, in several other studies.

We regress the holding change $\Delta Holding_{i,i,t}$ of a stock *i* in account *j* over a 6-month period as defined in (2), on (i) the three-year changes in the Fed Funds rates, ΔFFR_t ; (ii) a high-dividend dummy $HighDiv_{i,j,t}$ which 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 dummy variables $X_{j,t}$ that control for home ownership, marital status, and gender of the holder of account *j*. Formally, we estimate the following regression:

$$\Delta \text{Holding}_{i,j,t} = \beta_1 \Delta \text{FFR}_t + \beta_2 \text{High Div}_{i,j,t} + \beta_3 \Delta \text{FFR}_t \times \text{High Div}_{i,j,t} + \gamma' X_{j,t} + \varepsilon_{i,j,t}.$$
(5)

Column 1 of Table 4 presents the result for the entire sample. As for the case of mutual fund data analyzed in Section 2.2, we find that individual investors increase their position in stocks with a dividend yield in the top decile for a given month suggesting that retail

investors have a demand for dividend. More important, this demand for dividends appears to change over monetary cycles: a 1% decrease in the Fed Funds rates is associated with a 0.956% 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 (5). The results show that the impact of monetary policy on dividend-stock holdings in the retiree subsample is almost twice as large as that of the non-retiree sample: the interaction coefficient β_3 is -1.3 in the retiree sample and -0.793in the non-retiree sample with both coefficients are statistically significant at the 1% level. This is consistent with the idea that retirees are more likely to follow the 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.

To address the concern that our findings might be driven by some unobservable macroeconomic conditions that correlate with monetary policy, we exploit the cross-region variations in bank deposit rates, which represent an important transmission channel of monetary policy. Drechsler, Savov, and Schnabl (2017) show that when the Fed Funds rates increase, banks in less competitive markets do not raise the interest on their deposits as much as banks in more competitive market. Therefore, monetary policy has different amount of transmission to deposit rates in different regions depending on the market power of local banks. Given that deposits are an important source of current income for investors, we can sharpen our empirical identification by exploiting the cross-region variations in bank deposit rates.

To this purpose, we construct a measure of local deposits rates using banks that have branches in each Metropolitan Statistical Area (MSA). We then regress the changes in stock holdings, Δ Holding_{*i*,*j*,*t*}, on (i) the three-year changes in local deposit rates, $\Delta DepRates_{i,t}$; (ii) a high-dividend dummy $HighDiv_{i,j,t}$ which takes the value of one if a stock is in the top income yield decile for a given month; (iii) an interaction term $\Delta DepRates_{i,t} \times$ $HighDiv_{i,j,t}$; and (iv) a set of dummy variables $X_{j,t}$ that control for home ownership, marital status and gender of the holder of account *j*; (v) time fixed effects and MSA fixed effects.

$$\Delta \text{Holding}_{i,j,t} = \beta_1 \Delta \text{DepRates}_{i,t} + \beta_2 \text{High Div}_{i,j,t} + \beta_3 \Delta \text{DepRates}_{i,t} \times \text{High Div}_{i,j,t} + \gamma' X_{j,t} + \varepsilon_{i,j,t}$$
(6)

Time fixed effects here absorb any unobservable macro-economic factors that may drive the demand for dividends. β_3 is identified off the cross-regional variation in local deposit rates. Table 5 reports the results. Column 1 refers to the full sample while columns 2 and 3 refer to the retiree and non-retirees subsample, respectively. The interaction term coefficient β_3 is negative and significant, indicating that demand for dividend is negatively related to local deposit rates. The β_3 estimate for retirees is -3.375 while it is -2.496 for non-retirees, implying that retirees exhibit a tendency to reach for income that is about 50% stronger than non-retirees.

2.4 "Living off dividends" and reaching for income

The tendency to reach for income could be related to investors' lifetime consumption and saving decisions. Prior literature provides ample evidence that investors treat dividend income and capital differently in their consumption and savings decisions. For example, Baker, Nagel, and Wurgler (2007) and Kaustia and Rantapuska (2012) using, respectively, U.S. and Finnish data, find that investors usually spend almost all of their portfolio dividends but rarely dip into their capital. If investors do indeed follow the consumption rule of "living off income", then low interest rate monetary policy may increase their demand for dividends at times when income from deposits and bonds falls.

To evaluate the link between reaching for income and the consumption-saving decision, we follow Baker, Nagel, and Wurgler (2007) and construct a measure of net withdrawal from brokerage accounts. The net withdrawal from brokerage accounts can be interpreted as a proxy of consumption as suggested by Baker, Nagel, and Wurgler (2007). Specifically, for each account j and month t, we calculate net withdrawal $W_{j,t}$ as the change in account balance, $A_{j,t}$, adjusted for capital gain, $G_{j,t}$, and dividends, $D_{j,t}$:

$$W_{j,t} = A_{j,t-1} + G_{j,t} + D_{j,t} - A_{j,t}$$
(7)

Figure 2 shows a scatter plot of monthly net withdrawal against contemporaneous dividend income (Panel A) and capital gain (Panel B) for each household in each month of our dataset. Panel A shows that the dividend income data cluster around two clear sets. The first set of points lines up along the 45-degree line. These points represent investors who withdraw almost one-for-one their portfolio dividend income, likely for consumption reasons. We label these investors as "Dividend Withdrawers." The second set of points

lines up along the horizontal line corresponding to zero withdrawals. These points represent investors who never withdraw dividends, but instead reinvest them in their portfolios. We label these investors as "Dividend Non-Withdrawers." Interestingly, Panel B does not show any pattern in the scatter plot of net withdrawal against contemporaneous capital gains. This is first documented by Baker, Nagel, and Wurgler (2007) which shows that individual investors treat dividend income and capital gain differently for consumption decisions.

Based on the patterns documented in Figure 2, we define a "dividend withdrawal month" as a month when the withdrawal amount in the month is between 90% and 110% of an investor's contemporaneous dividend income.⁴ We classify an individual as a "Withdrawer" if its frequency of "dividend withdrawal month" is above the median among all investors, and "Dividend Non-Withdrawers" otherwise.

Which types of investors are more likely to be "Withdrawers"? We estimate the following logistic regression of the "Withdrawers" indicator on a set of demographic variables:⁵

Withdrawer^{*}_i =
$$\beta_1 \operatorname{Retiree}_i + \beta_2 \operatorname{Income}_i + \beta_3 \operatorname{Home} \operatorname{Owner}_i + \beta_4 \operatorname{Married}_i + \beta_5 \operatorname{Bank} \operatorname{Card}_i + \beta_6 \operatorname{Vehicles}_i + \varepsilon_i$$
(8)

Table 6 reports the demographic characteristics of withdrawers.

The table shows that retirees are more likely to be dividend withdrawers and that investors with higher labor income are less likely to be 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, Nagel, and Wurgler (2007), individuals view different sources of income as close substitutes and treat dividend income and capital differently.

Are withdrawers more likely to reach for income when interest rates fall? To answer this question, we estimate the same regression model of equation (5) separately for the withdrawers and non-withdrawers. Columns 4 and 5 in Table 4 report the result. Note that the coefficient β_3 of the interaction term between the Fed Funds rates change and the high

 $^{^4 \}rm We$ leave a margin of error of 10% since with drawal and dividends may be measured with error. In the data, 19% of the household-month observations are "dividend with drawal events".

⁵Withdrawer^{*}_i is the latent variable such that when it is positive, the indicator variable Withdrawer^{*}_i takes the value of 1, and 0 otherwise.

dividend dummy is indeed much larger for withdrawers (-0.977) than for non-withdrawers (-0.690) indicating that withdrawers are more likely to reach for income when the Fed Funds rates fall. Columns 4 and 5 in Table 5 perform the same estimation using local deposit rates instead of the Fed Funds rates, as in equation (6). The results in this case are even more striking: the magnitude of reaching for income for withdrawers is more than four times greater for withdrawers than for non-withdrawers.

In summary, the empirical findings in this section, obtained from both mutual fund flow data and individual portfolio holding data provide supporting evidence for the reachingfor-income hypothesis: low-interest-rate monetary policy increases the demand for highdividend stocks. The tendency to reach for income is predominant among retail investors, and in particular retirees and seems to be related to the heuristic consumption rule of "living off dividends."

3 Asset pricing implications

The above documented tendency of investor to reach for income may imply a role for monetary policy in the determination of equilibrium asset's return. To investigate this issue, in this section we study whether accommodative monetary policy affects the prices of high-dividend stocks.

As a preliminary analysis of the asset pricing implication of monetary policy, we divide the sample period from 1963 to 2016 into rising and declining interest rate environment based on the three year change in the Fed Fund rates, ΔFFR_t . For each sub-sample we compute excess returns (alphas) from Fama and French (2016) five-factor model. It is well known (see Fama and French 1993) that dividend decile portfolios do not exhibit risk-adjusted average excess returns. However, Table 7 shows that *conditional* on the monetary policy stance, dividend sorted portfolios do exhibit significant risk-adjusted excess returns. Specifically, high-dividend portfolios have negative and significant alphas during times of increasing Fed Funds rates, and positive and significant alphas during times of decreasing Fed Funds rates. The opposite is true for the low-dividend portfolios. Figure 3 graphically illustrates the patterns of alphas across dividend portfolios. Alphas increase across dividend deciles when rates decline and decrease when rates rise. 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. We then estimate the following regression model:

$$\alpha_{i,t} = \beta_1 \Delta FFR_t + \beta_2 \Delta FFR_t \times \text{DivDecile}_i + \zeta_i + \varepsilon_{i,t}, \tag{9}$$

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 represent the decile fixed-effects. Table 8 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 4 shows the cumulative returns for this strategy from 1956 to 2015. This strategy performs very well over the 1987–2015 period, earning a monthly Fama-French 5-factor alphas of 30 basis points, and generating an annual Sharpe ratio of about 0.18, a value comparable to that of a strategy that exploit 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 due to the fact that bond yields were much higher than stock dividend yields, thus muting the investors' incentive to reach for income.

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 excess returns $\alpha_{i,t}$ of each decile portfolio *i* on the lagged annual changes in the Fed Funds rates over the past ten years, as in the following model:

$$\alpha_{i,t} = \beta_{i,1} \Delta FFR_{t,t-1} + \beta_{i,2} \Delta FFR_{t-2,t-2} + \dots + \beta_{i,10} \Delta FFR_{t-9,t-10} + \varepsilon_{i,t}.$$
 (10)

Figure 5 reports the results 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 stock-buying pressure from individual investors. Comparing the impulse response of excess returns in Figure 5 with the impulse response of mutual fund flows in Figure 1, we find that excess returns disappear earlier than the fund flows. This finding means that some investors keep buying into high-

dividend mutual funds despite that there are no excess returns going forward. When monetary policy changes stance, these investors may stand to lose.

In summary, our analysis in the previous 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 question regarding both the functioning of markets and agent rationality. Why do investors have a demand for dividends? Why does monetary policy affect such a demand? In the next section we propose a portfolio choice model with self-control that has the potential to address these questions.

4 A portfolio choice model with self-control

We consider the portfolio choice problem of an agent with a self-control constraint. Such a constraint emerges naturally as a commitment device for agents whose preferences are time-inconsistent such as in the case of hyperbolic discounting (Laibson 1997). In this case, an agent consistently plans to be patient and save in the future, but, as the future arrives, he consistently consumes more than planned. A prevalent commitment device in this situation is to use current income to constrain consumption, as suggested by the popular advice "do not dip into the principal."⁶ The empirical analysis of Section 2 suggests that investors' portfolio decisions are consistent with the practice of withdrawing dividends while keeping capital intact. We introduce this consumption rule in our model and study and study its implication for the effect of monetary policy on portfolio choice.

4.1 General setup

Let us consider an asset market with N risky assets and one risk-free asset. Let θ_t^{\top} be a $N \times 1$ vector of portfolio weights invested in each of the risky assets. Agents are endowed

⁶As an example, consider the following quote appeared in the popular financial advice site *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 [...] Never forget this rule: Don't sacrifice what you want (in the long term) for what you want right now. (Kennon 2016)"

with wealth W_t at time t and make consumption decision C_t . Let $\tilde{R}_p(\theta)$ be the realized return from portfolio θ .

The household solves the following lifetime consumption and portfolio problem

$$\max_{\{C_{\tau},\theta_{\tau}\}_{\tau=t}^{\infty}} u(C_t) + \mathbb{E}_t \sum_{\tau=t}^{\infty} \beta \delta^{\tau+1-t} u(c_{\tau+1})$$
(11)

subject to the dynamic budget constraint

$$W_{t+1} = (W_t - C_t)\tilde{R}_{p,t+1}(\theta), \quad \theta^{\top} \mathbf{1} = 1$$
 (12)

and the "self control" constraint

$$0 \le C_t \le I_t(\theta_{t-1}),\tag{13}$$

where $I_t(\theta_{t-1})$ is the income generated by the portfolio, i.e. the sum of dividends and interests from bonds. Note that in (11) the agent's preferences are characterized by quasihyperbolic discounting. Specifically, the discount factor for the immediate future is lower, by a factor $\beta < 1$, than the discount factor, δ , for subsequent periods. This leads to time-inconsistency in the agent's preferences. Specifically, 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 $\beta \delta < \delta$. This in turn implies that the agent plans to save a lot in the future but, as the future arrives, the household systematically reneges on its promise and consumes more than it would have done if it were able to commit to the original plan. Agents with such preference are described as "present biased", where β measures the extent of present bias.⁷

In the presence of time-inconsistent preferences, commitment is valuable to the household. One way to prevent over-consumption in the immediate term is for the household to commit to a "self-control" constraint. The constraint (13) imposes that current consumption C_t cannot exceed the income $I(\theta_{t-1})$ generated by the portfolio inherited from time t-1.

To illustrate the solution of the optimal portfolio in (11)-(13), we consider first a two-period example.

⁷When β becomes smaller, the time-inconsistency problem becomes more severe. When $\beta = 1$, we go back to the time consistent case.

4.2 A two-period example

Let us consider the special case of a two-period, three-date portfolio choice problem with t = 0, 1, 2. The investor has CRRA preferences with risk aversion parameter $\gamma > 1$.

We assume that the return on an investor portfolio is log-normal. Specifically, we denote by r_f the log risk-free return, by μ the vector of expected log return on the risky asset and by Σ the covariance matrix of log excess returns. After log-linearization (see, Campbell and Viceira (2001)), we can write the log portfolio return $\tilde{r}_{p,t+1}(\theta_t) = \ln(\tilde{R}_{p,t+1}(\theta_t)), t = 0, 1$ as a normal random variable $\tilde{r}_{p,t+1}(\theta_t) \sim \mathcal{N}(\mu_p(\theta_t), \sigma_p^2(\theta_t))$ with mean $\mu_p(\theta_t)$ and variance $\sigma_p^2(\theta_t)$ given by⁸

$$\mu_p(\theta_t) = r_f + \theta_t^\top (\mu - r_f) + \frac{1}{2} \theta_t^\top \operatorname{Tr}(\Sigma) - \frac{1}{2} \theta_t^\top \Sigma \theta_t$$
(14)

$$\sigma_p^2(\theta) = \theta_t^\top \Sigma \theta_t. \tag{15}$$

We solve the problem (11) backwards starting at time t = 1. The agent has one period left and because of quasi-hyperbolic discounting in (11), his short-term discount rate is $\beta\delta$. The state variables are represented by the agent wealth W_1 and the income $I_1(\theta_0)$ generated by the assets in the portfolio chosen at time t = 0. We denote by $J_1(W_1, I_1)$ the agent value function

$$J_1(W_1, I_1) = \max_{\{0 \le C_1 \le I_1, \theta_1\}} \left\{ \frac{C_1^{1-\gamma}}{1-\gamma} + \beta \delta \mathbb{E}_1 \left[\frac{W_2^{1-\gamma}}{1-\gamma} \right] \right\},\tag{16}$$

where

$$W_2 = (W_1 - C_1)e^{\tilde{r}_{p,2}(\theta_1)}, \quad \tilde{r}_{p,1}(\theta_1) \sim \mathcal{N}(\mu_p(\theta_1), \sigma_p^2(\theta_1)).$$
(17)

The following proposition characterizes the solution at time t = 1.

Proposition 1. Let $i_1 \equiv I_1/W_1$ denote the income to wealth ratio at time 1. Then the optimal portfolio, θ_1^* , and consumption, $C_1^*(i_1)$ that solve the problem problem (16)–(17)

$$\tilde{r}_{p,t+1}(\theta_t) = \ln(\tilde{R}_{p,t+1}(\theta_t)) = r_f + \ln\left(1 + \theta^\top \left(e^{\tilde{r} - r_f} - \mathbf{1}\right)\right)$$

⁸Let $\tilde{R}_{t+1} = e^{\tilde{r}_{t+1}}$ denote the $N \times 1$ vector of individual asset returns and $R_f = e^{r_f}$ the risk-free rate. The portfolio return $\tilde{R}_{p,t+1}(\theta_t)$ is given by $\tilde{R}_{p,t+1}(\theta_t) = \theta_t^{\top} \tilde{R}_{t+1} + (1 - \theta_t^{\top} \mathbf{1})R_f$, where **1** denotes a $N \times 1$ vector of ones. The log portfolio return can then be written as

After applying a second-order Taylor approximation around r_f , we obtain the expressions (14)–(15) for the portfolio mean and variance.

are given by

$$\theta_1^* = \arg \max B_1(\theta_1) \tag{18}$$

$$C_1^*(i_1) = \xi_1^*(i_1) W_1 \tag{19}$$

where $B_1(\theta_1)$ is such that

$$\frac{B_1(\theta_1)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_1\left[\frac{e^{(1-\gamma)\tilde{r}_{p,2}(\theta_1)}}{1-\gamma}\right].$$
(20)

and $\xi_1^*(i_1)$ is given by

$$\xi_1^*(i_1) = \min\left\{i_1, \frac{x_1}{1+x_1}\right\}, \text{ where } x_1 \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_1(\theta_1^*)^{\frac{\gamma-1}{\gamma}} > 0.$$
(21)

The value function $J_1(W_1, i_1)$ is given by

$$J_1(W_1, i_1) = W_1^{1-\gamma} \frac{\kappa_J(i_1)^{1-\gamma}}{1-\gamma},$$
(22)

where $\kappa_J(i_1)$ represents the certainty equivalent wealth given by

$$\kappa_J(i_1) = \left((\xi_1^*)^{1-\gamma} + \beta \delta (1-\xi_1^*)^{1-\gamma} B_1(\theta_1^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}.$$
(23)

Now we solve the time-0 optimal solution. The value function at time-0 is

$$J_0(W_0, I_0) = \max_{\{0 \le C_0 \le I_0, \theta_0\}} \left\{ \frac{C_0^{1-\gamma}}{1-\gamma} + \beta \delta \mathbb{E}_0 \left[\frac{C_1^{1-\gamma}}{1-\gamma} + \delta \frac{W_2^{1-\gamma}}{1-\gamma} \right] \right\}.$$
 (24)

Note that, at time t = 0, the agent's discount factor at time 1 is equal to δ . However, when time 1 arrives, the agent becomes impatient and the discount factor becomes $\beta\delta$ as shown in (16). Therefore, the actual consumption wealth ratio chosen by the agent at time 1, ξ_1^* , will be higher than what the agent would prefer at time 0. This is precisely the notion of time-inconsistency: the agent plans to save in the future, but as the future arrives, the agent consumes more than planned. Anticipating himself becoming more impatient at time 1, the time-0 self tries to influence the time-1 self through the portfolio choice at time-0 which pins down the income stream and limits the choice set of the agent at time-1 through the self-control constraint (13). The value function faced by the agent at time-0 is given by $V_1(W_1, i_1)$,

$$V_1(W_1, i_1) = W_1^{1-\gamma} \frac{\kappa_V(i_1)^{1-\gamma}}{1-\gamma},$$
(25)

where

$$\kappa_V(i_1) = \left((\xi_1^*)^{1-\gamma} + \delta (1-\xi_1^*)^{1-\gamma} B_1(\theta_1^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}$$
(26)

Comparing to (22)–(35), the agent at time-0 uses δ instead of $\beta\delta$ as the discount factor at time 1 (the discount factor at time 0 is $\beta\delta$).

At time t = 0 the agent solves the following problem

$$J_0(W_0, I_0) = \max_{\{0 \le C_0 \le I_0, \theta_0\}} \left\{ \frac{C_0^{1-\gamma}}{1-\gamma} + \beta \delta \mathbb{E}_0 \left[V_1(W_1, i_1(\theta_0)) \right] \right\}.$$
 (27)

where next-period wealth is given by

$$W_1 = (W_0 - C_0)e^{\tilde{r}_{p,1}(\theta_0)}, \quad \tilde{r}_{p,1}(\theta_0) \sim \mathcal{N}(\mu_p(\theta_0), \sigma_p^2(\theta_0)), \tag{28}$$

and the next period income-to-wealth ratio $i_1(\theta_0)$ depends on the dividend yield of the current portfolio, that is,

$$i_1(\theta_0) = \frac{I_1}{W_1} = \frac{(W_0 - C_0)(e^{y_p(\theta_0)} - 1)}{(W_0 - C_0)e^{r_{p,1}(\theta_0)}} = \frac{e^{y_p(\theta_0)} - 1}{e^{\tilde{r}_{p,1}(\theta_0)}},$$
(29)

where we denote by $y_p(\theta_0)$ the portfolio log dividend yield.

The following proposition characterizes the solution at time t = 0.

Proposition 2. Let $i_0 \equiv I_0/W_0$ denote the income to wealth ratio at time 0 and $\kappa_V(i_1)$ the time-1 value function defined in (26). Then the optimal portfolio, θ_0^* , and consumption, $C_0^*(i_0)$ that solve the problem (27)–(28) are given by

$$\theta_0^* = \arg \max B_0(\theta_0) \tag{30}$$

$$C_0^* = \xi_0^*(i_0) W_0 \tag{31}$$

where $B_0(\theta_0)$ is such that

$$\frac{B_0(\theta_0)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_0\left[\frac{e^{(1-\gamma)\tilde{r}_{p,1}(\theta_0)}}{1-\gamma}\kappa_V(i_1(\theta_0))^{1-\gamma}\right],\tag{32}$$

and $\xi_0^*(i_0)$ is given by

$$\xi_0^*(i_0) = \min\left\{i_0, \frac{x_0}{1+x_0}\right\}, \text{ where } x_0 \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_0(\theta_0^*)^{\frac{\gamma-1}{\gamma}} > 0.$$
(33)

The value function $J_0(W_0, i_0)$ is given by

$$J_0(W_0, i_0) = W_0^{1-\gamma} \frac{\kappa_J(i_0)^{1-\gamma}}{1-\gamma},$$
(34)

where $\kappa_J(i_0)$ represents the certainty equivalent wealth given by

$$\kappa_J(i_0) = \left((\xi_0^*)^{1-\gamma} + \beta \delta (1-\xi_0^*)^{1-\gamma} B_0(\theta_0^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}.$$
(35)

Figure 6 illustrates the effect of the self-control constraint on the portfolio choice decision at time t = 0. We consider the case of two risky assets and a risk-free asset. The two risky assets, have identical excess returns and volatilities but differ in their dividend yields. Asset H has a higher dividend yield than asset L. We solve for the optimal consumption and portfolios at time 0 for different values of the risk-free rate. To explicitly illustrate how the presence of the self-control constraint induces a demand for high-dividend-paying assets when interest rates are low, we solve the consumption-portfolio problem for different values of the risk-free rate while keeping the Sharpe ratio of the two assets unchanged. The figure reports the holding in the high- and low-dividend-paying assets for different values of the risk-free rate. Notice that in the unconstrained case, the holdings of both assets are unaffected by the level of the risk-free rate, that is $\theta_{H,unc} = \theta_{L,unc}$. However, in the presence of a self-control constraint, the agent exhibits a clear reaching-for-income behavior, holding a much larger fraction of the high-dividend-paying assets, $\theta_{H,con} > \theta_{L,con}$. Furthermore, the sensitivity of the holding of the high-dividend asset is larger than that of the low-dividend asset. As the risk-free rate decreases, the agent shifts his portfolio more aggressively toward the high-dividend-paying asset.

4.3 The infinite-horizon case

The two-period example discussed in the previous section suggests that the solution to the infinite-horizon problem of (11)-(13) can be characterized recursively as follows

$$J(W,i) = W^{1-\gamma} \max_{\{0 \le \xi \le i,\theta\}} \left\{ \frac{\xi^{1-\gamma}}{1-\gamma} + \beta \delta (1-\xi)^{1-\gamma} \frac{B(\theta)^{1-\gamma}}{1-\gamma} \right\}.$$
 (36)

where

$$\frac{B(\theta)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}\left[\frac{e^{(1-\gamma)\tilde{r}_p(\theta)}}{1-\gamma}\kappa_V(i'(\theta))^{1-\gamma}\right], \quad \tilde{r}_p(\theta) \sim \mathcal{N}(\mu_p(\theta), \sigma_p^2(\theta)), \quad (37)$$

the next-period income-to-wealth ratio $i'(\theta)$ is given by

$$i'(\theta) = \frac{e^{y_p(\theta)} - 1}{e^{\tilde{r}_p(\theta)}},\tag{38}$$

and the continuation value function $\kappa_V(i)$ is defined as

$$\kappa_V^{1-\gamma}(i) = (\xi^*)^{1-\gamma} + \delta(1-\xi^*)^{1-\gamma} B(\theta^*)^{1-\gamma}, \tag{39}$$

with ξ^* and θ^* the optimal consumption and portfolio policies in (36). Because the optimal consumption ξ^* depends on the function κ_V , the solution of (39) involves finding the unknown value function κ_V . This is obtained iteratively, starting first with a guess of κ_V , using it to solve problems (36)–(38) and then updating the guess of κ_V using (39).

Figure 7 reports the optimal portfolios that solve the infinite-horizon problem under different values of the risk-free rate. The figure is the infinite-horizon equivalent of the two-period problem reported in Figure 6. As in the case of two-period, the sensitivity of the high-dividend-paying asset to changes in the risk-free rate is higher than that of the low-dividend-paying asset.

4.4 Endogenous self control

In the above analysis, we have assumed an exogenous self-control constraint, equation (13). As a consequence of this constraint, the agent holds more high-dividend stocks when accommodative monetary policy lowers the interest income from bonds. However, it is unclear whether the agent will optimally choose to commit to such a constraint. In this subsection, we characterize the condition under which the agent endogenously chooses to commit to such constraint as it improves the agent's utility.

The agent faces the following trade-off. On the one hand, the self-control constraint can benefit the agent by alleviating the over-consumption problem. On the other hand, the self-control constraint limits the flexibility of the agent to adjust consumption to portfolio returns. When the agent wants to consume more because of high portfolio returns, portfolio income inefficiently caps consumption.

Figure 8 illustrates this trade-off. 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 benchmark case where an agent can fully commit on future consumption, i.e., the time-0 self can dictate the consumption plan for time-1 self for all realization of time-1 wealth. The blue line, C_1^{unc} , is the unconstrained consumption. The blue line is always above the black one, indicating that the agent consume more than what is the time-0 planned 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 dash-dotted line, I_1 , in the figure. Intuitively, the self-control constraint reduces the over-consumption in high-wealth states. The trade-off between the benefit and cost of the self-control constraint depends on the severity of over-consumption problem and the value of flexibility.

Figure 9 shows the time-0 certainty equivalent wealth, κ_J from equation (35). 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, $\kappa_J^{con0,unc1}$; (ii) constrained, $\kappa_J^{con0,con1}$; and (iii) full commitment, $\kappa_J^{con0,fc1}$. For each case we report the certainty equivalent wealth as the value of the parameter β varies. Low value of β corresponds to high level of distortion in consumption induced by time inconsistency, while $\beta = 1$ represents the time consistent case. The black line, $\kappa_J^{con0,fc1}(i_0)$, shows the benchmark case where the agent has full commitment power. This will be the highest certainty equivalent wealth that the agent can achieve. When time-inconsistency is severe (low β), the constrained certainty equivalent wealth, $\kappa_{J,0}^{con0,con1}$, is *higher* than the unconstrained one, $\kappa_{J,0}^{con0,unc1}$, 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 10 repeats the analysis of Figure 9 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 self-control constraint is higher than the

unconstrained case for low level of return volatility but lower than the unconstrained for high level of return volatility.

5 Discussion

The above analysis highlights a new channel through which monetary policy affects the financial sector. 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 underdiversification of investors portfolios. As our example of Section 4 shows (Figures 6 and 7), a fully diversified portfolio would have equal weights in both the high- and lowdividend 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 11. In the data, stocks that pay high dividends usually concentrate in certain sectors such as utilities and telecommunication. Reaching for income would lead to excessive exposure in these sectors. Furthermore, firms' high dividend yield might not necessarily be the result of excess cash being paid out but a consequence of financial distress that, by depressing prices, inflates dividend yields. Reaching for income may then expose investors' portfolios to the excess volatility originating from distress events.

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.

Risk-taking. When accommodative monetary policy lowers bond yields below those of the stock market, "reach-for-income" investors may substitute from bonds to stocks, which increases their overall portfolio risk. As Figures 6 and 7 illustrate, 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.

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, real estate investment trusts (REITs), and master limited partnerships (MLPs). Many of these instruments may attract income-oriented investors who ignore the contribution of these tools to overall portfolio risk.

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. Although we are not advocating that monetary policy should totally change its course because of these distortions, it is certainly important for policy makers to be aware of these effects and devise measures to contain the consequences.

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 4.79% inflow over three years to mutual funds with high income yields over a three-year period, and a 0.965% increase in holdings of high-dividend-paying stocks. 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.

By influencing the demand for 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 a portfolio choice model in which investors have time-inconsistent preferences to explain these empirical results. We show that when investors rely on income 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 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, the allocation of capital between firms that follow different dividend policies.

A Proofs

Proof of Proposition 1

Let $\xi_1 \equiv C_1/W_1$ and $i_1 \equiv I_1/W_1$. Then we can re-express problem (16)–(17) as follows

$$J_1(W_1, i_1) = W_1^{1-\gamma} \max_{\{0 \le \xi_1 \le i_1, \theta_1\}} \left\{ \frac{\xi_1^{1-\gamma}}{1-\gamma} + \beta \delta(1-\xi_1)^{1-\gamma} \frac{B_1(\theta_1)^{1-\gamma}}{1-\gamma} \right\}.$$
 (A1)

where we define the quantity $B_1(\theta_1)$ such that

$$\frac{B_1(\theta_1)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_1\left[\frac{e^{(1-\gamma)r_{p,2}(\theta_1)}}{1-\gamma}\right].$$
(A2)

Note that $B_1(\theta_1) > 0$ for all values of γ . In the optimization (A1) the optimal portfolio θ_1^* is independent on the consumption choice ξ_1 and is given by

$$\theta_1^* = \arg \max \mathbb{E}_1 \left[\frac{e^{(1-\gamma)r_{p,2}(\theta_1)}}{1-\gamma} \right].$$
(A3)

From (A2), the optimization in (A3) is equivalent to

$$\theta_1^* = \arg\max B_1(\theta_1). \tag{A4}$$

Taking the first-order condition with respect to ξ_1 in (A1) we obtain that the unconstrained consumption ξ_1^{unc} is given by

$$(\xi_1^{\text{unc}})^{-\gamma} = \beta \delta (1 - \xi_1^{\text{unc}})^{-\gamma} B_1^{1-\gamma},$$
 (A5)

or

$$\xi_{!}^{\text{unc}} = \frac{x_1}{1+x_1}, \text{ where } x_1 \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_1(\theta_1^*)^{\frac{\gamma-1}{\gamma}} > 0.$$
 (A6)

Imposing the self-control constraint $\xi_1 < i_1$ we obtain

$$\xi_1^* = \min\left\{i_1, \frac{x_1}{1+x_1}\right\}.$$
 (A7)

From (A1), the value function $J_1(W_1, i_1)$ is then

$$J_1(W_1, i_1) = W_1^{1-\gamma} \left(\frac{(\xi_1^*)^{1-\gamma}}{1-\gamma} + \beta \delta (1-\xi_1^*)^{1-\gamma} \frac{B_1(\theta_1^*)^{1-\gamma}}{1-\gamma} \right)$$
(A8)

We define the certainty equivalent wealth as the function $\kappa_J(i_i)$ such that

$$\frac{\kappa_J(i_1)^{1-\gamma}}{1-\gamma} \equiv \frac{(\xi_1^*)^{1-\gamma}}{1-\gamma} + \beta \delta (1-\xi_1^*)^{1-\gamma} \frac{B_1(\theta_1^*)^{1-\gamma}}{1-\gamma},\tag{A9}$$

which implies

$$\kappa_J(i_1) = \left((\xi_1^*)^{1-\gamma} + \beta \delta (1-\xi_1^*)^{1-\gamma} B_1(\theta_1^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}.$$
 (A10)

Proof of Proposition 2

Using the definition of $V_1(W_1, i_1)$ in (25)–(26) we obtain

$$J_0(W_0, i_0) = W_0^{1-\gamma} \max_{\{0 \le \xi_0 \le i_0, \theta_0\}} \left\{ \frac{\xi_0^{1-\gamma}}{1-\gamma} + \beta \delta (1-\xi_0)^{1-\gamma} \frac{B_0(\theta_0)^{1-\gamma}}{1-\gamma} \right\}.$$
 (A11)

where we define the certainty equivalent $B_0(\theta_0)$ such that

$$\frac{B_0(\theta_0)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_0\left[\frac{e^{(1-\gamma)r_{p,1}(\theta_0)}}{1-\gamma}\kappa_V(i_1(\theta_0))^{1-\gamma}\right],\tag{A12}$$

where $i_1(\theta_0)$ is given in (29).

In the optimization (A11) the optimal portfolio θ_0^* is independent on the consumption choice ξ_0 and is given by

$$\theta_0^* = \arg\max B_0(\theta_0). \tag{A13}$$

Taking the first-order condition with respect to ξ_0 in (A11) and following the same steps as in the proof of Proposition 1 we obtain that the unconstrained consumption ξ_0^{unc} is given by

$$\xi_0^* = \min\left\{i_0, \frac{x_0}{1+x_0}\right\} \quad \text{where} \quad x_0 \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_0(\theta_0^*)^{\frac{\gamma-1}{\gamma}} > 0. \tag{A14}$$

From (A11), the value function $J_0(W_0, i_0)$ is then

$$J_0(W_0, i_0) = W_0^{1-\gamma} \left(\frac{(\xi_0^*)^{1-\gamma}}{1-\gamma} + \beta \delta (1-\xi_0^*)^{1-\gamma} \frac{B_0(\theta_0^*)^{1-\gamma}}{1-\gamma} \right).$$
(A15)

from which we obtain the certainty equivalent wealth function

$$\kappa_J(i_0) = \left((\xi_0^*)^{1-\gamma} + \beta \delta (1-\xi_0^*)^{1-\gamma} B_0(\theta_0^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}.$$
 (A16)

Table 1: 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 US Mutual Fund database from January 1991 to December 2016, covering a total of 23,166 fund share classes. Each observation is a month-fund share class combination. *Flow* represents net inflows into a fund share class; *Dividend Yield* represents the annual dividend yield of the fund; *High Div* represents a dummy variable which takes the value of 1 if the fund is in the top decile of the dividend yields, and 0 otherwise; *Return* is monthly fund return; *Volatility* is standard deviation of fund return for the past year; *Size* represents the asset under management (log); *Expense* represents the expense ratio; and *Turnover* is the percentage of a mutual fund's holdings that have been replaced in the past year. *Flow*, *Return*, *Volatility*, and *Expense* is in percentage. *Size* is in million (log).

	mean	sd	min	p10	p25	p50	p75	p90	max
Flow	1.596	11.925	-32.787	-4.740	-1.701	-0.064	2.273	7.954	74.851
Dividend Yield	0.013	0.011	0.000	0.002	0.005	0.011	0.019	0.028	0.232
High Dividend	0.080	0.271	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Return	0.006	0.049	-0.678	-0.051	-0.018	0.009	0.034	0.060	5.326
Volatility	1.244	0.664	0.000	0.611	0.806	1.109	1.538	2.014	44.422
Size	3.731	2.685	-6.908	0.095	2.015	3.936	5.639	7.034	12.323
Expense	1.166	0.588	-0.510	0.400	0.780	1.130	1.500	1.990	9.210
Turnover	0.685	0.818	0.000	0.100	0.230	0.470	0.860	1.380	6.740

Table 2. Summary Statistics of the Stock-Holding Samp	Table 2: 3	ummary	Statistics	of the	Stock-Holding	Sample
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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. $\Delta Holding$ 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; *High Div* represents a dummy variable which takes the value of 1 if the stock is in the top decile of the dividend yields, and 0 otherwise; *Retiree* represents a dummy variable which takes the value of 1 if the age of an account holder is above 65, and 0 otherwise; *Income* represents a categorical variable which classify account holders into 10 income groups; *Home Owner* represents a dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise; *Married* represents a dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise; *Male* represents a dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise; *Bank Card* represents a dummy variable which takes the value of 1 if an account holder has at least one bank card, and 0 otherwise; *Vehicles* represents the value of 1 if an account holder has an account holder has at least one bank card, and 0 otherwise; *Vehicles* represents the value of 1 if an account holder has at least one bank card, and 0 otherwise; *Vehicles* represents the value of 1 if an account holder has at least one bank card, and 0 otherwise; *Vehicles* represents the value of vehicles that an account holder has at least one bank card, and 0 otherwise; *Vehicles* represents the number of vehicles that an account holder owns.

	maan	ad	min	n10	n95	n50	n75	p 00	222 0 14
	mean	su	111111	p10	p_{23}	p90	p15	pao	max
Δ Holding	2.852	23.115	-100.000	0.000	0.000	0.000	0.000	1.810	100.000
Dividend Yield	0.021	0.060	0.000	0.000	0.000	0.012	0.034	0.053	9.600
High Div	0.100	0.300	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Retiree	0.237	0.425	0.000	0.000	0.000	0.000	0.000	1.000	1.000
Income	4.068	3.313	0.000	0.000	0.000	5.000	7.000	8.000	9.000
Home Owner	0.593	0.491	0.000	0.000	0.000	1.000	1.000	1.000	1.000
Married	0.425	0.494	0.000	0.000	0.000	0.000	1.000	1.000	1.000
Male	0.580	0.494	0.000	0.000	0.000	1.000	1.000	1.000	1.000
Bank Card	0.753	0.431	0.000	0.000	1.000	1.000	1.000	1.000	1.000
Vehicles	0.495	0.835	0.000	0.000	0.000	0.000	1.000	2.000	7.000

Table 3: Equity Mutual Fund Flows, Dividend Yields, and Monetary Policy

This table reports the coefficient estimates from panel regression (3):

 $Flows_{i,t} = \beta_1 \Delta FFR_t + \beta_2 High Div_{i,t} + \beta_3 \Delta FFR_t \times High Div_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t},$

where $Flow_{i,t}$ represents flows into equity 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 Div_{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*, $\Delta FFR \times Volatility$, *Return*, *Size*, *Expense*, and *Turnover*. *Return* is monthly fund return; *Volatility* is the standard deviation of fund returns for the past year; *Size* represents the asset under management (log); *Expense* represents the expense ratio; and *Turnover* is the percentage of a mutual fund's holdings that have been replaced in the past year. The sample includes all the equity mutual funds in the U.S. from 1991 to 2016. Each observation is a fund share class-month combination. Column 1 includes the whole sample. Column 2 includes only the retail mutual funds. Column 3 includes only the institutional funds. Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%,5%, and 1% levels. Standard errors are clustered at fund and month levels.

	(1)	(2)	(3)
	All	Retail	Institution
ΔFFR	-0.0660**	-0.119***	-0.0285
	[0.0329]	[0.0408]	[0.0432]
High Div	0.228**	0.456***	0.160
-	[0.0933]	[0.120]	[0.136]
$\Delta FFR imes High Div$	-0.133***	-0.152***	-0.0665
Ŭ	[0.0309]	[0.0415]	[0.0458]
Volatility	-0.388***	-0.468***	-0.326***
U	[0.0813]	[0.109]	[0.110]
$\Delta FFR \times Volatility$	0.0191	0.0413	-0.00963
·	[0.0218]	[0.0270]	[0.0283]
Return	9.006***	9.558***	8.209***
	[1.297]	[1.388]	[1.659]
Size	-0.196***	-0.249***	-0.116***
	[0.0135]	[0.0148]	[0.0183]
Expense	-0.714***	-0.711***	-0.495***
-	[0.0588]	[0.0771]	[0.0985]
Turnover	0.363***	0.556^{***}	0.0268
	[0.0463]	[0.0625]	[0.0650]
Observations	1008208	481764	418222
Adj. R-squared	0.007	0.012	0.003

Table 4: Stock Holdings, Dividend Yields, and Monetary Policy

This table reports the coefficient estimates from panel regression (5):

 $\Delta \text{Holding}_{i,j,t} = \beta_1 \Delta \text{FFR}_t + \beta_2 \text{High Div}_{i,j,t} + \beta_3 \Delta \text{FFR}_t \times \text{High Div}_{i,j,t} + \gamma' X_{j,t} + \varepsilon_{i,j,t}.$ where $\Delta Holding_{i,j,t}$ is defined in equation (2) 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 fund is in the top decile for a given month, and 0 otherwise; and $X_{j,t}$ is a set of control variables containing: Home Owner, Married, and Male. Home Owner represents a dummy variable which takes the value of 1 if an account holder owns a home, and 0 otherwise; Married represents a dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise; Male represents a dummy variable which takes the value of 1 if an account holder is male, and 0 otherwise. The sample includes all the stock positions in the LBD data from 1991 to 1996. Column 1 includes all the individuals. Columns 2-5 include retirees, non-retirees, withdrawers, and non-withdrawers respectively. Retirees represents subsample of individuals whose age is above 65; Withdrawers represents subsample of individuals who have above a median frequency to withdraw 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)	(2)	(3)	(4)	(5)
	All	Retirees	Non-retirees	Withdrawers	Non-withdrawers
ΔFFR	-0.0725*	-0.0252	-0.0873**	-0.0807*	-0.0404
	[0.0418]	[0.0428]	[0.0435]	[0.0430]	[0.0497]
High Div	1 616***	1 127***	1 030***	1 566***	5 891***
Ingii Div	4.040 [0.cff]	[0.754]	4.333 [0.710]	4.000	[1.000]
	[0.055]	[0.754]	[0.710]	[0.070]	[1.080]
Δ FFR×High Div	-0.957***	-1.300***	-0.793***	-0.977***	-0.690**
-	[0.237]	[0.262]	[0.244]	[0.244]	[0.337]
	0 197	0.910	0.0044	0 197	0.100
Home Owner	-0.137	-0.318	-0.0244	-0.137	-0.120
	[0.143]	[0.274]	[0.166]	[0.142]	[0.448]
Married	0.209^{*}	0.402^{*}	0.128	0.173	0.346
	[0.120]	[0.225]	[0.139]	[0.129]	[0.312]
	2				
Male	-0.0636	0.479^{*}	-0.220	-0.0753	-0.0404
	[0.142]	[0.262]	[0.163]	[0.137]	[0.444]
Observations	2,038,982	482,081	1,556,901	1,627,478	411,504
Adj. R-squared	0.003	0.005	0.002	0.004	0.001

Table 5: Local Deposit Rates and Stock Holdings

This table reports the coefficient estimates from panel regression (6):

 $\Delta \text{Holding}_{i,j,t} = \beta_1 \Delta \text{DepRates}_{i,t} + \beta_2 \text{High Div}_{i,j,t} + \beta_3 \Delta \text{DepRates}_{i,t} \times \text{High Div}_{i,j,t} + \gamma' X_{j,t} + \varepsilon_{i,j,t}$ where $\Delta Holding_{i,i,t}$ is defined in equation (2) 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. $\Delta DepRates_{i,t}$ 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; $X_{j,t}$ is a set of control variables containing: home-ownership, marital status, and gender. Home Owner represents a dummy variable which takes the value of 1 if an account holder owns a home, and 0 otherwise; Married represents a dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise; Male represents a dummy variable which takes the value of 1 if an account holder is male, and 0 otherwise. 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 2-5 include retirees, non-retirees, withdrawers, and non-withdrawers respectively. Retirees represents subsample of individuals whose age is above 65; Withdrawers represents subsample of individuals who have above a median frequency to withdraw 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)	(2)	(3)	(4)	(5)
	All	Retirees	Non-retirees	Withdrawers	Non-withdrawers
$\Delta DepRates$	0.110	-0.125	0.180	0.122	0.0364
	[0.0961]	[0.172]	[0.112]	[0.104]	[0.246]
II:ah Div	0 001***	9 106***	9 009***	0 170***	6 107***
nıgli Div	2.001	2.490	3.083	2.478	0.107
	[0.653]	[0.882]	[0.665]	[0.672]	[1.428]
$\Delta DepRates \times High Div$	-2.776***	-3.375***	-2.496***	-3.032***	-0.699
	[0.584]	[0.687]	[0.603]	[0.621]	[0.791]
Home Owner	-0.140	-0.496	0.0579	-0.168	-0.113
	[0.157]	[0.364]	[0.178]	[0.155]	[0.445]
Married	0 195	0 1 <u>9</u> 0	0 165	0.176	0.317
Married	[0.190]	[0.220]	[0 149]	[0, 140]	[0.220]
	[0.129]	[0.230]	[0.148]	[0.140]	[0.320]
Male	-0.231	0.642^{**}	-0.483***	-0.115	-0.488
	[0.149]	[0.290]	[0.172]	[0.156]	[0.411]
Time fixed effects	Yes	Yes	Yes	Yes	Yes
MSA fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	$1,\!502,\!619$	$374,\!423$	$1,\!128,\!196$	$1,\!199,\!787$	302,830
Adj. R-squared	.0063	.0109	.00619	.00838	.00597

Table 6: Demographics of Withdrawers

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

Withdrawer^{*}_i = β_1 Retiree_i+ β_2 Income_i+ β_3 Home Owner_i+ β_4 Married_i+ β_5 Bank Card_i+ β_6 Vehicles_i+ ε_i , where Withdrawer_i. Withdrawer_i takes the value of 1 if an individual has above a median frequency to withdraw their dividend income rather than reinvesting it, and 0 otherwise (Withdrawer^{*}_i is the latent variable of the indicator variable in the logistic model). 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 male and female 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)	(2)	(3)	(4)
	Withdrawer	Withdrawer	Withdrawer	Withdrawer
Retiree	0.273^{***}	0.273^{***}	0.275^{***}	0.258^{***}
	[0.040]	[0.040]	[0.048]	[0.075]
Income	-0.018**	-0.018**	-0.026**	0.024
	[0.008]	[0.008]	[0.011]	[0.018]
Home Owner	0.060	0.060	0.085	-0.002
	[0.055]	[0.055]	[0.070]	[0.107]
Married	0.019	0.019	0.046	0.063
	[0.041]	[0.041]	[0.045]	[0.113]
Bank Card	0.018	0.018	-0.001	0.029
	[0.043]	[0.043]	[0.082]	[0.052]
Vehicles	0.022	0.022	0.035	-0.044
	[0.020]	[0.020]	[0.021]	[0.070]
Sample	All	All	Male	Female
Occupation F.E.	No	Yes	Yes	Yes
Observations	19,392	19,392	11,440	$7,\!952$
Pseudo R-squared	0.002	0.002	0.003	0.002

Table 7: Monetary Policy and Excess Returns of Dividend Decile Portfolios

This table reports Fama French 5-factor alphas of 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's are in percentage points. The sample period is from July 1963 to June 2016.

	Rising FFR	Declining FFR	Rising-Declining
Decile 1	0.050	-0.200**	0.250**
	[0.088]	[0.092]	[0.127]
Decile 2	0.083	-0.111	0.194^{*}
	[0.076]	[0.071]	[0.104]
Decile 3	-0.018	-0.128*	0.110
	[0.071]	[0.068]	[0.099]
Decile 4	-0.040	-0.056	0.016
	[0.074]	[0.069]	[0.101]
Decile 5	-0.062	-0.059	-0.003
	[0.071]	[0.067]	[0.098]
Decile 6	-0.034	0.051	-0.086
	[0.073]	[0.070]	[0.101]
Decile 7	-0.080	0.173^{***}	-0.252***
	[0.070]	[0.066]	[0.097]
Decile 8	-0.029	0.254^{***}	-0.283***
	[0.073]	[0.070]	[0.101]
Decile 9	-0.100	0.225^{***}	-0.326***
	[0.071]	[0.073]	[0.102]
Decile 10	-0.146	0.212^{*}	-0.359**
	[0.106]	[0.125]	[0.163]
Decile 10 - Decile 1	-0.197	0.412^{***}	-0.609***
	[0.137]	[0.156]	[0.207]

Table 8: Fed Funds Rates and Excess Returns of Dividend Decile Portfolios

This table reports the coefficient estimates from panel regression (9):

 $\alpha_{i,t} = \beta_1 \Delta FFR_t + \beta_2 \Delta FFR_t \times DivDecile_i + \zeta_i + \varepsilon_{i,t},$

where $\alpha_{i,t}$ represent 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)	(2)	(3)	(4)
	CAPM Alpha	FF3 Alpha	FF4 Alpha	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



Figure 1: Impulse response of Fund Net Flow to Changes in Fed Fund Rates

The figure presents the impulse response of the mutual fund flows to a negative 1% shock on the Fed Funds rates. The upper panel shows the funds in the 1st income yield decile, and the lower panel shows the 10th income yield decile. The estimation sample includes the equity mutual funds in the U.S. from 1991 to 2016.



Figure 2: Dividend Income, Capital Gains, and Net Withdrawals

The figure shows a scatter plot of monthly net withdrawals against dividends or capital gains at the same month following Baker, Nagel, and Wurgler (2007). Withdrawals are defined as household monthly net withdrawals from their brokerage account scaled by household account value in previous month. Dividend yields/ capital gain are the dollar value of dividend income/capital gain from the portfolio scaled by household account value in previous month. The graph is truncated to drop outliers.



Figure 3: Alphas of Dividend Decile Portfolios Conditional on Monetary Policy

This figure plots Fama French 5-factor alphas of portfolios formed on dividend yields conditional on whether the 3-year change of the Fed Funds rates is positive or negative. The alphas are in percentage points. The sample period is from July 1963 to June 2016.



Figure 4: Cumulative Return of the Dividend Strategy

Dividend Strategy

SMB

HML

This figure plots the cumulative return of the dividend strategy. The dividend strategy is the following: when the 3-year change of Fed Funds rates are negative, long the 10th decile of the dividend portfolio and short the 1st decile; when the 3-year change of Fed Funds rates is positive, do the reverse. The annual Sharpe ratio of the dividend strategy is 0.18, while the Sharpe ratios of the "high-minus-low" and the "small-minus-big" portfolios are 0.23 and 0.12 respectively.



Figure 5: Impulse Response of Alphas to Monetary Policy by Dividend Deciles

This figure plots 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 sample period is from July 1963 to June 2016.



Figure 6: Portfolio Holdings and Self-control Constraint: Two-periods

The figure reports the optimal portfolio holdings at time 0 for the two-period problem described in Section 4.2. The portfolio $(\theta_{H,con}, \theta_{L,con})$ refers, respectively, to the holdings of the high- and low-dividends paying asset in the presence of a self-control constraint. The portfolio $(\theta_{H,unc}, \theta_{L,unc})$ 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: $\sigma_L = \sigma_H = 0.3$, correlation $\rho_{H,L} = 0.5$, identical log risk premium $\lambda = 0.1$, yielding a log expected return of $\mu_H = \mu_L = r_f + \lambda$. Asset H has a log dividend yield $y_H = 0.06$ and asset L has a dividend yield $y_L = 0.01$.



Figure 7: Portfolio Holdings and Self-control Constraint: Infinite Horizon

The figure reports the optimal portfolio holdings of the infinite-horizon problem described in Section 4.3. The portfolio $(\theta_{H,con}, \theta_{L,con})$ refers, respectively, to the holdings of the high- and low-dividend-paying asset in the presence of a self-control constraint. The portfolio $(\theta_{H,unc}, \theta_{L,unc})$ 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: $\sigma_L = \sigma_H = 0.3$, correlation $\rho_{H,L} = 0.5$, identical log risk premium $\lambda = 0.1$, yielding a log expected return of $\mu_H = \mu_L = r_f + \lambda$. Asset H has a log dividend yield $y_H = 0.06$ and asset L has a dividend yield $y_L = 0.01$.



Figure 8: Consumption and Self-control Constraint: Two-periods

The figure reports the optimal time-1 consumption as a function of the time-1 wealth of the twoperiod problem described in Section 4.2. $(C_1^{unc}, C_1^{con}, C_1^{fc})$ refers, respectively, to the consumption of an agent without a self-control constraint, with a self-control constraint, and with full commitment power. $I_1 = \$1$ is income from the portfolio. 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 $\rho_{H,L} = 0.5$, identical log risk premium $\lambda = 0.1$, yielding a log expected return of $\mu_H = \mu_L = r_f + \lambda$. Asset H has a log dividend yield $y_H = 0.7$ and asset L has a dividend yield $y_L = 0.5$.



Figure 9: Certainty Equivalent Wealth and Time-inconsistency

The figure reports the time-0 certainty equivalent wealth as a function of the time-inconsistency parameter, β , of the two-period problem described in Section 4.2. $(\kappa_J^{con0,unc1}, \kappa_J^{con0,con1}, \kappa_J^{con0,fc1})$ 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 in period 1 (see equation (35)). 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 $\rho_{H,L} = 0.5$, identical log risk premium $\lambda = 0.1$, yielding a log expected return of $\mu_H = \mu_L = r_f + \lambda$. Asset H has a log dividend yield $y_H = 0.7$ and asset L has a dividend yield $y_L = 0.5$.



Figure 10: Certainty Equivalent Wealth and Return Volatility

The figure reports the time-0 certainty equivalent wealth as a function of the stock return volatility parameter, $\sigma_L = \sigma_H$, of the two-period problem described in Section 4.2. $(\kappa_J^{unc1}, \kappa_J^{con1}, \kappa_J^{fc1})$ 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 in period 1 (see equation (35)). Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, $\beta = 0.21$. We assume that assets log returns have identical volatility: $\sigma_L = \sigma_H$, correlation $\rho_{H,L} = 0.5$, identical log risk premium $\lambda = 0.1$, yielding a log expected return of $\mu_H = \mu_L = r_f + \lambda$. Asset H has a log dividend yield $y_H = 0.7$ and asset L has a dividend yield $y_L = 0.5$.



Figure 11: Portfolio Volatility: Infinite Horizon

The figure reports the volatility of the unconstrained portfolio $\sigma_{p,unc}$ and that of the portfolio that satisfies the self-control constraint, $\sigma_{p,con}$, for different values of the log risk-free rate. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, $\beta = 0.95$. We assume that assets log returns have identical volatility: $\sigma_L = \sigma_H = 0.3$, correlation $\rho_{H,L} = 0.5$, identical log risk premium $\lambda = 0.1$, yielding a log expected return of $\mu_H = \mu_L = r_f + \lambda$. Asset *H* has a log dividend yield $y_H = 0.06$ and asset *L* has a dividend yield $y_L = 0.01$.

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