

# Monetary Policy and Reaching for Income

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## ABSTRACT

We study the impact of monetary policy on investors' portfolio choices and asset prices. Using data on individual portfolio holdings and on mutual fund flows, we find that a low-interest-rate monetary policy increases investors' demand for income-generating assets such as high-dividend stocks and high-yield bonds. The increase in demand for current income stream is more pronounced among investors who follow the rule of thumb of living off income. We show that this reaching for income behavior constitutes a channel through which monetary policy affects portfolio choices, asset prices, and capital allocation across firms that differ in their dividend policy.

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An asset's total return can be broken down into two components: current income and capital gains. In frictionless capital markets, Miller and Modigliani (1961) show that rational investors should be indifferent between these two sources of return. However, this core tenet of financial economics is at odds with a large body of popular retail investment advice that advocates a "rule of thumb" of living off an income stream while keeping the principal untapped.<sup>1</sup> Investors who follow this rule will necessarily structure their investment portfolio not only to maximize their risk-adjusted return, but also to provide a level of current income which, when combined with their other sources of income, matches their desired consumption. Thus, when these other sources of income fall, for example because of declines in interest rates, these rule-of-thumb investors slowly rebalance their portfolio into higher current income assets.<sup>2</sup> We label this behavior *reaching for income*.

Consider the following example of reaching for income, as reported in the *Wall Street Journal* on February 9, 2016.<sup>3</sup> Cathy Berger, a 55-year-old investor, used to invest a large portion of her savings in certificates of deposit in the years before the financial crisis, earning an annual rate of as much as 8%. After the Federal Reserve lowered rates to zero, Cathy moved a portion of her savings into high-dividend stocks to generate income.

In this paper, we show that the behavior described here generalizes to a large fraction of investors and that such behavior constitutes a channel through which monetary policy affects real outcomes. Specifically, when monetary policy becomes more accommodative, investment income from bank deposits and short-term bonds drops. In response to this reduction, investors who live off income move into higher income assets such as high-dividend stocks and high-yield bonds. Because the supply of these high-income assets is slow to adjust (Lintner, 1956; Baker and Wurgler, 2004b), the demand pressure from income-seeking investors drives up the prices of these assets, resulting in a lower financing cost for the issuers of these securities. Thus, the *reaching for income* behavior leads to a link between monetary policy and financial markets that is not explained by the standard New Keynesian models of monetary policy.

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<sup>1</sup>Living off income is a popular retail investment advice. For example, in the November 2, 2016 *Forbes* article "How To Make \$500,000 Last Forever," Brett Owens writes: "The only dependable way to retire and stay retired is to boost your payouts so that you never have to touch your capital."

<sup>2</sup>In one of the earliest studies documenting investors preference for cash dividends, Shefrin and Statman (1984) observe that one dividend omission by Consolidated Edison in 1974 forced some shareholders to reduce consumption by the full amount of the omitted dividend.

<sup>3</sup>See the February 9, 2016 *Wall Street Journal* article "The High Consequences of Low Interest Rates", (Strumpf and Light, 2016).

We begin our analysis of reaching for income using individual portfolio holding data from a large discount broker covering 19,394 accounts over the 1991–1996 period. To sharpen identification, we exploit heterogeneous transmission of monetary policy to local bank deposit rates which leads to cross-sectional variation in interest income. We find that investors who live in regions with larger reductions in the local deposit rates are more likely to increase their holding of high-dividend stocks. The increase in demand for high-dividend assets is much more pronounced for investors who tend to live off portfolio income for consumption. This result is consistent with our hypothesis that investors use high-dividend stocks as an alternative resource to generate income when the income from deposits and bonds fall as the Fed lowers interest rates.

We further quantify the reaching-for-income effect by estimating the impulse response of high- and low-income mutual fund flows to monetary policy shocks, which we identify through high-frequency shocks to the fed funds rate, as in Gertler and Karadi (2015). We find that an exogenous reduction in the fed funds rate lead to strong and persistent inflows to high-income equity and bond funds: a 1% decrease in the fed funds rate leads to about 5% increase in the assets under management of high-income equity and bond funds over a period of three years relative to their comparable low-income funds. We find that the inflows are likely to come from short-term bond funds and bank certificates of deposit whose current income is depressed by low-interest-rate policy.

To assess the robustness of our results we complement the impulse response analysis with a panel regression analysis. First, we find that reaching for income is mainly driven by retail share classes and not institutional share classes, consistent with the hypothesis that retail investors are more likely to follow a living-off-income rule of thumb. Second, we document that a reduction in the fed funds rate is associated with significant inflows to funds whose name include words such as “dividends” and “income”. Third, we find that both interest rate decreases and increases have significant (and opposite) effects on flows into high-dividend funds.

The increase in demand for high-dividend stocks following fed funds rate declines impacts the prices of these assets in ways that do not appear to be fully anticipated by the market: high-dividend-yield stocks exhibit positive risk-adjusted returns following monetary easing and negative or negligible abnormal returns following monetary tightening, consistent with investors reacting with a lag to these policy changes. A dynamic long-short strategy that (i) buys high-dividend stocks and shorts low-dividend stocks immediately

after falls in the fed funds rate and (ii) reverses the positions following rate increases generates, on average, a risk-adjusted monthly return of 0.29% over the 1963–2016 period. Not surprisingly, retail investors are generally not able to capture this premium because they purchase high-yield assets too long after declines in the fed funds rate when prices are already too high.

Finally, we propose a theoretical model to show that the preference for current income constitutes a new transmission channel of monetary policy outside the standard New Keynesian framework. In a standard New Keynesian model the key friction is price stickiness, and financial markets are largely a veil (Woodford, 2011). Because prices are sticky, a reduction in nominal interest rates lowers the real risk-free rate, leading to more investment and consumption. In contrast, in our model prices are fully flexible and the key friction is the presence of financial-income-consuming investors. A reduction in the nominal interest rate depresses the income that agents receive from their short-term bonds, leading them to rebalance into higher yield assets and driving up the relative prices.

Our model has three distinct implications: First, while in a standard New Keynesian model monetary policy mainly affects the consumption-saving decision of households, in our model the *composition* of savings, i.e., portfolio choice, plays a central role. Second, while in a standard New Keynesian model, monetary policy affects the cost of capital through the risk-free rate, in our model monetary policy affects the cost of capital through risk premia. Third, while in a standard New Keynesian model low-interest rate monetary policy usually has expansionary effects on consumption, in our model low interest rates depress consumption for agents who live off income. Although highly stylized, the channels we highlight in our model can be incorporated in a standard New Keynesian framework to identify important cross-sectional effects resulting from monetary policy tightening or loosening.

Our study has broad implications for aggregate capital allocation, dividend policy, and asset prices. First, our findings suggest that monetary policy can have redistributive effects across firms that differ in their dividend policies. As low interest rates raise the demand for income, mature firms that are able to pay steady dividends will find it relatively easier to raise capital than young growing firms. If the investment opportunities of mature firms are inferior to those of young firms, such capital retribution will dampen the stimulus effect of low-rate policy on aggregate investment. Second, low-interest-rate monetary policy can induce firms to initiate dividends to cater to income-consuming investors. This result

suggests that the low-interest-rate monetary policy that began in the 2000s could be a potential explanation for the “reappearing” of dividends in the same period (Julio and Ikenberry, 2004; Michaely and Moin, 2017). Third, we show that an ultra low rate policy like the ones in Europe and Japan have made bonds less attractive relative to a wide range of stocks in term of income yields.<sup>4</sup> Such a policy leads to a general rebalancing from safe to risky assets and lower risk premia.

Our paper contributes to three strands of literature. The first strand studies the financial channels of monetary transmission.<sup>5</sup> Unlike the New Keynesian paradigm which focuses on price stickiness, the financial channel literature studies how frictions in the financial market allow monetary policy to affect real outcomes. Existing channels often rely on institutional frictions to break the neutrality of money. For instance, Drechsler, Savov, and Schnabl (2018) show that the central bank can affect financial institutions’ willingness to take risk by influencing the opportunity cost of holding central bank reserves. In contrast, we show that individual investors’ preference for nominal income also constitutes a form of money non-neutrality. Our paper is also related to the studies on the “reaching-for-yield” hypothesis, according to which a low-interest-rate policy induces investors to take more risk in a bid to boost total returns.<sup>6</sup> In contrast to the “reaching for yield” hypothesis, the “reaching-for-income” hypothesis posits that a low-interest-rate policy increases the demand for assets with high current income. Reaching for income differs from reaching for yield insofar as investors have a special preference for income yields above and beyond their contribution to total returns.

The second strand of literature to which this paper contributes is the voluminous literature on the theory of dividends. Demand for dividends can emerge in settings with asymmetric information<sup>7</sup> or with agency frictions,<sup>8</sup> or it can arise as a result of behavioral biases.<sup>9</sup> We provide evidence that the demand for dividends could be driven by individual investors who live off income. Our paper is particularly related to Baker and Wurgler (2004a) who document strong variation over time in the demand for dividends, but do

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<sup>4</sup>As of June 2019, the annualized yield of ten-year German government bonds is  $-0.22\%$ . In comparison, the average dividend yield of the German stock market (DAX Index) is around  $2.8\%$ .

<sup>5</sup>See, e.g., Nagel (2016); Drechsler, Savov, and Schnabl (2017a,b, 2018); and Xiao (2018).

<sup>6</sup>See, e.g., Rajan (2006), Hanson and Stein (2015), Bekaert, Hoerova, and Duca (2013), Becker and Ivashina (2015), Gertler and Karadi (2015), Hau and Lai (2016), Choi and Kronlund (2017), Di Maggio and Kacperczyk (2017), and Lian, Ma, and Wang (2017).

<sup>7</sup>See, e.g., Bhattacharya (1979); John and Williams (1985); Miller and Rock (1985).

<sup>8</sup>See, e.g., Easterbrook (1984); Jensen (1986); Fluck (1998, 1999); Myers (1998); Gomes (2001); and Zwiebel (1996).

<sup>9</sup>See, e.g., Shefrin and Statman (1984), Hartzmark and Solomon (2017).

not examine in detail the source of this time-variation; we suggest that monetary policy is an important driver. Our asset pricing result is related to Jiang and Sun (2015) who document that high-dividend stocks exhibit a puzzling excessive co-movement with bond interest rates despite their low cash flow duration. We show that this strong correlation is likely driven by demand for income. Our dividend premium result also relates to the findings of Hartzmark and Solomon (2013, 2017) who document a *buying* pressure on the high-dividend stocks in the dividend payment month because of tax-exempt investors or investors subject to the “free-dividend fallacy.”<sup>10</sup> In contrast, we show high-dividend stocks experience a *selling* pressure when interest rates rise. This finding is consistent with the prediction of our model that investors move out of high-income assets when rates rise as deposits and short-term bonds can already provide enough income to finance their desired consumption.

Third, our paper adds to a literature that studies households’ consumption and saving decisions over the life-cycle. Standard life-cycle theories suggest that agents should not distinguish between capital and income when making spending choices (Statman, 2017). In contrast to the standard life-cycle theory, Baker, Nagel, and Wurgler (2007) and Kaustia and Rantapuska (2012) find that investors usually only spend their dividends but rarely dip into capital. Campbell and Mankiw (1989) argue that the aggregate time-series data on consumption, income, and interest rates suggest that roughly “half the consumers follow the ‘rule of thumb’ of consuming their current income.” We add to this literature by showing that the rule of thumb of consuming current income also impacts portfolio choices, asset prices, and monetary policy. Finally, our paper also relates to Graham and Kumar (2006), who find that older investors with lower labor income hold stocks with higher dividend yields than younger investors with higher labor income. We find that older investors not only hold more dividend-paying stocks on average, they are also more likely to reach for income when interest rates fall.

The rest of the paper is organized as follows. In Section I, we provide empirical evidence that low-interest-rate monetary policy induces investors to “reach for income.” In Section II, we show that investor reaching for income behavior is reflected in asset prices. In Section III, we develop an asset pricing model to interpret the empirical findings. Section IV discusses the implications of reaching for income for portfolio under-diversification,

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<sup>10</sup>The “free-dividend fallacy” is the belief that dividends are “free” in the sense that paying dividends would not lead to a reduction in prices. Consistent with this fallacy, Hartzmark and Solomon (2017) find that investors appear to make buy/sell decisions based on price changes as opposed to cum-dividend returns.

capital reallocation, and risk-taking. Section V concludes. Appendix A contains a detailed description of the data used in our empirical analyses. Appendix B contains technical details of the living-off-income constraints used in the general equilibrium model.

## I. Reaching for Income: Empirical Evidence

In this section we provide empirical evidence on the effect of monetary policy on the demand for income-generating assets. Section A describes our data. Section B provides evidence from individual portfolio holding data and Section C provides evidence based on mutual fund flow data.

### A. Data

Our analysis relies on two main datasets: (1) individual portfolio holdings gathered from a large discount broker, and (2) U.S. mutual fund flows obtained from the Center for Research in Security Prices (CRSP).<sup>11</sup>

**Individual portfolio holdings.** This dataset includes monthly observations on portfolio holdings for 78,000 households between 1991 and 1996.<sup>12</sup> For each household, we observe the number of assets and asset type held in its portfolio. We restrict our analysis to common stock holdings and focus on a smaller subset of 19,394 households for whom we have demographic information. Table I reports summary statistics for the investor portfolio dataset. The average household in this dataset holds approximately \$34,000 in common stock. Over the entire sample, 23.7% of stock positions belong to account holders who are retirees, 42.6% are married, 75.3% hold at least a bank card, and 58% are male. We merge the portfolio holding dataset with the CRSP stock database to measure the dividend payments. The dividend yield of a stock at time  $t$  is defined as the ratio of the dividend over the past year to the stock price at  $t$ . The average dividend yield across the stocks in our merged sample is 2.1%, and the 90th percentile dividend yield is 5.7%.

We classify a stock as a “high income yield” stock if it belongs to the top decile of the dividend yield distribution in a given month. We use a categorical variable  $\text{Net Buy}_{i,j,t+6}$  to indicate whether the holding of stock  $i$  by household  $j$  increases or decreases from month

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<sup>11</sup>Appendix A contains a detailed description of the variables used in our analysis.

<sup>12</sup>This dataset was used first by Barber and Odean (2000).

$t$  to  $t + 6$ . Net Buy $_{i,j,t+6}$  takes the value of 1 if stock  $i$ 's position in account  $j$  increases from month  $t$  to  $t + 6$ ;  $-1$  if the position decreases, and 0 if the position stays constant.<sup>13</sup>

$$\text{Net Buy}_{i,j,t+6} = \begin{cases} 1, & \text{if } Q_{i,j,t+6} > Q_{i,j,t} \\ 0, & \text{if } Q_{i,j,t+6} = Q_{i,j,t} \\ -1, & \text{if } Q_{i,j,t+6} < Q_{i,j,t} \end{cases} \quad (1)$$

where  $Q_{i,j,t}$  represents the number of (split-adjusted) shares of stock  $i$  held in account  $j$  at time  $t$ .

**Mutual fund flows.** Our second dataset includes the monthly observations of all equity and bond mutual funds from January 1991 to December 2016 covering a total of 23,166 fund share classes. We define net flow as the net growth in fund assets adjusted for price changes. Formally,

$$\text{Flow}_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} \times (1 + R_{i,t})}{TNA_{i,t-1}}, \quad (2)$$

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

We define the *income yield* of a mutual fund at time  $t$  as the total income (dividends and coupons) over the past year scaled by the net asset value at  $t$ . Table II reports summary statistics. The average income yield in our data is 1.3% for equity funds and 3.8% for bond funds, and the 90th percentile income yields are 2.8% and 6.2%, for the equity and bond funds, respectively. We classify a bond or equity fund as *high-income* if its income yield is in the top decile of income yield distribution of all bond or equity funds, respectively.

**Monetary policy.** We measure the stance of monetary policy using the fed funds rate (FFR) data available from the Federal Reserve Economic Data (FRED) website. Following Bernanke and Kuttner (2005), we measure monetary policy shocks using unexpected changes in the fed funds rate, based on changes in the fed funds futures price on FOMC announcement dates.<sup>14</sup> Monetary policy directly affects many investors' financial income through the level of interest paid on bank deposits. To construct measures of local

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<sup>13</sup>We use a discrete measure of holding changes instead of percentage changes in holdings to avoid outliers originating from low or zero account positions.

<sup>14</sup>The data are downloaded from Kenneth Kuttner's website at <https://econ.williams.edu/faculty-pages/research>

deposit rates paid by banks, we combine *Call Report*, the quarterly regulatory filings on bank balance sheets, with the FDIC *Summary of Deposits*, the annual survey of branch office deposits for all FDIC-insured institutions. Specifically, we construct a measure of deposit rates of each bank by dividing bank interest payments on deposits by total deposits held at the end of each quarter. The MSA level deposit rates is then defined as the weighted average of the deposit rates of bank branches located within that MSA, where the weight is based on the bank branch’s total deposits.

## B. Evidence from Individual Portfolio Holding Data

### B.1. Evidence on Living off Income

We begin our analysis by showing that a subset of investors appears to follow the living-off-income rule of thumb. These investors, who are primarily retired investors with lower labor income, regularly withdraw all income (ie., stock dividends and bond coupons) from their brokerage accounts. However, their withdrawals are unrelated to the level of capital gains.

Following Baker, Nagel, and Wurgler (2007) we construct a measure of net withdrawals in period  $t$  as:

$$W_{j,t} = -[(A_{j,t} - A_{j,t-1}) - (G_{j,t} + D_{j,t})], \quad (3)$$

where  $(A_{j,t} - A_{j,t-1})$  is the change in the account balance over month  $t$ .  $G_{j,t}$  and  $D_{j,t}$  are, respectively, the portfolio’s capital gains and current income, where current income is defined as the sum over both stock dividends and bond coupon payments. Note that if the investor withdraws nothing, then the account balance will increase by the sum of the capital gains and the current income, and  $W_{j,t}$  will be zero. Assuming that these withdrawals are not reinvested into other investments that we do not observe, we can treat them as being used to finance consumption.

Figure 1 is a scatter plot of monthly net withdrawals against contemporaneous current income (Panel A) and against capital gains (Panel B) for each household of our dataset. The vertical and horizontal axes represent, respectively, net withdrawals and the current income/capital gains. We scale all the quantities using the value of the portfolio at the start of the month. Panel A shows that current income data cluster around two clear sets. The first set of observations lines up along the 45-degree line. These observations

represent investors who withdraw their portfolio dividend income almost one-for-one, likely for consumption reasons. The second set of observations lines up along the horizontal line corresponding to zero withdrawals. These points represent investors who do not withdraw current income, but instead reinvest them in their portfolios.

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

To better understand which type of investors are likely to live off income, we relate the living-off-income behavior to demographic information. Specifically, we first define a “income-withdrawal month” as a month when the withdrawal amount is between 90% and 110% of an investor’s contemporaneous current income.<sup>15</sup> We then classify an individual as a “withdrawer” if the frequency of income-withdrawal months is above the median, and as a “non-withdrawer” otherwise. Finally, we estimate a logistic regression of the “withdrawer” indicator on a set of demographic variables such as a retiree dummy, labor income, home-owner dummy, married dummy, bank card owner dummy, and vehicle owner dummy.

Table III reports the estimation results. We find that retired investors or investors with lower labor income are more likely to be withdrawers. This suggests that the withdrawal behavior in Figure 1 is not mechanical but, instead, related to investors’ demographic characteristics. 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 labor income and dividends as close substitutes but treat current income and capital gains very differently.

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<sup>15</sup>We leave a margin of error of 10% because withdrawal and current income may be measured with error. In the data, 19% of the household-month observations are “income-withdrawal events”.

## B.2. Evidence on Reaching for Income

Next, we examine the hypothesis that investors who live off income will also reach for income. Specifically, following drops in interest rates, these investors shifting into high-dividend assets in order to compensate for the lower interest income now received on deposits and bonds.

We begin by examining how the relative current income of bonds and stocks varies over monetary cycles. Figure 2 plots the time series of the fed funds rate, the income yield of the aggregate U.S. stock market, and that of two commonly-held debt instruments: the 3-month certificates of deposit (CDs) and the 10-year Treasury bonds. The figure shows that the income yield of debt instruments strongly co-moves with the fed funds rate, while equity yields do not. Thus, during periods of monetary easing, equities become relative more attractive as a source of current income. In particular, while the ultra-easy monetary policy of the most recent decade has lowered bond yields to almost zero, while the equity dividend yield has actually risen very slightly.

Given that low interest rates reduce interest income from deposits and bonds, some investors may reach for income by shifting their portfolios from deposits and short-term bonds to high-dividend stocks. Figure 3 shows the aggregate fund flows to money market funds and bank CDs, together with the 3-year changes in the fed funds rate. We see that following a reduction in the fed funds rate, both money market funds and bank CDs suffer outflows. The reaching for income hypothesis suggests these outflows are likely reinvested in assets which pay high current income, such as high-dividend stocks.

To test this hypothesis, we use individual stock holdings data and examine whether a reduction in the fed funds rate is associated with an increase in the holding of high-dividend stocks. Specifically, we regress the categorical variable  $\text{Net Buy}_{i,j,t+6}$  defined in equation (1) on the three-year changes in the fed funds rate,  $\Delta\text{FFR}_t$ , and its interaction with the high-dividend dummy,  $\Delta\text{FFR}_t \times \text{High Div}_{i,j,t}$ .<sup>16</sup> Control variables include (i) stock characteristics, such as a high-dividend dummy, a high-repurchase dummy, market beta, book-to-market ratio, the past 1-year and 3-year returns, log market capitalization, profit margin, and return on equity (ROE) of each stock; (ii) demographic variables, such as

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<sup>16</sup>Our analysis in section C shows that investors appear to respond to monetary policy changes in a slow and persistent manner. Therefore, we consider a three-year horizon in the construction of the variable  $\Delta\text{FFR}$ , as it seems to capture the most salient effects of monetary policy change on portfolio flows. Our results are robust to alternative horizons in the construction of  $\Delta\text{FFR}$ .

home ownership, marital status, and gender of the holder of account  $j$ ; and (iii) household fixed effects and stock fixed effects. Formally, we estimate the following regression:

$$\text{Net Buy}_{i,j,t+6} = \beta_1 \Delta \text{FFR}_t + \beta_2 \Delta \text{FFR}_t \times \text{High Div}_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t}. \quad (4)$$

where the  $X_{i,j,t}$  is a vector of control variables. The coefficient  $\beta_2$  measures the additional net buy that high-dividend stocks experience relative to low-dividend stocks following a 1% change in the fed funds rate. If low-interest rates lead investors to reach for income, we should expect a negative value for the coefficient  $\beta_2$ .

Table IV presents the results. The estimated coefficient  $\beta_2$  is negative and statistically significant, and implies that a 1% decrease in the fed funds rate over the past 3 years leads to an extra 0.8% increase in the net buy of high-dividend stocks over a period of six months. We include household fixed effects and stock fixed effects cumulatively from Columns 2 to 3 to absorb unobservable shocks in stock and household level. In the most stringent specification, Column 3, the coefficient is identified from the relative changes in the holdings of two stocks which are held by the same household and have similar characteristics other than their dividend yield. The magnitude of the coefficient estimates are stable across the different specifications.

A possible concern affecting the interpretation of our results is that high-dividend stocks may differ from low-dividend stocks in multiple dimensions. Companies which pay out dividends are often more mature and tend to be in relatively acyclical industries such as utilities.<sup>17</sup> It is possible that retail investors buy these stocks not because of their dividends per se but because they see them as relatively safe. We address this concern in two ways. First, we directly control for the growth prospects and cyclicity of a stock using its book-to-market ratio and market beta, as well as interactions with changes in the fed funds rate. We find that holding market beta and book-to-market ratio constant, investors are still more likely to purchase stocks with higher dividends when the fed funds rate decreases. This result suggests that the income yields of the stocks have an independent effect on investors' demand.

Second, we exploit the fact that cash dividends and share repurchases are two main ways companies distribute earnings to investors. Unlike cash dividends, which boost investors' current income, share repurchases benefit most investors through capital gains.

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<sup>17</sup>However, it is also the case that some high-dividend companies belong to cyclical industries such as real estate and banking.

Therefore, under the reaching for income hypothesis, one would expect different results when comparing share repurchases to cash dividends. In contrast, if investors happen to value more mature companies when the fed funds rate falls, there should not be difference between share repurchases and cash dividends. To test this conjecture, in the regressions of Table IV we include a dummy variable, High Repurchase, which equals 1 if a stock lies in the top decile of the distribution of share repurchases, as well as its interaction with the three-year change in the fed funds rate. We find that low interest rates do not significantly increase the demand for high-repurchase stocks. This result suggests that investors treat cash dividends differently from share repurchases.

### *B.3. Identifying Monetary Policy Effects through Local Bank Deposit Rates*

A common challenge in studying the impact of monetary policy is the difficulty in disentangling monetary policy changes from other confounding macro factors that affect the common policy rate set by the monetary authority. To address this challenge, we exploit the heterogeneity in the transmission of monetary policy to local bank deposit rates. Drechsler, Savov, and Schnabl (2017a) show that the transmission to local deposit rates differs across regions because of differences in local bank market power. Specifically, deposit rates in regions with a more competitive banking sector are more sensitive to changes in the fed funds rate. This heterogeneity helps our identification along multiple fronts. First, local deposit rates provide a more accurate measure of current financial income for investors in the local area. Second, local banking concentration is highly persistent and can be viewed as predetermined with respect to changes in monetary policy. Third, the rich cross-sectional variation in interest income allows us to filter out other macroeconomic shocks correlated with monetary policy.

We construct a measure of local deposit rates using the weighted average of deposits rates of banks with branches in the same MSA. We map investors to local MSAs based on their zip codes and regress the categorical variable Net Buy $_{i,j,t+6}$  defined in equation (1) on: (i) the three-year changes in local deposit rates,  $\Delta\text{Dep Rates}_{m,t}$ ; and (ii) its interaction with the high-dividend dummy  $\Delta\text{Dep Rates}_{m,t} \times \text{High Div}_{i,t}$ . We control for stock characteristics as in the regression model (4) and their interactions with changes in local deposit rates. We further include household fixed effects, time fixed effects, MSA fixed effects, and the growth rates of MSA total personal income. Column 1 of Table V reports the results from

estimating the following model:

$$\text{Net Buy}_{i,j,m,t+6} = \beta_1 \Delta \text{Dep Rates}_{m,t} + \beta_2 \Delta \text{Dep Rates}_{m,t} \times \text{High Div}_{i,t} + \gamma' X_{i,j,m,t} + \varepsilon_{i,j,m,t}. \quad (5)$$

The estimated coefficient  $\beta_2$  (on the interaction term  $\Delta \text{Dep Rates}_{m,t} \times \text{High Div}_{i,t}$ ) is negative and significant, indicating that demand for dividends is negatively related to local deposit rates. Moreover, the magnitude of  $\beta_2$ , estimated here using local deposit rates, is twice as large as that estimated in Table IV using the fed funds rate. This result suggests that local bank deposit rates provide a more accurate proxy for interest income for local investors than does the fed funds rate.

Columns 2 and 3 of Table V separate the sample into withdrawers and non-withdrawers, respectively. Recall that withdrawers are individuals who have an above-median frequency of withdrawing their dividend income rather than reinvesting it. As shown in Table III, these withdrawers usually have low labor income and tend to live off their financial income. Therefore, monetary policy is more likely to significantly affect their portfolio allocations. We find this is indeed the case in the data. The reaching-for-income phenomenon is mostly driven by the withdrawer sample. For the non-withdrawer sample, neither the local deposit rates nor the fed funds rate significantly affect the holding of high-dividend paying stocks. This result suggests that the consumption rule of living off income seems to be the main driver of the reaching for income phenomenon.

### *C. Evidence from Mutual Fund Flow Data*

With the goal of better quantifying the magnitude and timing of reaching for income effects, in this section we evaluate the effects of reaching for income on mutual fund flows. We study the effect of monetary policy on mutual fund flows using two separate approaches. We first examine the impulse response of stock and bond mutual fund holdings to changes in the fed funds rate. Second, we analyze the response of flows to interest rate changes using panel regressions. The former approach focuses mainly on the time-series dimension, while the latter focuses mainly on the cross-sectional dimension.

### C.1. Fund Flow Dynamics

As monetary policy changes the relative income yields between equity and bonds, we may expect income-seeking investors to rebalance their portfolios across different types of mutual funds. To test this conjecture, we estimate the impulse response of mutual fund flows to the current and lagged changes in the fed funds rate,  $\Delta\text{FFR}$ . To address concerns regarding the potential endogeneity of monetary policy, we follow Bernanke and Kuttner (2005) and measure monetary policy shocks through high-frequency unexpected fed funds rate changes around monetary policy announcements. As emphasized by Bernanke and Kuttner (2005), these high-frequency unexpected fed funds rate shocks are unlikely to be correlated with other economic news. This allows us to identify the causal effects of monetary policy on mutual fund flows. A related challenge is the difference in the frequency of the monthly mutual fund flows and the irregularly spaced FOMC meeting days. To address this challenge, we follow Gertler and Karadi (2015) and use high-frequency monetary policy shocks as external instruments in the impulse response estimation. Finally, we use the local projections method of Jordà (2005), which allows us to estimate the impulse response without specifying the underlying multivariate dynamic system. It also allows us to take advantage of the large cross-sectional dimension of our panel data. Specifically, the local projections method can be implemented with the following regression model:

$$\text{Flow}_{i,t+h+1} = \beta_h \Delta\text{FFR}_{t,t-12} + \gamma' X_{i,t} + \varepsilon_{i,t+h}, \quad (6)$$

where  $\text{Flow}_{i,t+h+1}$  is the flow into fund  $i$  from month  $t+h$  to month  $t+h+1$ ,  $\Delta\text{FFR}_{t,t-12}$  is the change in the fed fund rate from time  $t-12$  to  $t$ , and  $X_{i,t}$  denotes a set of control variables that may be important drivers of fund flows. We use the within-year high-frequency interest rate surprises as instruments for  $\Delta\text{FFR}_{t,t-12}$ . The control variables here include a fund characteristics such as past fund returns, fund return volatility, fund expenses, and the log of fund assets under management. We also include the 1-year change in the CBOE Volatility Index (VIX) and the 1-year lagged level of VIX to control for market volatility.

Within each type of funds, we classify funds in the top decile of income yield as “high-income funds” and the remaining ones as “low-income funds.” We estimate model (6) separately for high- and low-income funds and for different forecast horizons, from 1 year to 5 years. The sum of coefficients  $\sum_{h=1}^n \beta_h$  represents the cumulative fund flows up to  $n$

years to a 1% change in the fed funds rate. Our sample includes monthly observations for all domestic mutual funds from 1991 to 2016 in monthly frequency.

Figure 4 reports cumulative fund flows in response to a 1% reduction in the fed funds rates over different time horizons for equity funds (Panel A) and bond funds (Panel B). In each panel, the red solid line is the impulse response for high-income funds, and the blue dashed line is the impulse response for low-income funds.

High-income equity funds receive larger inflows following a reduction in the fed funds rate. Over the three years following a 1% reduction in the fed funds rate, high-income equity funds receive an additional inflow of about 5% of assets under management (AUM), relative to low-income equity funds. Like high-income equity funds, high-income bond funds initially gain assets after a reduction in the fed funds rate. However, these inflows gradually reverse after 2 years. A possible reason for this reversal is that income yields of high-income bond funds fall relative to equity funds reflecting lower coupon levels of newly-issued bonds. In contrast, following a reduction in the fed funds rate, low-income bond funds suffer outflows in favor of high-income equity and bond funds.

Interestingly and importantly, the inflows into high income bond and equity funds do not occur immediately after the policy shocks. Instead, investors seem to respond to these changes with long lags. Two potential reasons for this slow persistent response are: (1) investors are likely to adjust their portfolios only periodically, and (2) investors may be holding long-term bonds that were issued before a change in monetary policy. Income yields therefore may change slowly as long-term bonds gradually mature and are replaced by newly issued bonds. Consistent with this idea, the inflows to high-income bond funds reverse in the long run.

### *C.2. Evidence from Panel Regressions*

To complement the evidence on fund flow dynamics from the previous subsection, we here estimate the following panel regression:

$$\text{Flows}_{i,t+1} = \beta_1 \Delta \text{FFR}_t \times \text{High Income}_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t+1}, \quad (7)$$

where we regress the monthly fund flows into fund  $i$ ,  $\text{Flows}_{i,t+1}$ , on the interaction of our high-income dummy and the three-year changes in the fed funds rate,  $\Delta \text{FFR}_t \times \text{High Income}_{i,t}$ . The set of control variables  $X_{i,t}$  includes fund returns, fund return volatil-

ity, the interaction between volatility and the three-year change in the fed funds rate, log assets under management, expenses, income tax, and the interaction between income tax and a high-income dummy. Controlling for volatility and its interaction with the changes in the fed funds rate is particularly important to allay the concern that our results are driven by investors' desire to reach for yield by investing in riskier assets when interest rates are lower. We also include time fixed effects to absorb unobservable macroeconomic shocks. Here we are particularly interested in the coefficient of the interaction term,  $\beta_1$ , which measures the additional fund flows that high-income funds receive relative to low-income funds following a 1% change in the fed funds rate. If low-interest rate monetary policy indeed leads investors to reach for income, we should expect a negative value for the coefficient  $\beta_1$ .

Table VI reports the regression results. Columns 1 and 2 report the results for this regression estimated across the full sample of equity and bond funds respectively. The coefficient of the interaction term,  $\beta_1$ , in regression (7) is negative and significant, indicating that high-income funds receive more inflows when interest rates fall. The economic magnitude is large: a 1% decrease in the fed funds rate leads to a 5% (0.128% per month  $\times$  36 months) cumulative increase in assets under management for high-income equity funds over a period of three years, compared to low-income equity funds. The effect on bond mutual funds is somewhat smaller: a 1% decrease in the fed funds rate leads to a 2% (0.054% per month  $\times$  36 months) cumulative increase in assets under management for high-income bond funds over a period of three years, compared to low-income bond funds. These magnitudes are consistent with the findings in Figure 4. Note that these findings are obtained after controlling for fund return volatility and its interaction with the changes of the fed funds rate. This allays the concern that our results are driven by investors' desire to reach for yield by investing in riskier assets when interest rates are lower.

Columns 3–6 in Table VI split the sample between retail and institutional funds. The results show that the coefficient of the interaction term  $\beta_2$  is statistically significant only for the retail funds, but not the institutional funds, indicating that only retail investors have a tendency to reach for income when the fed funds rate declines. The difference between the estimates for retail and institutional investors is statistically different from zero at the 5% significance level for the equity fund sample.

The above results can help differentiate among theories that have been proposed to explain the “dividend puzzle” (Black, 1976), that is, the observation that investors do ex-

hibit a strong preference for dividends despite the irrelevance of dividend policy in perfect capital markets with rational agents (Miller and Modigliani, 1961). The literature has proposed two broad groups of theories. The first group introduces institutional frictions such as asymmetric information and agency problems while the second group argues that behavioral reasons, such as self-control motives, loss aversion, or regret aversion, can generate a demand for dividends. If institutional frictions were the source of the demand for dividends, then one would expect institutional investors to exhibit a similar, if not stronger, preference for dividends. However, it seems that institutional investors do not reach for income, in contrast to retail investors. To the extent that retail investors are likely to be more subject to behavioral biases than institutional investors, our results lend support to the second group of theories that explain the dividend puzzle as a departure from investor rationality.

### *C.3. Robustness*

To assess the robustness of the results reported in Table VI we consider: (i) an alternative way to characterize high-dividend funds; (ii) an alternative definition of monetary policy changes; (iii) the symmetry of the effect of rate increases and decreases; and (iv) a longer sample dating back to 1961 with annual data.

Column 1 of Table VII considers an alternative classification of mutual funds into high- and low-income funds based on fund names. In the data, about 10% of equity funds have “dividends,” “income,” or “yield” in their names. Most of these funds seek to generate a high income to cater to income-seeking investors.<sup>18</sup> Using the information inferred from fund names, we classify a fund as a high-income fund if its name contains “dividends,” “income,” or “yield”. For bond funds, we use “high dividends,” “high income,” or “high yield” to identify high-income funds.<sup>19</sup> Under this classification, we find that a reduction in the fed funds rate is associated with significantly larger flows into funds whose name alludes to a high-income focus.

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<sup>18</sup>For instance, a Pittsburgh-based asset management company, Federated, manages a fund called Federated Strategic Value Dividend Fund. As indicated by the fund name, this fund “seeks a higher dividend yield than that of the broad equity market.” See the 2017 Prospectus of Federated Strategic Value Dividend Fund.

<sup>19</sup>Because many bond funds contain the generic string “fixed income,” a single word “income” would not be sufficient to identify high-income funds.

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

Column 3 of Table VII separately estimate the effects of rate increases and decreases. We find these effects to be symmetric: when rates decrease, high-income funds gain inflows; when rates increase, high-income funds suffer outflows. The economic magnitudes are similar. Finally, Column 4 of Table VII extends the analysis to a sample ranging from 1961 to 2016 and available only at an annual frequency. Our result are robust over this longer sample period.<sup>20</sup>

## II. Asset Pricing Implications of Reaching for Income

In the last section we established the tendency, especially among investors who live off financial income, to reach for income by rebalancing toward individual stocks and bonds with high income yields, and into high income mutual funds following monetary-policy induced drops in interest rates. We further showed that this rebalancing takes place over several years following these changes. In this section, we investigate whether reaching for income can result in a link between monetary policy and asset prices. We hypothesize that, by increasing the demand for dividends, a transition to a low-interest rate monetary policy will increase the valuations of high-dividend-yield stocks relative to low-dividend-yield stocks. Specifically, in Section A we analyze variations in the aggregate “dividend premium/discount” with changes in monetary policy. In Section B we study excess returns in the cross section of dividend portfolios, and in Section C we focus on the time-series dynamics of excess returns in response to monetary policy shocks.

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<sup>20</sup>Another possible concern is that the boom and bust of dot-com bubble may affect our results. In the Online Appendix, we show that our results are unaffected by dropping the 1998–2002 period.

## A. Monetary Policy and the Dividend Premium

We begin our analysis of the asset pricing implications of reaching for income with an examination of how the valuation spread between high- and low-dividend yield stocks changes with monetary policy. To begin, we follow Baker and Wurgler (2004b) and define the *dividend premium* as the difference between the (equal-weighted average) of the log market-to-book ratios of dividend-paying stocks and of non-dividend-paying stocks at a given point in time. We then relate the dividend premium to monetary policy.

Figure 5 plots the annual change in the dividend premium and against the contemporaneous annual change in the fed funds rate for each year from 1963 to 2016. Consistent with Baker and Wurgler (2004b), we find that a 1% decrease in the fed funds rate is associated with a 2.6% increase in the relative valuation of dividend-paying stocks versus non-dividend paying stocks. The estimated slope coefficient is significant at the 1% level.<sup>21</sup>

## B. Monetary Policy and Dividend-Yield Sorted Portfolio Returns

To formally test whether high-dividend-yield stocks outperform low-dividend-yield stocks following drops in the fed funds rate, we divide our 1963–2016 sample period into rising and declining interest rate environments based on  $\Delta\text{FFR}_t$ , which is the one-year change in the fed funds rate leading up to month  $t$ . For each sub-sample we compute excess returns (alphas) from the five-factor model of Fama and French (2016).

Fama and French (1993) show that, unconditionally, dividend-yield sorted portfolios have three-factor alphas statistically indistinguishable from zero. However, Table VIII shows that *conditional* on the monetary policy stance, dividend-yield sorted portfolios do exhibit significant risk-adjusted excess returns. Specifically, following decreases in the fed funds rate, high-dividend portfolios have positive and significant alphas while low-dividend portfolios have negative and significant alphas. Following increases in the fed funds rate, the opposite pattern occurs. This result suggests that other market participants do not seem to fully anticipate the rebalancing of living-off-income investors. If such rebalancing were fully anticipated, asset prices would have fully adjusted at the time when monetary policy news was released.

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<sup>21</sup>We determine significance levels using Newey-West standard errors with 4 lags.

These patterns in alphas suggest a simple trading strategy that goes long high-dividend stocks and shorts low-dividend stocks following rate declines, and reverses the position following increases in the fed funds rate. Panel A of Figure 6 shows that, over the 1963–2016 period, this strategy earned a monthly Fama-French 5-factor alpha of 29 basis points, and generated an annualized Sharpe ratio of about 0.455, comparable to that of a strategy that exploits the value premium in the cross-section.<sup>22</sup>

### C. Timing of the Return Realizations

To understand the timing of the realization of these excess returns following monetary policy changes, we run the following predictive regressions of excess returns of dividend-yield sorted portfolio  $i$  on lagged changes in the fed funds rate for different forecast horizons:

$$\alpha_{i,t+h+1} = \beta_{i,h}\Delta\text{FFR}_{t,t-12} + \varepsilon_{i,t+h+1}, \quad i = 0, 12, \dots, 48, \quad (8)$$

where  $\alpha_{i,t+h+1}$  is the excess return of holding portfolio  $i$  from time  $t+h$  to  $t+h+1$ ;  $\Delta\text{FFR}_{t,t-12}$  is the change in the fed funds rate from time  $t-12$  to  $t$ . We estimate model (8) separately for different forecast horizon  $h$  ranging from 12 months to 60 months. Because the high-frequency unexpected fed funds rate shocks are only available after 1991, we use the raw changes in the fed funds rate to define  $\Delta\text{FFR}$  in (8).<sup>23</sup>

Figure 7 reports the estimated coefficients  $\beta_{i,h}$  as a function of  $h$  for the each dividend decile portfolio. Specifically, this analysis shows that high-dividend portfolios earn positive excess returns in the first two years following a reduction in the fed funds rate, but that the alphas for low-dividend portfolios are indistinguishable from zero. The persistent excess returns in the high-dividend portfolios are consistent with the persistent mutual fund inflows and the stock-buying pressure from individual investors that follow these shocks. Note also that the excess returns of high-dividend portfolios turn zero or even negative after year 3. This is consistent the hypothesis that the demand pressure dissipates as the supply of these assets adjusts in the long run.<sup>24</sup>

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<sup>22</sup>The t statistics for the mean alpha of the dividend strategy is 2.8. The annualized Sharpe ratio for the Fama and French (1993) HML factor over the same period is 0.428.

<sup>23</sup>This choice should bias us against finding any excess return because investors may have anticipated some of the changes in the fed fund rate.

<sup>24</sup>In Section IV, we find that some firms cater to the increasing demand for dividends by initiating dividends when the fed funds rate decreases.

The argument that we are making here is that, following a negative shock to that fed funds rate, retail investors reach for yield and in so doing push up the prices high yield stocks and bonds. However, it is possible that some other effect is leading to these positive excess returns, and retail investors are instead (rationally) buying in anticipation the excess returns of the high-income stocks and bonds. If this were the case, then the set of individual investors would earn positive excess returns as a result of these trading patterns.

We do not find support of this hypothesis in the data. Comparing the timing of realization of excess returns in Figure 7 to the timing of the fund flows in Figure 4 shows that a large fraction of fund flows occur *after* the realization of positive excess return. In aggregate, retail investors appear to acquire high-dividend stocks too late, and in the period where stocks’ alphas have already turned negative. To see this point, we construct lagged version of our trading strategy discussed in Section B. Specifically, we define “dividend strategy (lag  $n$ )” as a comparable dynamic long-short strategies, implemented with a lag of  $n$  years. Panel B of Figure 6 shows that the lagged dividend strategies earn *negative* alphas.

To examine whether retail investors on average earn negative alphas based on their trading, we form a trading strategy to mimic retail investors’ flows to high-income equity funds over monetary cycles. Using Equation (6), we first estimate  $\beta_h$ , the predicted retail fund flows to high-income equity funds at horizon  $h$  following a 1% change in the fed funds rate over the period  $t - 12$  to  $t$ . We then calculate the total predicted flows in month  $t$  as  $\text{Flows}_t = \sum_{h=1}^{60} \beta_h \Delta \text{FFR}_{t-h, t-h-12}$ . Finally, we go long the top-decile dividend portfolio and short the bottom-decile dividend portfolio when the total predicted flow in month  $t$  is positive, and reverse the position when the predicted flow is negative. As shown in Panel B of Figure 6, this strategy earned a negative alpha of 9 bps over the 1963–2017 sample period, which is not statistically different from zero. This result suggests that retail investors, rather than buying high-dividend stocks to capture positive excess returns, instead gradually rebalance when they realize that their portfolios do not generate enough current income to finance consumption needs.

Our asset pricing result is related to the findings of Hartzmark and Solomon (2013, 2017) who document that stocks experience positive abnormal “interim returns” between the dividend announcement date and the ex-dividend date. However, while Hartzmark and Solomon (2013) find that the dividend interim returns are almost always positive (73

out of 83 years), our dividend premium turns negative when interest rates rise. This is because our dividend premium is different from the dividend interim return both in terms of underlying driver and empirical measure. Specifically, the dividend month premium of Hartzmark and Solomon (2013) is likely driven by tax-exempt investors who actively capture dividends around dividend payment date (Michaely and Vila, 1996) or investors who are subject to “free-dividend fallacy” (Hartzmark and Solomon, 2017). Because such tax-exempt investors exist regardless of the stance of monetary policy, the buying pressure for high-dividend stocks in dividend payment month is always present. In contrast, our dividend premium is likely to be driven by retail investors who use current income to finance consumptions. If interest rates rise, high-dividend stocks may face *selling* pressure because they become less attractive compared to short-term bonds or bank CDs. This explains why the dividend premium can turn into dividend discount as shown Table VIII. Second, the buying pressure for high-dividend stocks in dividend payment month in Hartzmark and Solomon (2013) is short-lived: the buying pressure usually dissipates in the 40 days after the ex-dividend day. This is consistent with tax-exempt investors capturing dividends around the short window between the dividend announcement date and the ex-dividend date and liquidate their position afterwards. In contrast, we find fund flows following changes in monetary policy are persistent for several years. This is more consistent with retail investors slowly adjusting their portfolios in response to changes in monetary policy.

In summary, the empirical analysis of the previous two sections suggests that the reaching-for-yield effect causes certain types of investors to rebalance into high-income assets following the drop in interest rates that accompanies a transition to a more accommodative monetary policy. Further, the change in demand for dividend-paying assets following such a shock does not appear to be fully anticipated by the market, and leads to temporary positive excess returns to high-income stocks and bonds over the three years following the shock, which subsequently reverse. Retail investors, rather than benefiting from this shock, continue rebalancing into high income assets even when the prices are already too high, and as a result suffer aggregate losses in their portfolios as a result of reaching for income.

### III. A Model of Reaching for Income

We now propose a model that allows us to more formally analyze the equilibrium implications for monetary policy in a stylized economy in which a fraction of investors

follow the rule of thumb of living off income.<sup>25</sup> The model shows how “living off income” can lead to the reaching for income behavior and the return predictability in response to monetary policy shocks that we have documented in Sections I and II. The analysis of this section further shows that, as long as there are “living-off-income” investors, monetary policy will have an impact on portfolio allocations and equilibrium risk premia, even in an economy in which prices are fully flexible.

We consider an endowment economy populated by two types of agents A, and B. Type A agents follow the consumption rule of “living off current income”, while type B agents make their consumption and savings decisions based on their permanent income. Time is discrete and runs over two periods,  $t = 0, 1, 2$ .

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

$$u^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 + \sigma_j}, \quad \text{and} \quad d^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 - \sigma_j} \quad j = L, H. \quad (9)$$

The high dividend-yield asset has a *lower* dividend growth rate than the low dividend-yield asset, that is,  $\mu_H < \mu_L$ . Note that a low dividend growth rates implies a high dividend-price ratio at time 1. We assume that dividend growth of the two assets have a correlation equal to  $\rho$  and the following joint probability distribution<sup>26</sup>

$$\Pr(u^L, u^H) = \Pr(d^L, d^H) = \frac{1}{4}(1 + \rho), \quad \text{and} \quad \Pr(u^L, d^H) = \Pr(d^L, u^H) = \frac{1}{4}(1 - \rho). \quad (10)$$

Denoting by  $P_t^j$  the price of asset  $j \in \{H, L\}$  at time  $t$ , we have that the one period return  $\tilde{R}_{j,t1}$  is given by

$$\tilde{R}_{j,t+1} = \frac{D_{t+1}^j + P_{t+1}^j}{P_t^j}, \quad j = H, L. \quad (11)$$

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<sup>25</sup>Online Appendix A provides a discussion on possible microfoundations of the living-off-income rule, including 1) a self-control motive to discipline consumption and savings; 2) a way to minimize transaction costs of financing consumption; 3) minimizing mental costs of trading.

<sup>26</sup>The choice of this probability distribution guarantees that the correlation between the dividend growth of asset  $H$  and  $L$  is indeed equal to  $\rho$ .

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

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

**Preferences.** We assume that all agents have the same attitude toward atemporal risk, captured by CRRA preferences. Each agent,  $h = A, B$ , solves the following problem

$$\max \mathbb{E}_0 \left[ \sum_{t=0}^2 \delta^t u(C_{h,t}) \right], \quad (12)$$

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

$$C_{h,t} = W_{h,t} - n_{h,t}^F P_t^F - n_{h,t}^L P_t^L - n_{h,t}^H P_t^H \quad (13)$$

$$W_{h,t+1} = n_{h,t}^F D_{t+1}^F + n_{h,t}^L (D_{t+1}^L + P_{t+1}^L) + n_{h,t}^H (D_{t+1}^H + P_{t+1}^H), \quad (14)$$

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

$$W_{h,0} = \omega_h (S^F D_0^F + S^L (D_0^L + P_0^L) + S^H (D_0^H + P_0^H)), \quad (15)$$

where  $\omega_h$  denotes agent  $h$ 's share of total wealth.

**Monetary policy.** We model monetary policy as determining the *nominal* risk-free rate in the economy,  $r_t^{\$,F}$ . To keep the model simple, following Stein (2012), we assume that prices are fully flexible. Notice that monetary policy does not affect the real endowment process in our model. Therefore, in the absence of any nominal friction, monetary policy is completely neutral: any change in the nominal interest rates is canceled by an equal change in the inflation rate  $\pi_t$  and the real interest rate  $r_t^F = r_t^{\$,F} - \pi_t$  stays constant. However, as we show below, the presence of a fraction of agents following the living-off-

income rule introduces a nominal friction in the model that renders money non-neutral. As a consequence, monetary policy has a real effect on the real asset prices.

**“Living off income”.** Agent  $A$  follows a rule of thumb of living off income. Formally, agent  $A$  is subject to an income constraint, that is, the nominal consumption  $C_{A,t}^\$$  is bounded by the current income available at time  $t = 0, 1$ :

$$C_{A,t}^\$ \leq n_{A,t-1}^F \left( \Pi_t - P_{t-1}^{\$,F} \right) + n_{A,t-1}^L D_t^{\$,L} + n_{A,t-1}^H D_t^{\$,H}, \quad (16)$$

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

The following proposition illustrates that a change in the nominal risk-free rate on the income constraint (16) affects the agents *real* consumption/savings ratio.

**Proposition 1.** *Let  $\Pi_t$  denote the time- $t$  price level. Then income constraint (16) on nominal consumption is equivalent to a constraint on the ratio of real consumption to real savings, that is,*

$$\frac{C_{A,t}}{W_{A,t-1} - C_{A,t-1}} \leq \theta_{A,t-1}^F r_t^{\$,F} + \theta_{A,t-1}^L dp_t^L + \theta_{A,t-1}^H dp_t^H, \quad (17)$$

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

$$\theta_{A,t}^j = \frac{n_{A,t}^j P_t^j}{W_{A,t} - C_{A,t}}, \quad (18)$$

$dp_t^j = \frac{D_t^j}{P_{t-1}^j}$  is the dividend yield of asset  $j = H, L$ , and  $r_t^{\$,F}$  is the nominal risk-free rate at time  $t$ .

**Proof:** See Appendix B.

The expression of the constraint (17) in the proposition shows that an increase in the nominal interest rate  $r_t^{\$,F}$  at time  $t$  relaxes the income constraint. The source of nominal friction in the model comes from the fact that agents think about bond income in nominal

terms rather than in real terms. Hence, the presence of investors who follow the nominal consumption rule (16) is the reason why monetary policy has a real effect in our otherwise frictionless economy.

**Equilibrium.** Given an endowment process of treasuries  $S^F$  and risky assets  $S^L$  and  $S^H$ , an equilibrium is characterized by a set of prices  $\{P_t^F, P_t^H, P_t^L\}$  and allocation (consumption and portfolio rules) such that both agents maximize expected utility (12) subject to (13), (14), and (16) and markets clear

$$n_{A,t}^F + n_{B,t}^F = S^F \quad (19)$$

$$n_{A,t}^L + n_{B,t}^L = S^L \quad (20)$$

$$n_{A,t}^H + n_{B,t}^H = S^H. \quad (21)$$

**Consumption.** We first examine the effect of monetary policy on consumption. Figure 8 reports the equilibrium consumption of the income-consuming Agent A as a function of the nominal interest rate. The blue line is the real consumption in the unconstrained equilibrium in which none of the agents live off income, while the red line is the real consumption in the constrained equilibrium in which Agent A lives off income. In absence of the income constraint, real consumption is independent of the nominal interest rate. In other words, monetary policy is neutral for consumption-savings decision. However, when agent A lives off nominal income, a low nominal interest rate reduces his consumption. In the standard New Keynesian framework with sticky prices, a decrease in nominal interest rates reduces real interest rates, and hence has an expansionary effect on consumption. In contrast, our result formalizes practitioners' intuition that low-interest-rate monetary policy may have *contractionary* effects on the consumption of investors who live off their income from savings.<sup>27</sup>

Notice that the contractionary effect on consumption is not mechanical. The income-consuming investors can relocate their portfolio to higher income assets. However, such reallocation cannot perfectly offset the effect of monetary policy because of two main reasons. First, portfolios that generate high income may disrupt the optimal allocation in terms of risk diversification. Second, demand for high-income assets is curbed by its general equilibrium effects on asset prices. We examine each factor separately.

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<sup>27</sup>For example, in an April 2011 WSJ article called "Fed's Low Interest Rates Crack Retirees' Nest Eggs" Mark Whitehouse reports that low interest rates force retirees to cut back their consumption (Whitehouse, 2011).

**Portfolio composition.** To understand the effect of the nominal constraint on agents' optimal portfolios independently of the general equilibrium effect, we first take returns as given and derive the optimal portfolio in a partial equilibrium setting in which asset have the same risk-return trade-off but differ in their dividend yield.<sup>28</sup> Figure 9 illustrates the agents' portfolio holdings of the high- and low-dividend stocks at time  $t = 0$  for each level of nominal interest rates. The blue and red lines are the portfolio holdings with and without the income constraint, respectively. Notice that, in the unconstrained setting, the portfolio holding of high-dividend stock and the low-dividend stock is the same, that is,  $\theta_H^{\text{unc}} = \theta_L^{\text{unc}}$ , because the two stocks have the same risk-return trade off. The split between current income and capital gain is irrelevant for the portfolio choice. More importantly, the portfolio holdings are unaffected by the level of the nominal interest rate. In contrast, in the constrained equilibrium, the income-consuming agent exhibits clear reaching-for-income behavior, holding a much larger fraction of the high-dividend assets,  $\theta_H^{\text{con}} > \theta_L^{\text{con}}$ . Furthermore, as the nominal risk-free rate  $r^{\$,F}$  decreases, the agent shifts his portfolio more aggressively toward the high-dividend asset.

**Equilibrium risk premia.** The demand patterns induced by the presence of the income constraint have implications for equilibrium asset prices in this economy. In the spirit of Baker and Wurgler (2004b), we define the equilibrium *dividend premium* as the ratio of the risk premium—the expected excess return over the risk-free rate—of the low-dividend yield stock and that of the high-dividend yield stock. Note that risk premia are inversely related to prices. Intuitively, this measure captures the relative valuation high- versus low-dividend yield assets in the economy. If the demand for the high-dividend yield asset increases, investors will bid up its prices and depress its risk premium.

Figure 10 plots the relationship between the equilibrium dividend premium and the nominal risk-free rate at time  $t = 0$ . The blue and red lines are the dividend premium in the unconstrained and constrained equilibrium respectively. In the unconstrained equilibrium, the dividend premium is unaffected by the level of the nominal risk free rate. Monetary policy is completely neutral. In constrained equilibrium, however, the reaching-for-income behavior of the time-inconsistent agent bids up the price of the high dividend yield asset ( $H$ ) relative to that of the low-dividend yield asset ( $L$ ) thus implying a higher dividend

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<sup>28</sup>Specifically, we assume that the realized return to each asset in each period has a binomial distribution with realizations  $R_u^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 + \sigma_j}$ , and  $R_d^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 - \sigma_j}$   $j = L, H$ , with  $\mu_H = \mu_L = 0.12$ , and  $\sigma_H = \sigma_L = 0.2$ . The probability distribution of outcomes is  $\Pr(R_u^H, R_u^L) = \Pr(R_d^H, R_d^L) = (1 + \rho)/4$  and  $\Pr(R_u^H, R_d^L) = \Pr(R_d^H, R_u^L) = (1 - \rho)/4$ , with  $\rho = 0.5$ . To implement the income constraint (17) we assume that the dividend yield  $dp^H = 0.7$  and  $dp^L = 0.1$

premium. These findings are qualitatively consistent with our empirical finding in Figure 5.<sup>29</sup>

Note that, in our model, monetary policy affects the *risk premium* of assets. This is in contrast to standard New Keynesian models in which monetary policy works by influencing the real *risk-free rate*. This feature of our model is consistent with a growing body of evidence that documents the impact of monetary policy shocks on asset prices through the risk premium channel (Bernanke and Kuttner, 2005; Gertler and Karadi, 2015; Hanson and Stein, 2015). Unlike the standard New Keynesian model, in which the main friction is price stickiness, in our model, prices are fully flexible and the key friction is the presence of a non-negligible fraction of agents that consume out of their financial income. This mechanism places our model within the class of models that studies the financial channel of monetary policy transmission.<sup>30</sup> The channel featured in our model can be incorporated in the standard New Keynesian framework by introducing 1) multiple assets with various level of current income yields; 2) living-off-income households in the spirit of constraint (16).

## IV. Implications of Reaching for Income

The previous section shows that in a model in which a group of investors follow the consumption rule of living off income, the optimal portfolio choices exhibit patterns that are consistent with our empirical finding in Sections I and II: a decrease in the interest rates leads these agents to reach for income. The resulting demand pressure further leads to asset price distortions. In this section, we discuss the relevance of these effects for capital allocation, portfolio diversification, and investors' risk-taking behavior.

*Capital reallocation.* In Section II, we show that monetary policy affects the returns of dividend-sorted portfolios. This has implications for the allocation of capital across firms with different dividend payout policies. In times of monetary policy easing, mature firms that are able to pay steady dividends will find it relatively easier to raise capital than young growing firms. If the investment opportunities of mature firms are inferior to those

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<sup>29</sup>Notice, however, that the variations in the dividend premium from our model are small. This is due to our stylized setting. In our two-period model, the dividend yield is high because in each period the dividend represents a large fraction of the price. Therefore, the variation in the risk-free rate has a small effect on the relative risk premium of the risky assets.

<sup>30</sup>See Drechsler, Savov, and Schnabl (2017b) for a survey of the literature on the financial channels of monetary policy.

of young firms, such capital retribution will dampen the stimulus effect of low-rate policy on aggregate investment.

*Catering.* In Section II, we show that low-interest rate monetary policy leads to higher valuation of dividend-paying stocks. Catering to such demand, firms may initiate dividends to boost their share prices. We find suggestive evidence of this in the data. Figure 12 plots the level of the fed funds rate (right axis) and the fraction of firms that initiate cash dividends in the following year (left axis). Panel A considers cash dividends while Panel B refers to share repurchases. From Panel A we note that more firms initiate cash dividends when the fed funds rate is lower. In contrast, Panel B shows that the likelihood of initiating share repurchases does not exhibit the same correlation with the fed funds rate. The different pattern between cash dividends and share repurchases is consistent with the hypothesis that low-interest rates increase the demand for current income rather than capital gains. In aggregate, however, the catering behavior of firms does not seem to be able to satisfy all of the excess demand as asset prices of dividend-paying firms still rise. A possible reason is that it may be costly for some firms to change their dividend payout policy, e.g., Lintner (1956). The finding that low-interest-rate monetary policy induces firms to initiate dividends also provides a possible explanation for the reappearing dividends after 2000s as documented by Julio and Ikenberry (2004) and Michaely and Moin (2017).

*Portfolio under-diversification.* Accommodative monetary policy may induce under-diversification of investors' portfolios. As Figure 9 shows, a fully diversified portfolio in our model would have equal weights in both the high- and low-dividend stocks. However, as accommodative monetary policy depresses interest income, reaching-for-income investors buy 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 a high dividend usually concentrate in certain sectors such as utilities and telecommunications. Reaching for income would lead to excessive exposure to these sectors. Furthermore, to the extent that firms' high-dividend yields might be a consequence of depressed prices during financial distress, reaching for income may over-expose investors' portfolios to distress-related events.

*Risk-taking.* In an ultra low rate environment, "reaching-for-income" investors may take excessive risks. As Figure 9 illustrates, when the risk-free rate is below a certain threshold, a further cut in interest rates can increase the weight of *both* high- and low-

dividend stocks. This is because low-dividend stocks become attractive for income-seeking investors when bond yields are extremely low. As investors are substituting into both high- and low-dividend stocks, the overall portfolio risks in a non-linear fashion.

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

## V. Conclusion

This paper proposes a new channel of monetary transmission through the differential demand for high- and low-income assets following changes in interest rates. We start our analysis from an observation that many investors follow the rule of thumb of living off the income from their investments, while keeping the principal untapped. This rule of thumb implies that investors may “reach for income” during periods of accommodative monetary policy when the interest income from deposits and short-term bonds becomes insufficient relative to their desired consumption. Using data on individual stock holdings and mutual fund flows, we show that the reaching for income phenomenon is widespread and economically important. We document large and persistent inflows to high-income-yield assets following monetary loosening, and reversals following monetary tightening, implying strong shifts in investors’ demand. We also find that monetary policy significantly affects the relative valuation of firms with different dividend policies. A dynamic trading strategy which exploits such changes in relative valuations generates significant excess returns.

We construct a theoretical model which shows that a departure from the permanent income hypothesis in the form of “living off income” naturally leads to a violation of the dividend irrelevance theorem in investors’ portfolio choice decisions (Miller and Modigliani, 1961). Monetary policy, by influencing investors’ portfolio choices, will have real effects even in an economy in which prices are fully flexible. This channel is outside the standard New Keynesian framework in which the key friction driving the link between monetary policy and real activity is price stickiness, and in which the financial market is largely a veil.

Overall, our results add to a growing body of research showing that the monetary authority exerts a profound impact on the economy through the financial sector. We show that, through the reaching-for-income channel, monetary policy affects the cross-section of asset prices and ultimately, capital allocation in the aggregate. Furthermore, an ultra-low interest rate policy may induce investors to rebalance from bonds to stocks, potentially taking excessive amount of risk. We believe that these effects should be properly accounted for in the design and implementation of monetary policy.

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**Table I: Summary Statistics of the Stock-Holding Sample**

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

	mean	sd	p10	p25	p50	p75	p90
Net Buy	0.156	0.524	0.000	0.000	0.000	0.000	1.000
Income Yield	0.021	0.025	0.000	0.000	0.011	0.036	0.057
Repurchase Yield	0.005	0.027	0.000	0.000	0.000	0.000	0.012
Market Beta	1.113	0.578	0.417	0.719	1.083	1.459	1.856
Book-to-Market	0.628	0.505	0.153	0.274	0.505	0.826	1.213
Past 1-year Return	0.820	1.247	-0.732	0.127	1.013	1.559	2.232
Past 3-year Return	0.217	0.753	-0.675	-0.120	0.292	0.622	1.044
Market Cap (log)	14.181	2.478	10.666	12.310	14.431	16.167	17.316
Profit Margin	0.291	0.597	0.107	0.213	0.351	0.495	0.652
ROE	0.033	0.362	-0.261	0.012	0.103	0.187	0.289
Retiree	0.233	0.422	0.000	0.000	0.000	0.000	1.000
Labor Income	3.921	3.345	0.000	0.000	5.000	7.000	8.000
Home Owner	0.593	0.491	0.000	0.000	1.000	1.000	1.000
Married	0.425	0.494	0.000	0.000	0.000	1.000	1.000
Male	0.582	0.493	0.000	0.000	1.000	1.000	1.000
Bank Card	0.724	0.447	0.000	0.000	1.000	1.000	1.000
Vehicles	0.479	0.825	0.000	0.000	0.000	1.000	2.000

**Table II: Summary Statistics of the Mutual Fund Sample**

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

## Panel A: Equity Funds

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

## Panel B: Bond Funds

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

**Table III: Demographics of Withdrawers**

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

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

**Table IV: Stock Holdings and Monetary Policy**

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

$$\text{Net Buy}_{i,j,t+6} = \beta_1 \Delta \text{FFR}_t + \beta_2 \Delta \text{FFR}_t \times \text{High Div}_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t}.$$

where  $\text{Net Buy}_{i,j,t+6}$  is a categorical variable defined in equation (1) which indicates whether the holding of stock  $i$  by household  $j$  increases or decreases from month  $t$  to  $t + 6$ .  $\Delta \text{FFR}_t$  represents the three-year change in the fed funds rate leading up to month  $t$ ;  $\text{High Div}_{i,t}$  is a dummy variable that equals 1 if the income yield of a stock is in the top decile for a given month, and 0 otherwise; and  $X_{i,j,t}$  is a set of control variables. The first subset of control variables are stock characteristics including high repurchase dummy and its interaction with the 3-year change in the fed funds rate ( $\Delta \text{FFR}_t * \text{High Repurchase}_{i,t}$ ), market beta and its interaction with the 3-year change in the fed funds rate ( $\Delta \text{FFR}_t * \text{Beta}_{i,t}$ ), book-to-market ratio and its interaction with the 3-year change in the fed funds rate ( $\Delta \text{FFR}_t * \text{BM}_{i,t}$ ), past 1-year and 3-year returns, log market capitalization, profit margin, and ROE. The second set of characteristics are demographic variables such as home-ownership, marital status, and gender. The sample includes all the stock positions in the LBD data from 1991 to 1996. Standard errors are in parentheses, with \*, \*\*, and \*\*\* denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered by household and by month.

	(1)	(2)	(3)
	Net Buy	Net Buy	Net Buy
$\Delta \text{ FFR}$	0.615*** [0.119]	0.497*** [0.109]	0.384*** [0.132]
$\Delta \text{ FFR} * \text{High Dividend}$	-0.837** [0.373]	-1.013*** [0.350]	-0.655** [0.326]
$\Delta \text{ FFR} * \text{High Repurchase}$	-0.134 [0.196]	-0.0621 [0.195]	-0.0141 [0.222]
$\Delta \text{ FFR} * \text{Beta}$	-0.273*** [0.0643]	-0.215*** [0.0595]	-0.0907 [0.0646]
$\Delta \text{ FFR} * \text{BM}$	0.0867 [0.0930]	0.0652 [0.0978]	0.0638 [0.110]
Stock Characteristics	Yes	Yes	Yes
Demographics	Yes	Yes	Yes
Household F.E.	No	Yes	Yes
Stock F.E.	No	No	Yes
Observations	1,988,275	1,988,108	1,988,006
Adj. R-squared	0.001	0.095	0.113

**Table V: Local Deposit Rates and Stock Holdings**

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

Net Buy $_{i,j,m,t+6} = \beta_1 \Delta \text{Dep Rates}_{m,t} + \beta_2 \Delta \text{Dep Rates}_{m,t} \times \text{High Div}_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t}$   
 where *Net Buy* $_{i,j,m,t+6}$  is a categorical variable defined in equation (1) which indicates whether the holding of stock  $i$  by household  $j$  in MSA  $m$  increases or decreases from month  $t$  to  $t + 6$ .  $\Delta \text{Dep Rates}_{m,t}$  is the 3-year change in deposit rates leading up to month  $t$ . *High Div* $_{i,t}$  is a dummy variable that equals 1 if the dividend yield of a stock is in the top decile for a given month and 0 otherwise;  $X_{i,j,t}$  is a set of control variables including high repurchase dummy and its the interaction with the 3-year change in deposit rates ( $\Delta \text{Dep Rates}_{m,t} * \text{High Repurchase}_{i,t}$ ), market beta and its interaction with the 3-year change in deposit rates ( $\Delta \text{Dep Rates}_{m,t} * \text{Beta}_{i,t}$ ), book-to-market ratio and its interaction with the 3-year change in deposit rates ( $\Delta \text{Dep Rates}_{m,t} * \text{BM}_{i,t}$ ), past 1-year and 3-year returns, log market capitalization, profit margin, and ROE. The local deposit rates are average bank deposit rates in each MSA weighted by deposits. The sample includes all the stock positions in the LBD data from 1991 to 1996. Column 1 includes all the individuals. Columns 2–3 include withdrawers and non-withdrawers respectively. *Withdrawers* represents individuals who have an above-median frequency of withdrawing their dividend income rather than reinvesting it. Standard errors are in parentheses, with \*, \*\*, and \*\*\* denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered by household and by month.

	(1) All	(2) Withdrawers	(3) Non-Withdr.
$\Delta$ Dep Rates	0.00881 [0.437]	0.00440 [0.475]	0.102 [0.730]
$\Delta$ Dep Rates*High Dividend	-2.750*** [0.997]	-3.062*** [1.076]	-1.266 [1.249]
$\Delta$ Dep Rates*High Repurchase	0.812 [0.625]	0.747 [0.585]	1.257 [1.345]
$\Delta$ Dep Rates*Beta	0.414* [0.243]	0.359 [0.246]	0.580* [0.316]
$\Delta$ Dep Rates*BM	0.0931 [0.185]	0.136 [0.204]	-0.0917 [0.275]
Stock Characteristics	Yes	Yes	Yes
Household F.E.	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes
MSA F.E.	Yes	Yes	Yes
Observations	1,451,722	1,160,144	291,578
Adj. R-squared	0.096	0.093	0.083

**Table VI: Mutual Fund Flows, Income Yields, and Monetary Policy**

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

$$\text{Flow}_{i,t+1} = \beta_1 \text{FFR}_t \times \text{High Income}_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t},$$

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

	All		Retail		Institution	
	(1) Equity	(2) Bond	(3) Equity	(4) Bond	(5) Equity	(6) Bond
$\Delta \text{ FFR} \times \text{High Income}$	-0.128*** [0.032]	-0.054* [0.030]	-0.142*** [0.048]	-0.101*** [0.038]	-0.066 [0.044]	-0.067 [0.048]
$\Delta \text{ FFR} \times \text{Volatility}$	0.012 [0.014]	-0.134*** [0.017]	0.043** [0.019]	-0.081*** [0.022]	0.012 [0.016]	-0.154*** [0.033]
$\Delta \text{ Tax} \times \text{High Dividend}$	-0.203*** [0.030]	-0.018 [0.030]	-0.193 [0.207]	0.152 [0.171]	0.033 [0.161]	-0.061 [0.171]
Fund Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	870034	1075129	411721	500503	292252	237698
Adj. R-squared	0.017	0.013	0.021	0.021	0.009	0.006

**Table VII: Mutual Fund Flows and Monetary Policy: Robustness**

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

$$\text{Flow}_{i,t+1} = \beta_1 \Delta \text{FFR}_t \times \text{High Income}_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t},$$

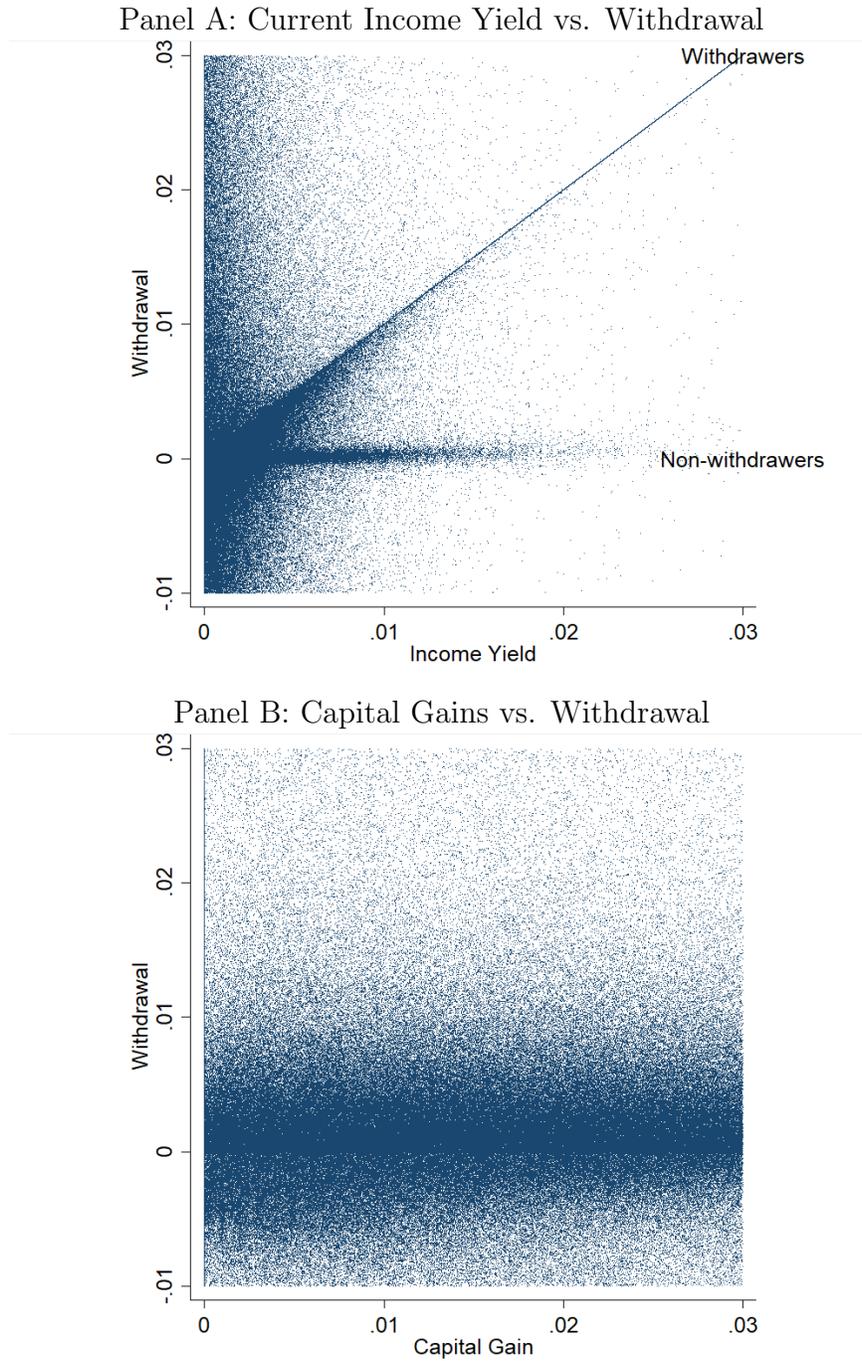
where  $\text{Flow}_{i,t}$  represents flows into mutual fund  $i$  at time  $t$ ;  $\Delta \text{FFR}_t$  represents the three-year change in the fed funds rate leading up to month  $t$ ; and  $X_{i,t}$  is a set of control variables including: *Volatility*,  $\Delta \text{FFR} \times \text{Volatility}$ ,  $\Delta \text{Tax} \times \text{High Dividend}$ , *Return*, *Size*, *Turnover*, and *Expense*. *Return* is fund return over the preceding month; *Volatility* is the standard deviation of fund returns for the past year;  $\Delta \text{Tax}$  is the difference between the maximum individual income tax rate and the capital gain tax rate; *Size* represents the assets under management (log); and *Expense* represents the expense ratio. Column 1 uses fund names to classify high income. Column 2 adds the interaction term between the high-income dummy with the change in term spreads. Column 3 separately estimate the effect of rate increase and rate reduction. Column 4 uses the sample from 1961 to 2016 with annual frequency. Standard errors are in parentheses, with \*, \*\*, and \*\*\* denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered by month.

	(1)	(2)	(3)	(4)
	Fund Name	Term Spreads	Increase vs. Decrease	Long Sample
$\Delta \text{FFR} \times \text{High Income}$	-0.185*** [0.027]	-0.468*** [0.099]		-0.052** [0.026]
$\Delta \text{Term Spread} \times \text{High Income}$		-0.399*** [0.130]		
$\Delta \text{FFR} \times \text{High Income (Increase)}$			-0.138** [0.064]	
$\Delta \text{FFR} \times \text{High Income (Decrease)}$			-0.123** [0.047]	
Fund Controls	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes
Objective F.E.	Yes	Yes	Yes	Yes
Observations	2195135	2195135	1887323	223116
Adj. R-squared	0.010	0.011	0.011	0.068

**Table VIII: Monetary Policy and Excess Returns of Dividend Decile Portfolios**

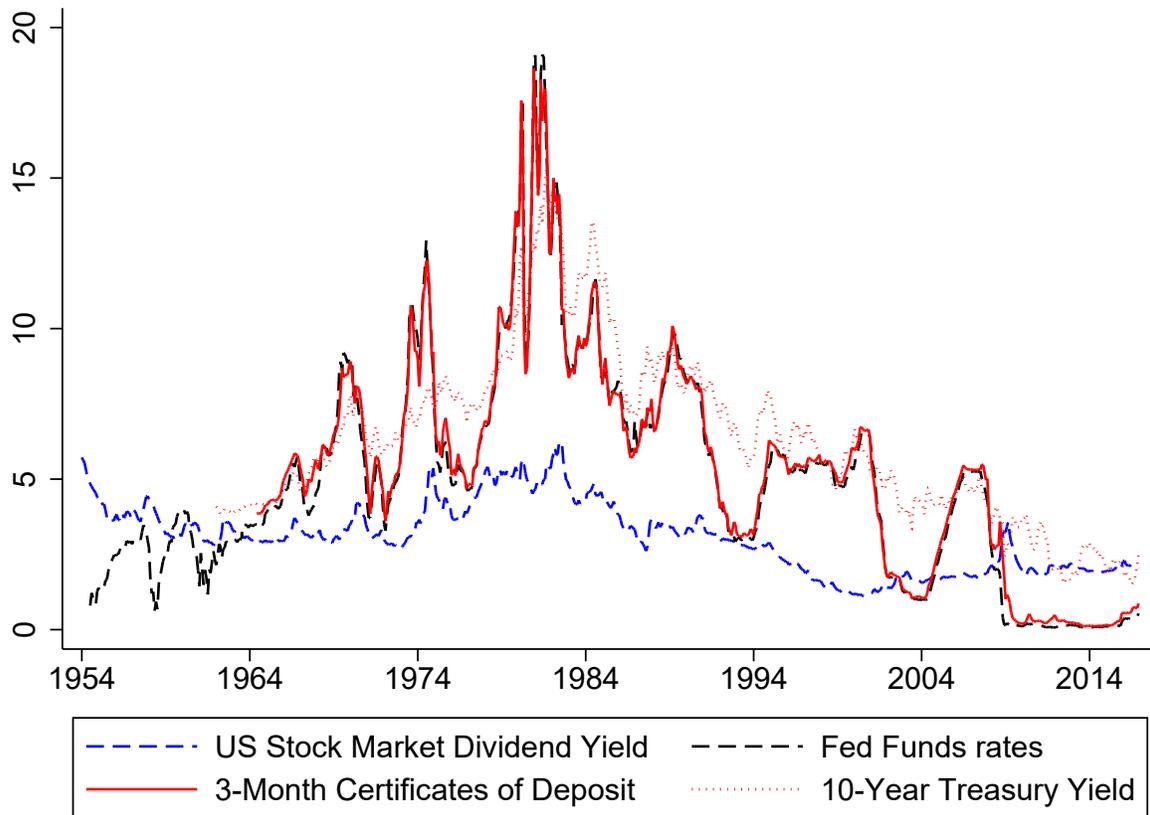
This table reports Fama French 5-factor alphas of equal-weighted portfolios formed on dividend yields conditional on the stance of monetary policy over the sample period of 1963 to 2016. When the 1-year change of fed funds rate is positive, we classify it as rising FFR; when negative, we classify it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

	Rising FFR	Declining FFR	Rising-Declining
Decile 1	0.019 [0.087]	-0.172* [0.094]	0.191 [0.128]
Decile 2	-0.006 [0.077]	-0.021 [0.071]	0.015 [0.105]
Decile 3	-0.046 [0.071]	-0.100 [0.069]	0.054 [0.099]
Decile 4	-0.047 [0.073]	-0.048 [0.070]	0.000 [0.101]
Decile 5	-0.103 [0.069]	-0.015 [0.069]	-0.088 [0.098]
Decile 6	-0.043 [0.070]	0.062 [0.073]	-0.105 [0.101]
Decile 7	-0.057 [0.067]	0.152** [0.070]	-0.209** [0.097]
Decile 8	-0.024 [0.069]	0.254*** [0.075]	-0.278*** [0.101]
Decile 9	-0.121* [0.064]	0.253*** [0.079]	-0.374*** [0.102]
Decile 10	-0.164 [0.101]	0.237* [0.129]	-0.401*** [0.163]
Decile 10 - Decile 1	-0.184 [0.134]	0.408*** [0.160]	-0.592*** [0.208]



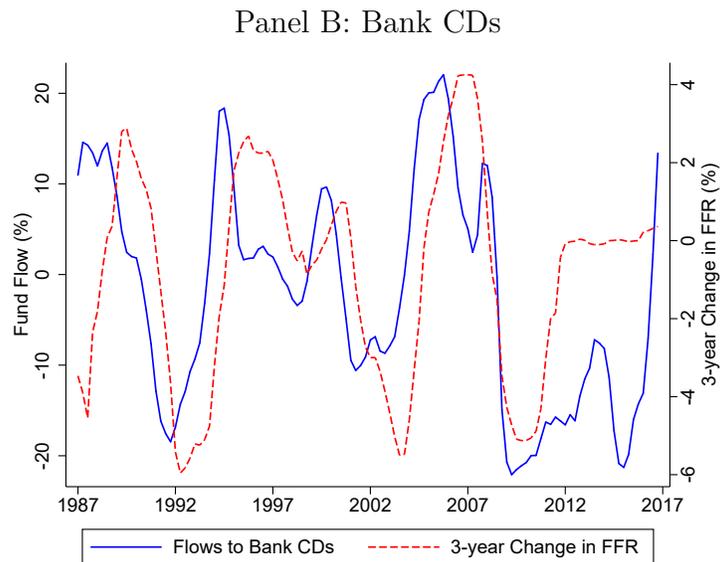
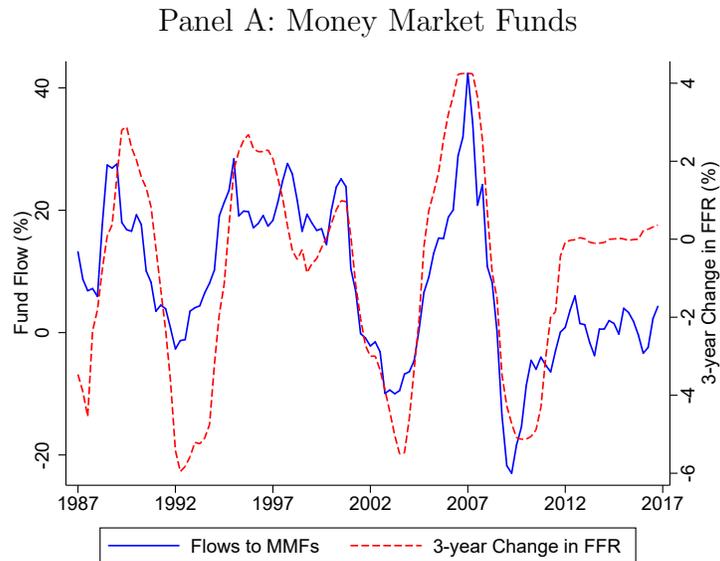
**Figure 1: Current Income, Capital Gains, and Net Withdrawals**

The figure shows a scatter plot of monthly net withdrawals against current income yields (Panel A) or capital gains (Panel B) in the same month. Following Baker, Nagel, and Wurgler (2007), withdrawals are defined as households' monthly net withdrawals from their brokerage account scaled by the account value in the previous month. Income yields are defined as the sum of stock dividends and bond coupons scaled by the account value in the previous month. Capital gains are defined as the total price changes scaled by the account value in the previous month. The graph is truncated at 4% for both axes to drop outliers.



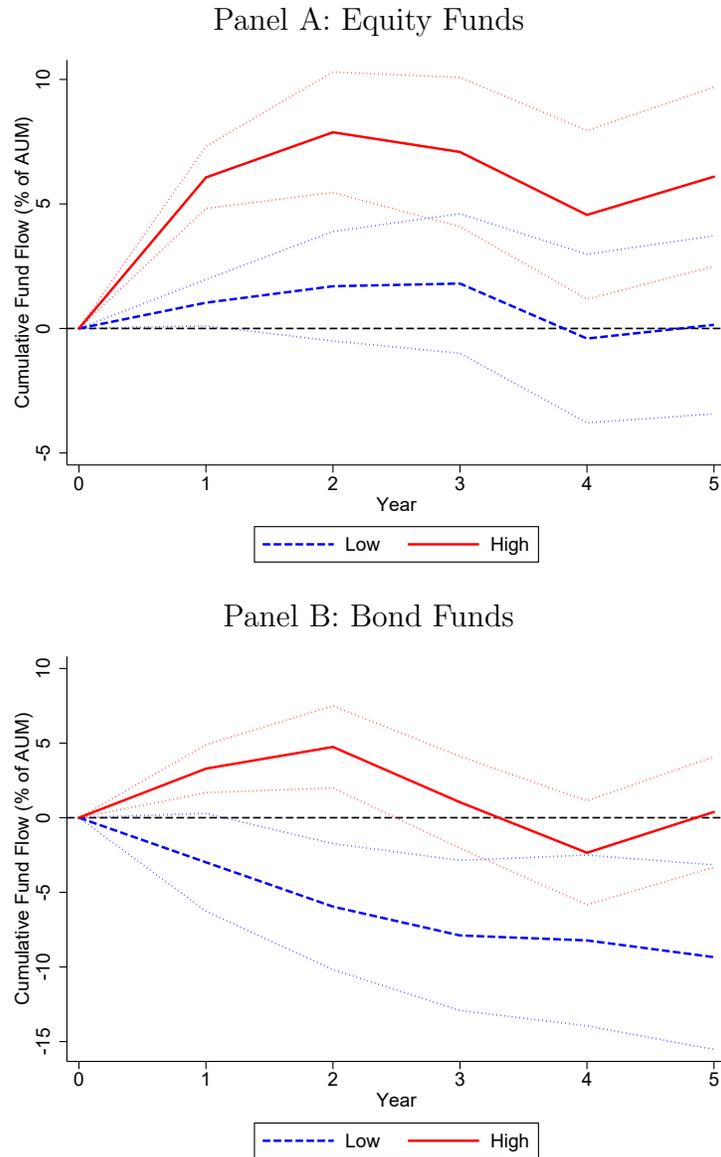
**Figure 2: Income Yields of Stocks and Bonds over Monetary Cycles**

This figure shows the aggregate U.S. stock market dividend yield and the fed funds rate from 1963 to 2016. The aggregate stock market dividend yield is retrieved from Robert Shiller’s website. The yield of 3-month certificates of deposit and 10-year Treasury yield is retrieved from the FRED database of the St. Louis Fed.



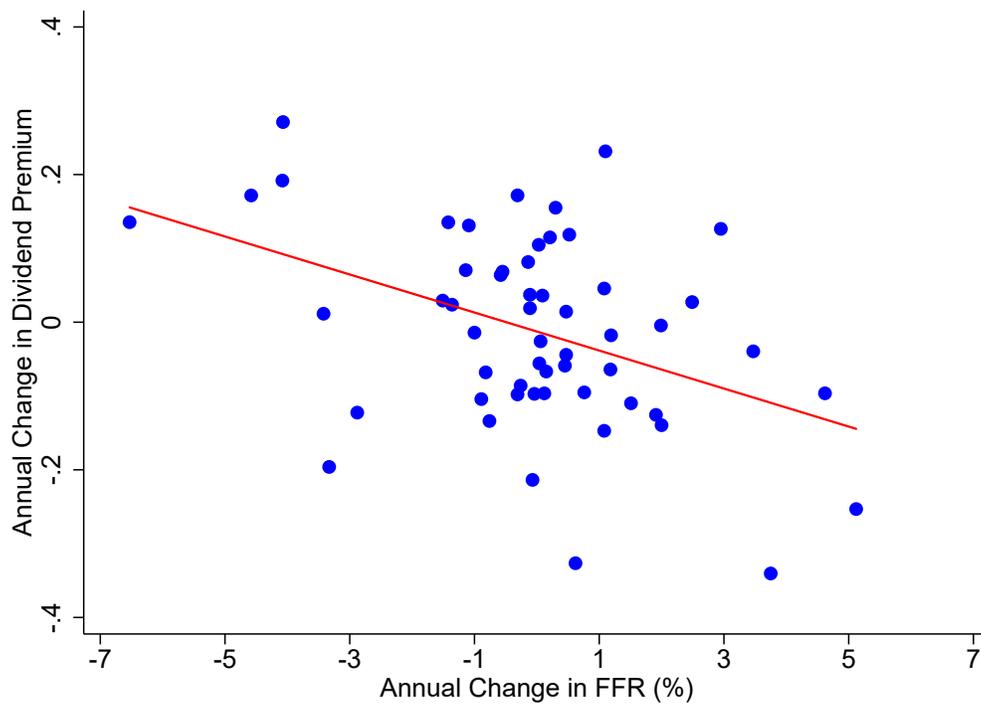
**Figure 3: Fund Flows to Money Market Funds and Bank CDs**

The solid lines plot the time series of annual fund flows for money market funds (the upper panel) and bank CDs (the lower panel); the dashed lines are the changes in the fed funds rate over the past 3 years. The data is at a quarterly frequency. The data source is the FRED database of the St. Louis Fed.



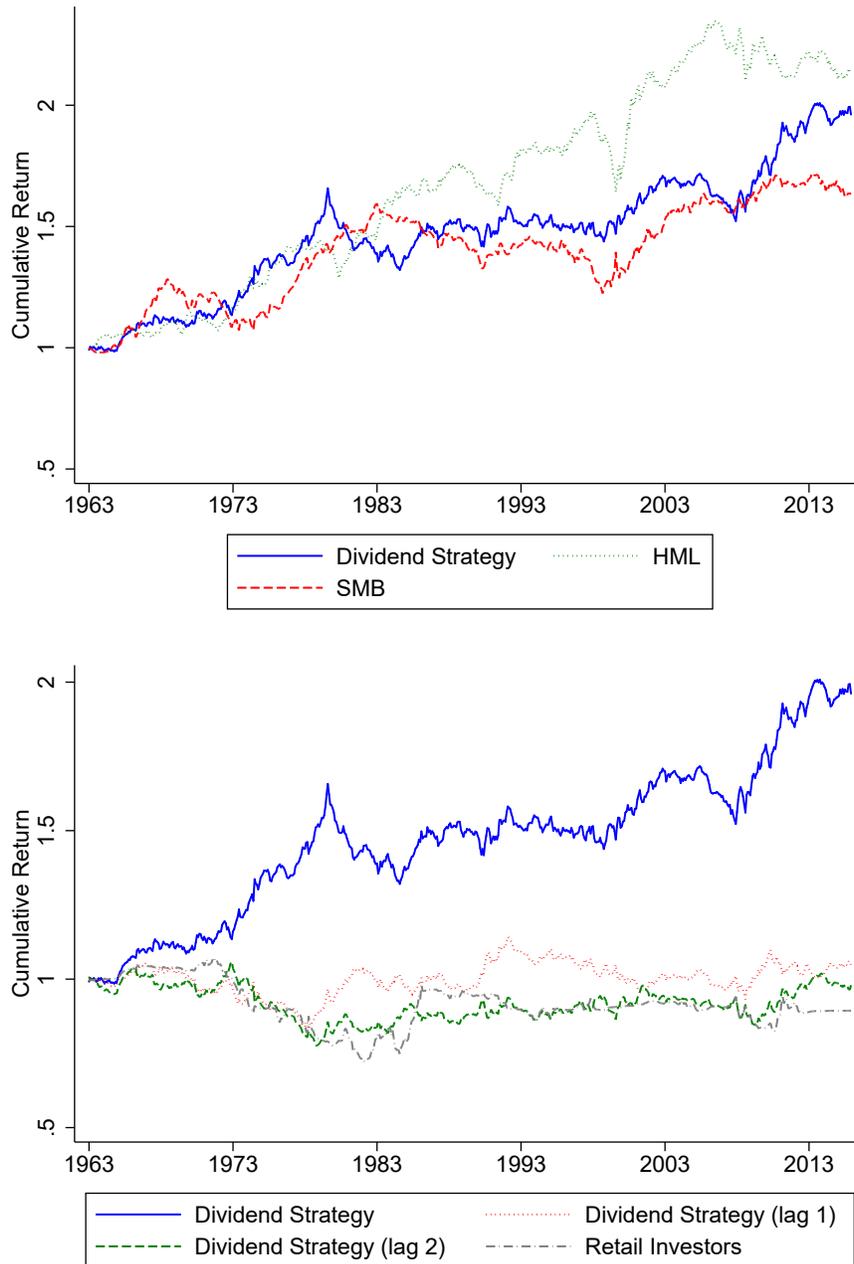
**Figure 4: Impulse Response of Fund Flows to Changes in the Fed Funds Rate**

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



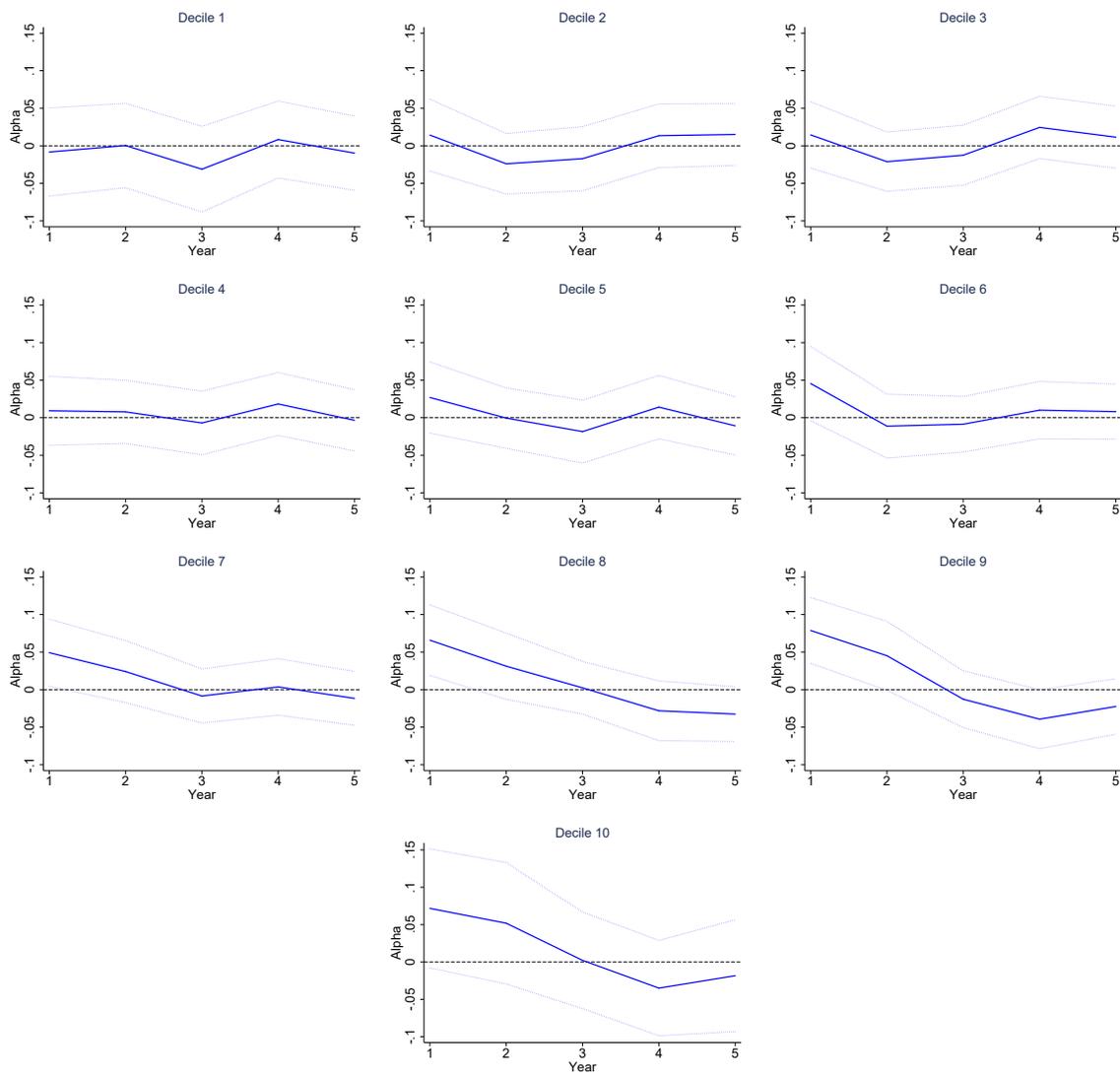
**Figure 5: Changes in the Dividend Premium and the Fed Funds Rate**

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



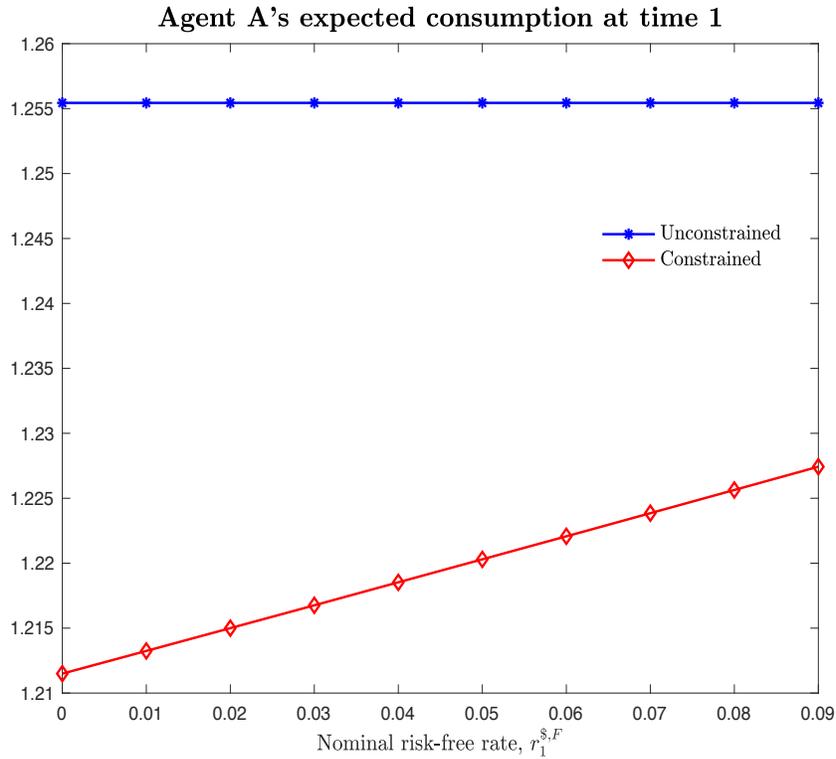
**Figure 6: Cumulative Return of the Dividend Strategy**

This figure plots the cumulative risk-adjusted return of the dividend strategy that (i) buys the tenth decile of the dividend portfolio and shorts the first decile after a negative one-year change in the fed funds rate, and (ii) buys the first decile of the dividend portfolio and shorts the tenth decile after a positive one-year change in the fed funds rate. Dividend strategy (lag  $n$ ) is defined as the same long-short portfolios as the baseline but the portfolio adjustment is made with a  $n$ -year lag. The retail investor returns are calculated using a strategy which mimic the flows to high-income equity funds when the fed funds rate changes. The returns are normalized to have the same monthly standard deviation of 1%.



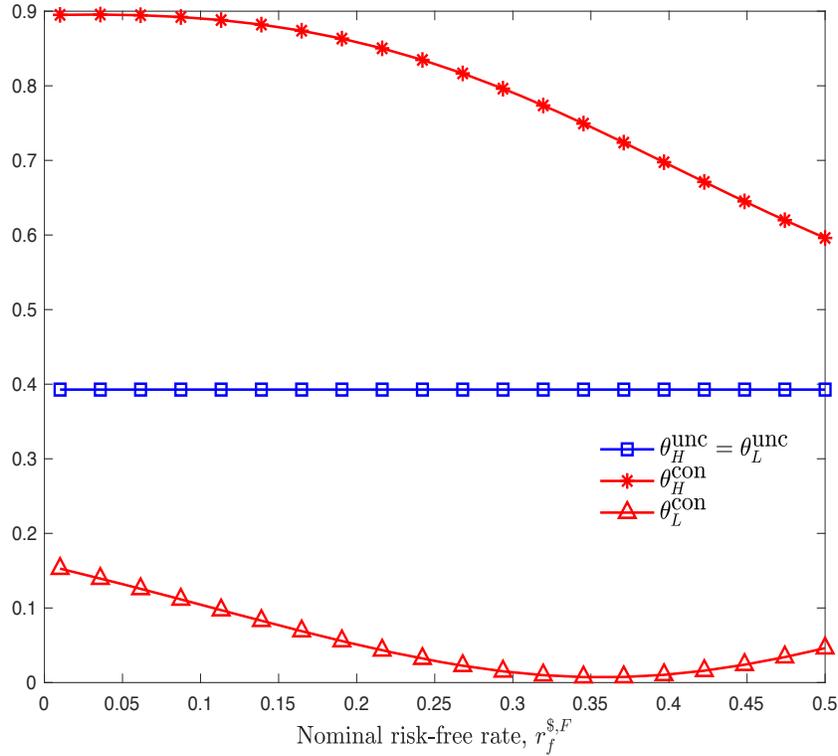
**Figure 7: Impulse Response of Alphas to Monetary Policy by Dividend Deciles**

This solid lines in each figure plot the impulse response ( $\beta_{i,h}$  from regression (8)) of the Fama-French 5-factor alphas of the 10 dividend decile portfolios to a negative 1% shock on the fed funds rate. The dotted lines represent 95% confidence intervals. The sample period is from July 1963 to June 2016.



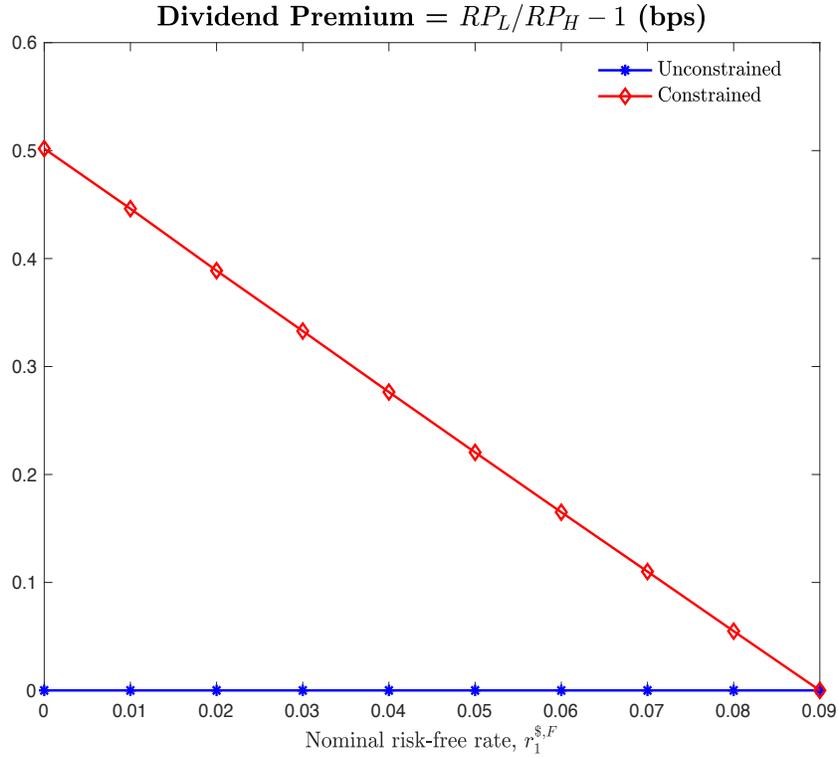
**Figure 8: Monetary Policy and Consumption**

The figure reports the equilibrium expected consumption at time 1 of Agent A. Expected consumption is computed as the probability weighted average of consumption in the four possible states. The blue and red lines represent the unconstrained and constrained equilibrium respectively. Preferences parameter values:  $\gamma_A = \gamma_B = 3$ ,  $\delta_A = \delta_B = 0.98$ . We assume that the dividend growth of both endowment trees have volatility:  $\sigma_H = \sigma_L = 0.2$  and correlation  $\rho = 0.5$ . Asset  $H$  (value stock) has an expected dividend growth rate  $\mu_H = 0.02$  and asset  $L$  (growth stock) has expected dividend growth rate  $\mu_L = 0.04$ .



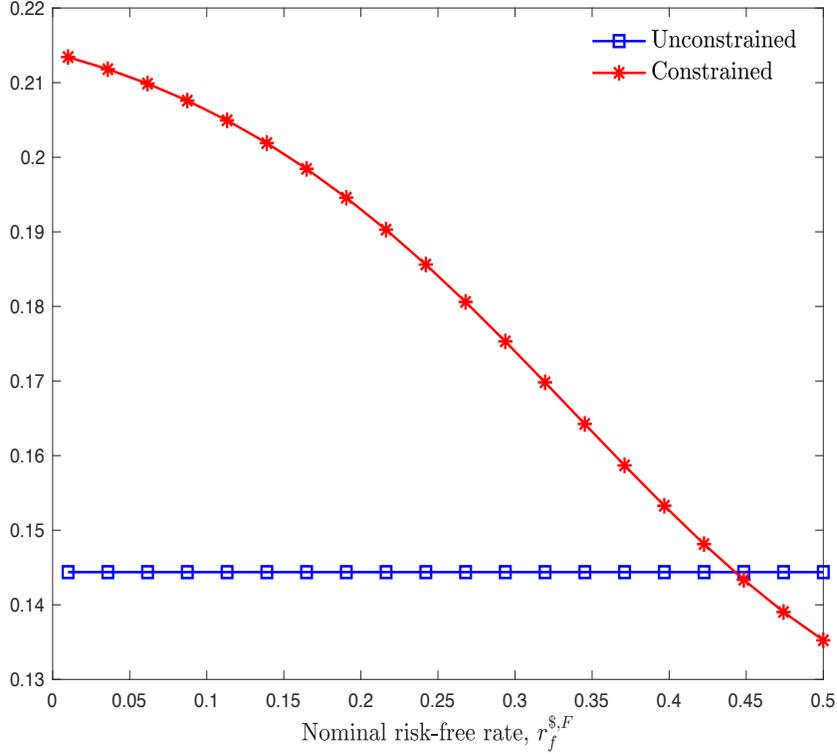
**Figure 9: Monetary Policy and Portfolio Holdings**

The figure reports portfolio holdings as a function of the nominal interest rate. For illustrative purposes we take asset returns as given. The portfolio  $(\theta_H, \theta_L)$  refers, respectively, to the holdings of the high- and low-dividend-paying asset. The blue and red lines represent the unconstrained and constrained portfolios, respectively. The realized return to each asset in each period has a binomial distribution with realizations  $R_u^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 + \sigma_j}$ , and  $R_d^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 - \sigma_j}$   $j = L, H$ , with  $\mu_H = \mu_L = 0.12$ , and  $\sigma_H = \sigma_L = 0.2$ . The probability distribution of outcomes is  $\Pr(R_u^H, R_u^L) = \Pr(R_d^H, R_d^L) = (1 + \rho)/4$  and  $\Pr(R_u^H, R_d^L) = \Pr(R_d^H, R_u^L) = (1 - \rho)/4$ , with  $\rho = 0.5$ . To implement the income constraint (17) we assume that the dividend yield  $dp^H = 0.7$  and  $dp^L = 0.1$ . The agent has risk aversion parameter is  $\gamma = 3$  and time preference parameter  $\delta = 0.98$ .



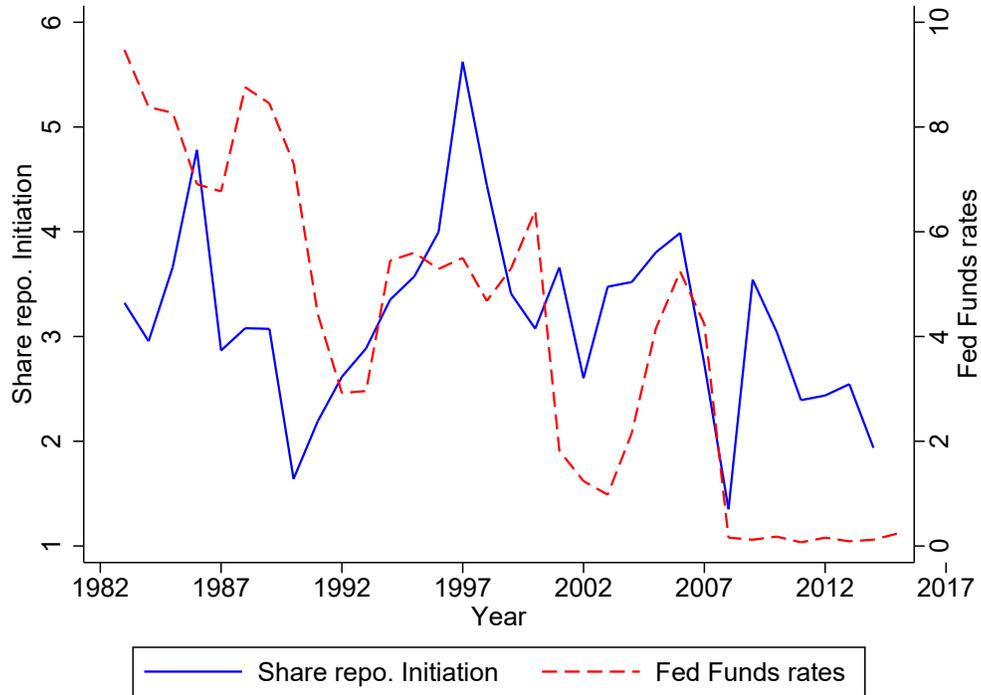
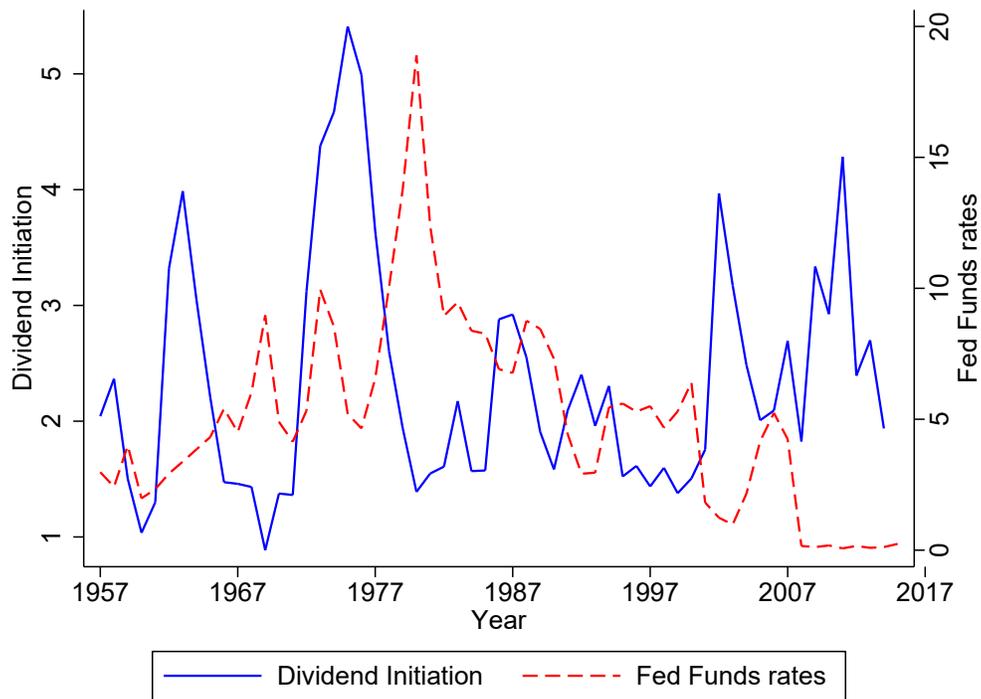
**Figure 10: Monetary Policy and Dividend Premium**

The figure reports the dividend premium as a function of the nominal risk-free rates in the general equilibrium model of two agents. The blue and red lines represent the unconstrained and constrained equilibrium respectively. Preferences parameter values:  $\gamma_A = \gamma_B = 3$ ,  $\delta_A = \delta_B = 0.98$ . We assume that the dividend growth of both endowment trees have volatility:  $\sigma_H = \sigma_L = 0.2$  and correlation  $\rho = 0.5$ . Asset  $H$  (value stock) has an expected dividend growth rate  $\mu_H = 0.02$  and asset  $L$  (growth stock) has expected dividend growth rate  $\mu_L = 0.04$ . The dividend premium is defined as the ratio of the risk premium of the growth stock and the value stock minus one. We normalize the dividend premium for the unconstrained economy to zero to facilitate comparison. We express the dividend premium in basis points.



**Figure 11: Monetary Policy and Portfolio Volatility**

The figure reports the volatility of the time-0 portfolio as a function of the nominal interest rate. For illustrative purposes we take asset returns as given. The blue and red lines represent the unconstrained and constrained setting, respectively. The realized return to each asset in each period has a binomial distribution with realizations  $R_u^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 + \sigma_j}$ , and  $R_d^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 - \sigma_j}$   $j = L, H$ , with  $\mu_H = \mu_L = 0.12$ , and  $\sigma_H = \sigma_L = 0.2$ . The probability distribution of outcomes is  $\Pr(R_u^H, R_u^L) = \Pr(R_d^H, R_d^L) = (1 + \rho)/4$  and  $\Pr(R_u^H, R_d^L) = \Pr(R_d^H, R_u^L) = (1 - \rho)/4$ , with  $\rho = 0.5$ . To implement the income constraint (17) we assume that the dividend yield  $dp^H = 0.6$  and  $dp^L = 0.1$ . The agent has risk aversion parameter is  $\gamma = 3$  and time preference parameter  $\delta = 0.98$ .



**Figure 12: Dividend Initiations and the Fed Funds Rate**

The figure reports the time series plot of the fed funds rate and the frequency of dividend and repurchases initiations in next year scaled by total number of firms in the Compustat database. The sample includes all the Compustat firms from 1962 to 2016.

## A. List of variables

<b>Individual Holding Data</b>	
<b>Variable</b>	<b>Details of construction</b>
Net Buy	A categorical variable which takes the value of 1 if stock $i$ 's position in account $j$ increases from month $t$ to $t+6$ ; $-1$ if the position decreases, and 0 if the position stays constant.
Dividend Yield	The ratio of the dividend over the past year to the stock price at $t$
Repurchase Yield	The dollar value of repurchase per share of stock to the share price.
Home Owner	A dummy variable which takes the value of 1 if an account holder owns a home, and 0 otherwise
Married	A dummy variable which takes the value of 1 if an account holder is married, and 0 otherwise
Male	A dummy variable which takes the value of 1 if an account holder is male, and 0 otherwise
Retirees	Individuals whose age is above 65
Withdrawers	Individuals who have above a median frequency to withdraw their dividend income rather than reinvesting it
$\Delta$ Deposit Rates	Local deposit rates are constructed in the following steps. First, we calculate deposit rates of each bank by dividing bank interest payments on deposits by total deposits held at the end of each quarter. Then we take average across all the banks in a metropolitan statistical area (MSA) to calculate the MSA level deposit rates. Each bank's deposit rate is weighted by the amount of deposits of this bank's branches in the MSA.
Income	Labor income of the account holder
Bank Card	A dummy variable which takes the value of 1 if an account holder has a bank card
Vehicles	A dummy variable which takes the value of 1 if an account holder has a vehicle

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## Mutual Fund Data

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Variable	Details of construction
Flow	Monthly changes in total net assets (TNA) adjusted for fund returns
Income Yield	The total income (dividends and coupons) over the past year to the net asset value
High Income	A dummy variable that takes the value of 1 if a fund is in the top decile of the income yield distribution for a given month, and 0 otherwise
Return	Past one-month gross return
Volatility	Annualized monthly return volatility over the past 12 months.
Size	Assets under management (log)
Expense	Expense ratio
$\Delta$ Tax	3-year change in the difference in tax on dividends and capital gains. The tax rate on dividends is the maximum individual tax rate retrieved from the FRED database from the St. Louis Fed. The series name is "IITTRHB." The tax rate on capital gains is retrieved from Treasury Department website.
$\Delta$ FFR	3-year change in the fed funds rate. The fed funds rate is retrieved from the FRED database from the St. Louis Fed. The series name is "FEDFUNDS."

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## B. Proof of Proposition 1:

Using the definition of portfolio weights (18), we can express the nominal constraint (16) as follows

$$C_{A,t}\Pi_t \leq (W_{A,t-1}^{\$} - C_{A,t-1}^{\$}) \left[ \theta_{A,t-1}^F \frac{\Pi_t - P_{t-1}^{\$,F}}{P_{t-1}^{\$,F}} + \theta_{A,t-1}^L \frac{D_t^{\$,L}}{P_{t-1}^{\$,L}} + \theta_{A,t-1}^H \frac{D_t^{\$,H}}{P_{t-1}^{\$,H}} \right] \quad (\text{B1})$$

$$= (W_{A,t-1}^{\$} - C_{A,t-1}^{\$}) \left[ \theta_{A,t-1}^F \left( R_t^{\$,F} - 1 \right) + \theta_{A,t-1}^L \frac{D_t^{\$,L}}{P_{t-1}^{\$,L}} + \theta_{A,t-1}^H \frac{D_t^{\$,H}}{P_{t-1}^{\$,H}} \right] \quad (\text{B2})$$

where

$$R_t^{\$,f} \equiv \frac{\Pi_t}{P_{t-1}^{\$,f}} = \frac{1}{P_{t-1}^F \frac{\Pi_{t-1}}{\Pi_t}} = R_t^F \frac{\Pi_t}{\Pi_{t-1}}, \quad (\text{B3})$$

where  $R_t^F$  denotes the time- $t$  real risk free rate  $R_t^F = 1/P_{t-1}^F$ .

Transforming the income constraint in real terms using the price levels  $\Pi_t$  and  $\Pi_{t-1}$  and using (B3) we have

$$C_{A,t}\Pi_t \leq (W_{A,t-1} - C_{A,t-1}) \Pi_{t-1} \left[ \theta_{A,t-1}^F \left( R_t^F \frac{\Pi_t}{\Pi_{t-1}} - 1 \right) + \theta_{A,t-1}^L \frac{D_t^L \Pi_t}{P_{t-1}^L \Pi_{t-1}} + \theta_{A,t-1}^H \frac{D_t^H \Pi_t}{P_{t-1}^H \Pi_{t-1}} \right],$$

which simplifies to

$$C_{A,t} \leq (W_{A,t-1} - C_{A,t-1}) \left[ \theta_{A,t-1}^F \left( R_t^F - \frac{\Pi_{t-1}}{\Pi_t} \right) + \theta_{A,t-1}^L \frac{D_t^L}{P_{t-1}^L} + \theta_{A,t-1}^H \frac{D_t^H}{P_{t-1}^H} \right]. \quad (\text{B4})$$

By definition, inflation  $\pi_t$  is the change in price levels, that is,

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

When inflation is small,  $\frac{\Pi_{t-1}}{\Pi_t} \approx 1 - \pi_t$ , and therefore the income yield of bonds in (B4) is the *net* nominal interest rate, that is,

$$R_t^F - \frac{\Pi_{t-1}}{\Pi_t} \approx 1 + r_t^F - (1 - \pi_t) = r_t^F + \pi_t = r_t^{\$,F}.$$

Using this approximation in (B4), we obtain that the nominal income constraint (16) can be written as a function of the nominal interest rate  $r_t^{\$,F}$  and risky assets' real dividend

yields  $dp_t^j = D_t^j/P_{t-1}$ ,  $j = H, L$ , that is,

$$\frac{C_t}{W_{t-1} - C_{t-1}} \leq \theta_{t-1}^F r_t^{s,F} + \theta_{t-1}^L dp_t^L + \theta_{t-1}^h dp_t^H. \quad (\text{B5})$$

■

# Online Appendix for: Monetary Policy and Reaching for Income

Kent Daniel, Lorenzo Garlappi, Kairong Xiao

## A. Microfoundation of living off income

This section discusses possible microfoundations of the living-off-income rule. Financial advisors usually suggest that this rule helps investors to discipline their consumption and savings. For instance, Kennon (2016) writes that “*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.*” Owens (2016) also provides similar justification.

We formalize this intuition by considering a investor who has the tendency to over-consume because of its quasi-hyperbolic preference. We show that the living-off-income consumption rule can be an optimal commitment device to limit the tendency to over-consume.

Let us consider an asset market consisting of  $N$  assets. We take the asset returns as given and denote by  $R_t$  the  $N \times 1$  vector of asset returns. Let  $\theta_t$  be a  $N \times 1$  vector of portfolio weights invested in each of the risky assets. We consider an agent with quasi-hyperbolic discounting preference who solves the following lifetime consumption and portfolio problem (Harris and Laibson, 2001)

$$\max_{\{C_\tau, \theta_\tau\}_{\tau=t}^{T-1}} u(C_t) + \mathbb{E}_t \sum_{\tau=t}^T \beta \delta^{\tau+1-t} u(C_{\tau+1}) \quad (\text{A6})$$

subject to the dynamic budget constraint

$$W_{t+1} = (W_t - C_t)R_{p,t+1}(\theta_t), \quad \theta_t^\top \mathbf{1} = 1, \quad (\text{A7})$$

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

In (A6), the parameter  $\beta$  captures the intensity of the agent’s present bias, that is, the extent to which the agent values immediate rewards at the expense of long-term intentions. When  $\beta < 1$ , the agent’s preferences are time-inconsistent. At any time  $t$  the discount rate between *any* two periods from  $t + 1$  onward is  $\delta$ , but the discount rate from  $t$  to  $t + 1$  is  $\beta\delta < \delta$ . This implies that the agent consistently plans to be patient in the future (when the discount rate is  $\delta$ ) but as the future arrives, he changes his mind and becomes impatient, discounting the immediate future at a rate  $\beta\delta$ . This in turn implies that the agent plans to save in the future but, as the future arrives, he systematically reneges on his promise and consumes more than he would have done if he were able to commit to his original plan.<sup>31</sup>

In the presence of time-inconsistent preferences, commitment may become valuable to the agent. A prevalent commitment device in this situation is to use current income to discipline consumption, as suggested by the popular advice “live off income, do not dip into the principal.” Financial advisors usually suggest investors direct the interest and dividend income into a bank account for daily consumption while keep their principal in a brokerage account that is inconvenient for immediate or impulsive spending.”<sup>32</sup> Motivated by this practice, we allow the agent in our model to *choose* to adopt the consumption rule of living off income:<sup>33</sup>

$$0 \leq C_{t+1} \leq I_{t+1}(\theta_t), \quad t = 0, \dots, T - 2, \quad (\text{A8})$$

where  $I_{t+1}(\theta_t)$  is the income generated by portfolio  $\theta_t$  at time  $t + 1$ , that is, the sum of dividends and interest. The constraint (A8) imposes that future consumption  $C_{t+1}$  cannot exceed the income  $I_{t+1}(\theta_t)$  generated by the portfolio inherited from time  $t$ . Therefore, the current “self” can constrain the future “self” by choosing a portfolio  $\theta_t$  which delivers at time  $t + 1$  a level of income that constrains future consumption.

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<sup>31</sup>Smaller value of  $\beta$  implies a more severe present bias while  $\beta = 1$  corresponds to the time-consistent case.

<sup>32</sup>As an example, consider the following quote that appeared in a popular financial advice website *The Balance*: “One way you can avoid the temptation to dip into your seed corn is to use what I call a central collection and disbursement account. Doing so results in the dividends, interest, profits, rents, licensing income, or other gains you see being deposited into a bank account dedicated to disbursements, not the brokerage accounts or retirement trusts that hold your investments [ .... ] It erects a barrier between you and your principal.” (Kennon, 2016)

<sup>33</sup>Note that the constraint does not bind in the last period  $t = T$  because, in a finite horizon problem without bequest, the agent has to consume his entire wealth.

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

The following proposition characterizes the solution of the problem (A6)–(A8) for an investor with CRRA preferences.

**Proposition 2.** *Let us consider an investor with CRRA preferences,  $u(C) = C^{1-\gamma}/(1-\gamma)$ , with  $\gamma > 1$  is the coefficient of relative risk aversion, and an asset market consisting of  $N$  assets with return vector  $R_t$  and dividend-yield vector  $Y_t$ . Let  $i_t \equiv I_t/W_t$  denote the income to wealth ratio at time  $t$ . Then the optimal portfolio,  $\theta_t^*$ , and consumption,  $C_t^*$ , that solve the problem (A6)–(A8) for  $t = 0, \dots, T - 1$  are given by*

$$\theta_t^* = \arg \max_{\theta_t} B_t(\theta_t) \quad (\text{A9})$$

$$C_t^* = \xi_t^*(i_t) W_t, \quad (\text{A10})$$

where  $B_t(\theta_t)$  is given by

$$\frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_t \left[ \frac{R_{p,t+1}^{1-\gamma}(\theta_t)}{1-\gamma} \kappa_{V,t+1}(i_{t+1})^{1-\gamma} \right], \quad (\text{A11})$$

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

$$i_{t+1} = \frac{Y_{p,t+1}(\theta_t)}{R_{p,t+1}(\theta_t)}, \quad t = 0, \dots, T - 1, \quad (\text{A12})$$

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

$$\kappa_{V,t+1}(i_{t+1}) = \begin{cases} ((\xi_{t+1}^*)^{1-\gamma} + \delta(1 - \xi_{t+1}^*)^{1-\gamma} B_{t+1}(\theta_{t+1}^*)^{1-\gamma})^{\frac{1}{1-\gamma}}, & \text{for } t = 0, \dots, T - 2 \\ 1, & \text{for } t = T - 1 \end{cases}. \quad (\text{A13})$$

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

$$\xi_t^*(i_t) = \min \left\{ i_t, \frac{x_t}{1 + x_t} \right\}, \quad \text{where } x_t \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_t(\theta_t^*)^{\frac{\gamma-1}{\gamma}} > 0. \quad (\text{A14})$$

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

$$J_t(W_t, i_t) = W_t^{1-\gamma} \frac{\kappa_{J,t}(i_t)^{1-\gamma}}{1-\gamma}, \quad (\text{A15})$$

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

$$\kappa_{J,t}(i_t) = \left( (\xi_t^*)^{1-\gamma} + \beta\delta(1 - \xi_t^*)^{1-\gamma} B_t(\theta_t^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}. \quad (\text{A16})$$

**Proof:** We solve the problem (A6)–(16) backwards starting at time  $t = T - 1$ . The agent has one period left and, because of quasi-hyperbolic discounting in (A6), his short-term discount rate is  $\beta\delta$ . The state variables are represented by the agent's wealth  $W_{T-1}$  and income  $I_{T-1}$ . We denote by  $J_{T-1}(W_{T-1}, I_{T-1})$  the agent value function

$$J_1(W_{T-1}, I_{T-1}) = \max_{\{0 \leq C_{T-1} \leq I_{T-1}, \theta_{T-1}\}} \left\{ \frac{C_{T-1}^{1-\gamma}}{1-\gamma} + \beta\delta \mathbb{E}_{T-1} \left[ \frac{W_T^{1-\gamma}}{1-\gamma} \right] \right\}, \quad (\text{A17})$$

where

$$W_T = (W_{T-1} - C_{T-1})R_{p,T}(\theta_{T-1}). \quad (\text{A18})$$

Let  $\xi_1 \equiv C_{T-1}/W_{T-1}$  and  $i_{T-1} \equiv I_{T-1}/W_{T-1}$ . Then we can re-express problem (A17)–(A18) as follows:

$$J_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \max_{\{0 \leq \xi_{T-1} \leq i_{T-1}, \theta_{T-1}\}} \left\{ \frac{\xi_{T-1}^{1-\gamma}}{1-\gamma} + \beta\delta(1 - \xi_{T-1})^{1-\gamma} \frac{B_{T-1}(\theta_{T-1})^{1-\gamma}}{1-\gamma} \right\}. \quad (\text{A19})$$

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

$$\frac{B_{T-1}(\theta_{T-1})^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_{T-1} \left[ \frac{R_{p,T}^{1-\gamma}(\theta_{T-1})}{1-\gamma} \right]. \quad (\text{A20})$$

Note that  $B_{T-1}(\theta_{T-1}) > 0$  for all values of  $\gamma$ . In the optimization (A19), the optimal portfolio  $\theta_{T-1}^*$  is independent of the consumption choice  $\xi_{T-1}$  and is given by

$$\theta_{T-1}^* = \arg \max \mathbb{E}_{T-1} \left[ \frac{R_{p,T}^{1-\gamma}(\theta_1)}{1-\gamma} \right]. \quad (\text{A21})$$

From (A20), the optimization in (A21) is equivalent to

$$\theta_{T-1}^* = \arg \max B_{T-1}(\theta_{T-1}). \quad (\text{A22})$$

Taking the first-order condition with respect to  $\xi_{T-1}$  in (A19) we obtain that the unconstrained consumption  $\xi_{T-1}^{\text{unc}}$  is given by

$$(\xi_{T-1}^{\text{unc}})^{-\gamma} = \beta\delta(1 - \xi_{T-1}^{\text{unc}})^{-\gamma} B_{T-1}^{1-\gamma}, \quad (\text{A23})$$

or

$$\xi_{T-1}^{\text{unc}} = \frac{x_{T-1}}{1 + x_{T-1}}, \quad \text{where } x_{T-1} \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_{T-1}(\theta_{T-1}^*)^{\frac{\gamma-1}{\gamma}} > 0. \quad (\text{A24})$$

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

$$\xi_{T-1}^* = \min \left\{ i_{T-1}, \frac{x_{T-1}}{1 + x_{T-1}} \right\}. \quad (\text{A25})$$

From (A19), the value function  $J_{T-1}(W_{T-1}, i_{T-1})$  is then

$$J_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \frac{(\kappa_{J,T-1}(i_{T-1}))^{1-\gamma}}{1 - \gamma}, \quad (\text{A26})$$

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

$$\kappa_{J,T-1}(i_{T-1}) = ((\xi_{T-1}^*)^{1-\gamma} + \beta\delta(1 - \xi_{T-1}^*)^{1-\gamma} B_{T-1}(\theta_{T-1}^*)^{1-\gamma})^{\frac{1}{1-\gamma}}. \quad (\text{A27})$$

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

$$J_{T-2}(W_{T-2}, I_{T-2}) = \max_{\{0 \leq C_{T-2} \leq I_{T-2}, \theta_{T-2}\}} \left\{ \frac{C_{T-2}^{1-\gamma}}{1 - \gamma} + \beta\delta \mathbb{E}_{T-2} \left[ \frac{C_{T-1}^{1-\gamma}}{1 - \gamma} + \delta \frac{W_T^{1-\gamma}}{1 - \gamma} \right] \right\}. \quad (\text{A28})$$

Under the optimal consumption and portfolio policy, the term in the above expression is the continuation value from time  $t = T - 1$  onward. From the above analysis, we infer that the continuation value is of the form (A17) where  $\beta\delta$  is replaced by  $\delta$ . Hence, using (A26) we can express the continuation value as

$$V_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \frac{(\kappa_{V,T-1}(i_{T-1}))^{1-\gamma}}{1 - \gamma}, \quad (\text{A29})$$

where

$$\kappa_{V,T-1}(i_{T-1}) = ((\xi_{T-1}^*)^{1-\gamma} + \delta(1 - \xi_{T-1}^*)^{1-\gamma} B_{T-1}(\theta_{T-1}^*)^{1-\gamma})^{\frac{1}{1-\gamma}} \quad (\text{A30})$$

We can then express the problem (A28) recursively as follows:

$$J_{T-2}(W_{T-2}, I_{T-2}) = \max_{\{0 \leq C_{T-2} \leq I_{T-2}, \theta_{T-2}\}} \left\{ \frac{C_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta \mathbb{E}_{T-2} [V_{T-1}(W_{T-1}, i_{T-1}(\theta_{T-2}))] \right\}, \quad (\text{A31})$$

where

$$W_{T-1} = (W_{T-2} - C_{T-2})R_{p,T-1}(\theta_{T-2}), \quad (\text{A32})$$

and

$$i_{T-1}(\theta_{T-2}) = \frac{I_{T-1}}{W_{T-1}} = \frac{(W_{T-2} - C_{T-2})Y_{p,T-1}(\theta_{T-2})}{(W_0 - C_0)R_{p,T-1}(\theta_{T-2})} = \frac{Y_{p,T-1}(\theta_{T-2})}{R_{p,T-1}(\theta_{T-2})}. \quad (\text{A33})$$

Using the definition of  $V_{T-1}(W_{T-1}, i_{T-1})$  in (A29)–(A13) we obtain

$$J_{T-2}(W_{T-2}, i_{T-2}) = W_{T-2}^{1-\gamma} \max_{\{0 \leq \xi_{T-2} \leq i_{T-2}, \theta_{T-2}\}} \left\{ \frac{\xi_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta(1 - \xi_{T-2})^{1-\gamma} \frac{B_{T-2}(\theta_{T-2})^{1-\gamma}}{1-\gamma} \right\}, \quad (\text{A34})$$

where

$$\frac{B_{T-2}(\theta_{T-2})^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_{T-2} \left[ \frac{R_{p,T-1}^{1-\gamma}(\theta_{T-2})}{1-\gamma} \kappa_{V,T-1}(i_{T-1}(\theta_{T-2}))^{1-\gamma} \right], \quad (\text{A35})$$

and  $i_{T-1}(\theta_{T-2})$  is given in (A33). In the optimization (A34) the optimal portfolio  $\theta_{T-2}^*$  is independent on the consumption choice  $\xi_{T-2}$  and is given by

$$\theta_{T-2}^* = \arg \max B_{T-2}(\theta_{T-2}). \quad (\text{A36})$$

Taking the first-order condition with respect to  $\xi_{T-2}$  in (A34) and following the same steps used at time  $t = T - 1$  above, we obtain that the unconstrained consumption  $\xi_{T-2}^{\text{unc}}$  is given by

$$\xi_{T-2}^* = \min \left\{ i_{T-2}, \frac{x_{T-2}}{1 + x_{T-2}} \right\} \quad \text{where} \quad x_{T-2} \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_{T-2}(\theta_{T-2}^*)^{\frac{\gamma-1}{\gamma}} > 0. \quad (\text{A37})$$

From (A34), the value function  $J_{T-2}(W_{T-2}, i_{T-2})$  is then

$$J_{T-2}(W_{T-2}, i_{T-2}) = W_{T-2}^{1-\gamma} \frac{(\kappa_{J,T-2}(i_{T-2}))^{1-\gamma}}{1-\gamma}, \quad (\text{A38})$$

where

$$\kappa_{J,T-2}(i_{T-2}) = ((\xi_{T-2}^*)^{1-\gamma} + \beta\delta(1 - \xi_{T-2}^*)^{1-\gamma} B_{T-2}(\theta_{T-2}^*)^{1-\gamma})^{\frac{1}{1-\gamma}}. \quad (\text{A39})$$

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

$$J_t(W_t, i_t) = W_t^{1-\gamma} \max_{\{0 \leq \xi_t \leq i_t, \theta_t\}} \left\{ \frac{\xi_t^{1-\gamma}}{1-\gamma} + \beta\delta(1 - \xi_t)^{1-\gamma} \frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \right\}, \quad (\text{A40})$$

with

$$\frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_t \left[ \frac{R_{p,t+1}^{1-\gamma}(\theta_{T-2})}{1-\gamma} \kappa_{V,t+1}(i_{t+1}(\theta_t))^{1-\gamma} \right], \quad (\text{A41})$$

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

$$\kappa_{V,t+1}(i_{t+1}) = ((\xi_{t+1}^*)^{1-\gamma} + \delta(1 - \xi_{t+1}^*)^{1-\gamma} B_{t+1}(\theta_{t+1}^*)^{1-\gamma})^{\frac{1}{1-\gamma}}, \quad (\text{A42})$$

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

As the proposition illustrates, the solution of the problem is recursive and proceeds backward, starting with the boundary condition (A13) for the continuation value  $\kappa_{V,T} = 1$ . Comparing the continuation value from  $t+1$  onwards, equation (A13), and time- $t$  certainty equivalent wealth (A16), we note that at each time  $t$ , the agent's discount factor for times  $t + 1$  and onward is equal to  $\delta$  while the discount rate between time  $t$  and  $t + 1$  is equal to  $\beta\delta$ . Therefore, the consumption wealth ratio chosen by the agent at time  $t + 1$ ,  $\xi_{t+1}^*$ , will be higher than what the agent would have preferred at time  $t$ . This is the manifestation of time-inconsistency: the agent plans to save in the future, but as the future arrives, the agent consumes more than planned. Anticipating that the time- $t + 1$  self will become impatient at time  $t + 1$ , the time- $t$  self tries to affect the choice set of his future self through his current portfolio choice at time- $t$  and the imposition of the self-control constraint (A8).

To illustrate the solution derived in Proposition 2, we implement the model for the case of two risky assets and a risk-free asset. We assume that the two risky assets have identical binomial return distributions in each period, but differ in their dividend yields. We denote by  $H$  the risky asset with the higher dividend yield and by  $L$  the risky asset with the low dividend yield.<sup>34</sup>

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<sup>34</sup>Specifically, we assume that the return on asset  $j = H, L$  in each period is either  $R_u^j = e^{\mu_j + \frac{1}{2}\sigma_j^2 + \sigma_j}$  or  $R_d^j = e^{\mu_j + \frac{1}{2}\sigma_j^2 - \sigma_j}$ . The probability distribution of outcomes is  $\Pr(R_u^H, R_u^L) = \Pr(R_d^H, R_d^L) = (1 + \rho)/4$

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

Figure A.2 shows the time-0 certainty equivalent wealth,  $\kappa_J$  from equation (A16). 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,  $\kappa_J^{\text{unc}}$ ; (ii) constrained,  $\kappa_J^{\text{con}}$ ; and (iii) first-best case,  $\kappa_J^{\text{fc}}$ . For each case we report the certainty equivalent wealth as the value of the present bias parameter  $\beta$  varies. Low value of  $\beta$  corresponds to a high level of distortion in consumption induced by time inconsistency, while  $\beta = 1$  represents the time-consistent case. The black line,  $\kappa_J^{\text{fc}}$ , shows the first-best-case certainty equivalent wealth. When time-inconsistency is severe (low  $\beta$ ), the constrained certainty equivalent wealth,  $\kappa_J^{\text{con}}$ , is *higher* than the unconstrained one,  $\kappa_J^{\text{unc}}$ , while the opposite is true if the time-inconsistency is less severe ( $\beta$  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  $\beta$ .

Figure A.3 repeats the analysis of Figure A.2 and reports certainty equivalent wealth as a function of stock return volatility. Intuitively, flexibility is more valuable when volatility is high and therefore a constraint is more harmful. Consistent with this intuition, the certainty equivalent wealth in the presence of a self-control constraint is higher than the

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and  $\Pr(R_u^H, R_d^L) = \Pr(R_d^H, R_u^L) = (1 - \rho)/4$ . We assume that  $\mu_H = \mu_L$  and  $\sigma_H = \sigma_L$ . We take the gross risk-free rate  $R^F = 1 + r^F$  and the dividend yields  $Y_H > Y_L$  to be constant over time.

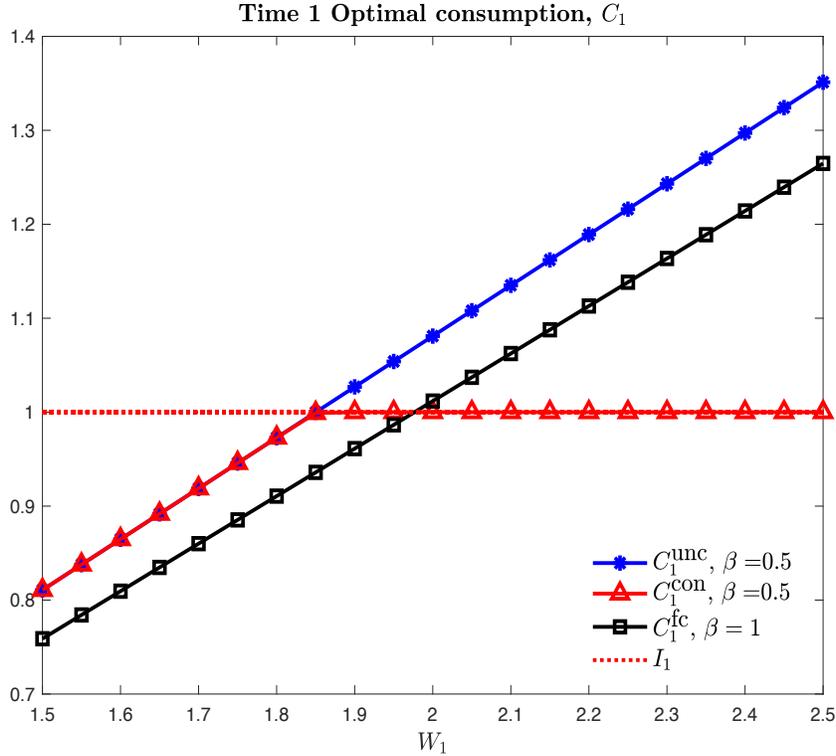
unconstrained case for low levels of return volatility but lower than the unconstrained case for high levels of return volatility.

In summary, the analysis in this section provides a potential microfoundation of the consumption rule of living off income by showing that this rule can be an *optimal* commitment device for an agent with a hyperbolic discounting preference. Other frictions or behavioral biases may also lead to such a consumption rule. For example, prior to 1975, the NYSE set large minimum trade commissions that were almost always binding (Jones, 2002).<sup>35</sup> The rule of living off income is a plausible response to such high transaction costs. While transaction costs are now too low to provide a plausible explanation for the living off income rule-of-thumb, we cannot exclude that such a rule became established in the fixed-commission period, and that investors continue to follow it despite being sub-optimal.<sup>36</sup> Another related explanation is that using current income stream to finance consumption reduces the “mental effort” involved in liquidating asset positions constantly. Regardless of the fundamental reasons underlying the consumption rule of living off income, as long as some investors follow such a rule, monetary policy will have an impact on portfolio allocations and the risk premium, even in an economy in which prices are fully flexible.

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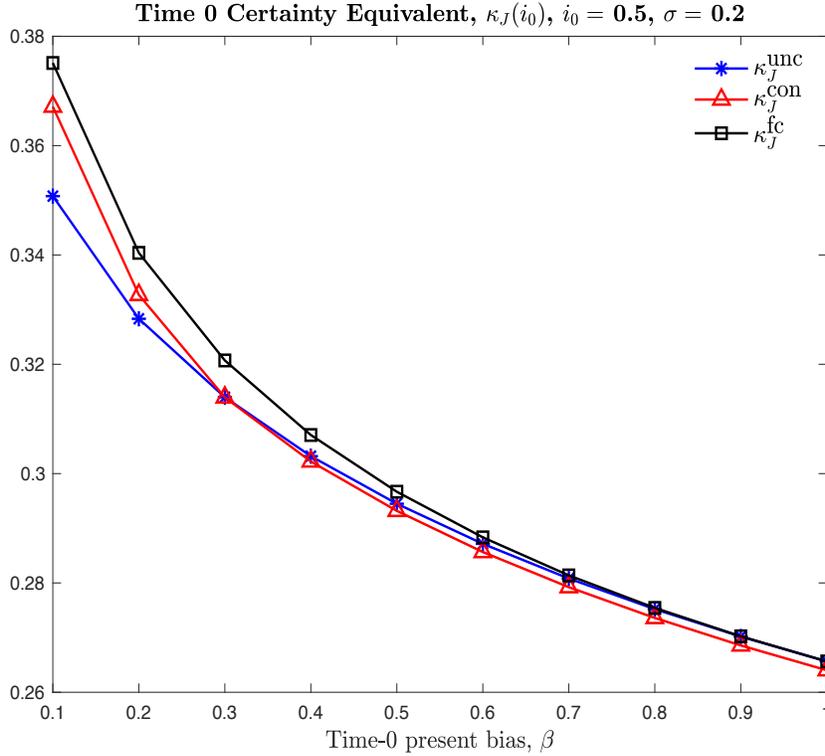
<sup>35</sup>Specifically, Jones reports that, between March 3, 1959 and December 5, 1968, trades of less than \$400 paid a minimum commission of \$3 plus 2% of the amount traded. For trades between \$400 and \$2,400, the minimum commission was \$7 plus 1% of the amount traded. Jones also reports that commission rebates were strictly prohibited by the exchange.

<sup>36</sup>We thank Terry Odean for pointing this out to us.



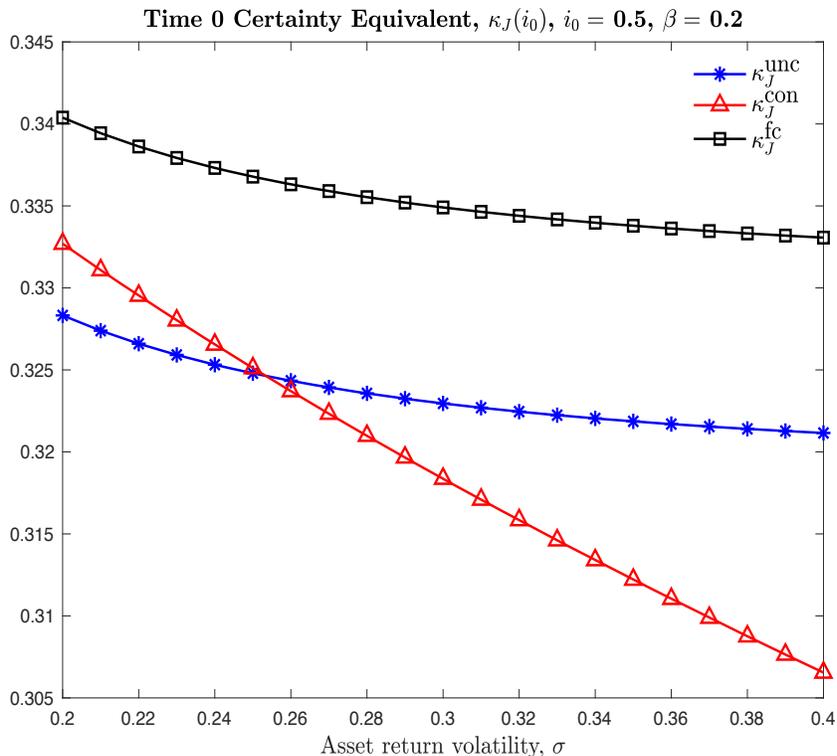
**Figure A.1: Consumption and Self-Control Constraint**

The figure reports the optimal time-1 consumption as a function of the time-1 wealth of the two-period version of the problem described in Proposition 2.  $C_1^{\text{unc}}$ ,  $C_1^{\text{con}}$ , and  $C_1^{\text{fc}}$  refers, respectively, to the consumption of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is,  $\beta = 1$  in the time-1 portfolio choice problem.  $I_1 = 1$  is the income from the portfolio. Preferences parameter values:  $\gamma = 3$ ,  $\delta = 0.98$ ,  $\beta = 0.5$ . We assume that the distribution of asset returns is binomial, as discussed in footnote 34, with parameters  $\sigma_L = \sigma_H = 0.4$ , correlation  $\rho = 0.5$ ,  $\mu_H = \mu_L = 0.11$ , and  $R_f = 0.01$ . Asset  $H$  has a dividend yield of  $Y_H = 0.7$  and asset  $L$  has a dividend yield of  $Y_L = 0.5$ .



**Figure A.2: Certainty Equivalent Wealth and Time-Inconsistency**

The figure reports the time-0 certainty equivalent wealth as a function of the time-inconsistency parameter,  $\beta$ , for the two-period version of the problem described in Proposition 2.  $\kappa_J^{\text{unc}}$ ,  $\kappa_J^{\text{con}}$ , and  $\kappa_J^{\text{fc}}$  refers, respectively, to the time-0 certainty equivalent wealth of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is,  $\beta = 1$  in the time-1 portfolio choice problem. Preferences parameter values:  $\gamma = 3$ ,  $\delta = 0.98$ . We assume that the distribution of asset return is binomial, as discussed in footnote 34, with parameters  $\sigma_L = \sigma_H = 0.2$ , correlation  $\rho = 0.5$ ,  $\mu_H = \mu_L = 0.11$ , and  $R_f = 0.01$ . Asset  $H$  has a dividend yield of  $Y_H = 0.7$  and asset  $L$  has a dividend yield of  $Y_L = 0.5$ .



**Figure A.3: Certainty Equivalent Wealth and Return Volatility**

The figure reports the time-0 certainty equivalent wealth as a function of the stock return volatility parameter,  $\sigma_L = \sigma_H$ , for the two-period version of the problem described in Proposition 2.  $\kappa_J^{\text{unc}}$ ,  $\kappa_J^{\text{con}}$ , and  $\kappa_J^{\text{fc}}$  refers, respectively, to the time-0 certainty equivalent wealth of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is,  $\beta = 1$  in the time-1 portfolio choice problem. Preferences parameter values:  $\gamma = 3$ ,  $\delta = 0.98$ ,  $\beta = 0.2$ . We assume that assets log returns have identical volatility:  $\sigma = \sigma_L = \sigma_H$ , correlation  $\rho = 0.5$ ,  $\mu_H = \mu_L = 0.11$ , and  $R_f = 0.01$ . Asset  $H$  has a dividend yield of  $Y_H = 0.7$  and asset  $L$  has a dividend yield of  $Y_L = 0.5$ .

**Table A.1: Mutual Fund Flows: Excluding Dot-Com Bubble Period**

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

$$\text{Flow}_{i,t+1} = \beta_1 \text{FFR}_t \times \text{High Income}_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t},$$

where  $\text{Flow}_{i,t+1}$  represents flows into mutual fund  $i$  at time  $t$ ;  $\Delta \text{FFR}_t$  represents the three-year change in the fed funds rate leading up to month  $t$ ;  $\text{High Income}_{i,t}$  is a dummy variable that equals 1 if the income yield of a fund is in the top decile for a given month, and 0 otherwise; and  $X_{i,t}$  is a set of control variables including: *Volatility*,  $\Delta \text{FFR} \times \text{Volatility}$ ,  $\Delta \text{Tax} \times \text{High Dividend}$ , *Return*, *Size*, *Turnover*, and *Expense*. *Return* is fund return over the preceding month; *Volatility* is the standard deviation of fund returns for the past year;  $\Delta \text{Tax}$  is the difference between the maximum individual income tax rate and the capital gains tax rate; *Size* represents the assets under management (log); and *Expense* represents the expense ratio. The sample includes all the equity or bond mutual funds in the United States from 1991 to 2016, excluding the dot-com bubble period from 1998 to 2002. Each observation is a fund share class-month combination. Columns 1 and 2 include the whole sample. Columns 3 and 4 include only the retail share classes. Columns 5 and 6 include only the institutional share classes. Standard errors are in parentheses, with \*, \*\*, and \*\*\* denoting significance at the 10%, 5%, and 1% levels. Standard errors are clustered by month.

	All		Retail		Institution	
	(1) Equity	(2) Bond	(3) Equity	(4) Bond	(5) Equity	(6) Bond
$\Delta \text{ FFR} * \text{High Income}$	-0.129*** [0.033]	-0.070** [0.029]	-0.134** [0.052]	-0.134*** [0.038]	-0.070 [0.046]	-0.066 [0.050]
$\Delta \text{ FFR} * \text{Volatility}$	0.012 [0.016]	-0.109*** [0.018]	0.042* [0.021]	-0.055** [0.024]	0.005 [0.017]	-0.157*** [0.034]
$\Delta \text{ Tax} * \text{High Dividend}$	-0.181*** [0.035]	0.002 [0.031]	-0.606 [0.531]	-0.108 [0.321]	-0.841** [0.344]	-0.084 [0.427]
Fund Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	740259	813174	357130	395794	265806	205299
Adj. R-squared	0.017	0.011	0.021	0.014	0.009	0.007