Monetary Policy and Reaching for Income

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ABSTRACT

Using data on individual portfolio holdings and on mutual fund flows, we find that low interest rates lead to a significantly higher demand for income-generating assets such as high-dividend stocks and high-yield bonds. We argue that this "reaching for income" phenomenon is driven by investors who follow the rule-of-thumb of "living off income." Our empirical analysis shows that this preference for current income affects both household portfolio choices and the prices of income-generating assets. In addition, we explore the implications of reaching for income for capital allocation and the effectiveness of monetary 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 the income stream from one's investment portfolio, while keeping the principal untapped.[1] 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 rebalance their portfolio into higher current income assets.[2] We label this behavior *reaching for income*.[3]

In this paper, we show that the reaching for income behavior generalizes to a large fraction of investors and affects the prices of income-generating assets. Specifically, a fall in interest rates reduces investment income from bank deposits and short-term bonds. In response to this decline, investors who live off income will 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 increased demand from income-seeking investors drives up the prices of these assets, resulting in a lower financing cost for the issuers of these securities. We argue that the reaching for income behavior can affect the consumption of these investors and, through the effect on security prices, can potentially affect firms' capital allocation decisions. The reaching for income behavior we document represents a novel link between monetary policy and financial markets.

[1]Living off income is consistent with 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."

[2]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.

[3]The following example, reported in the February 9, 2016 *Wall Street Journal* article "The High Consequences of Low Interest Rates," (Strumpf and Light, 2016), provides an illustration of how low interest rates may lead investors to "reach for income". 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.

We begin our analysis by using individual portfolio holding data from a large discount broker covering 19,394 accounts over the 1991–1996 period. We find that retail investors purchase more high-dividend stocks than low-dividend ones in response to a reduction in the fed funds rate. 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. This result is consistent with the hypothesis that investors use high-dividend stocks as an alternative source of income when the income from deposits and bonds falls.

We then quantify the reaching-for-income effect by estimating the impulse response of high- and low-income mutual fund flows to unexpected monetary policy shocks, which we identify through high-frequency shocks to the fed funds rate, as in Gertler and Karadi (2015).[4] We find that an exogenous reduction in the fed funds rate leads 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 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 the low-interest-rate policy.

To assess the robustness of our results we further complement the impulse response analysis with a panel regression analysis. This analysis delivers four key findings. First, investors appear to be more sensitive to changes in nominal rates than changes in real rates. Second, reaching for income is mainly driven by retail instead of institutional share classes, consistent with the hypothesis that retail investors are more likely to follow a living-off-income rule-of-thumb. Third, a reduction in the fed funds rate is associated with significant inflows to funds whose names include words such as "dividends" and "income". Fourth, 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 interest

[4] Note that changes in fed funds rate could be driven by economic growth, inflation, or pure unexpected policy shocks. Our analysis is agnostic to the source of interest rate variation.

rate decrease and negative or negligible abnormal returns following interest rate increase, consistent with investors reacting with a lag to rate changes. A dynamic long-short strategy that (i) buys high-dividend stocks and shorts low-dividend stocks immediately after a reduction in the fed funds rate and (ii) reverses these positions following rate increases generates, on average, a risk-adjusted monthly return of 0.29% over the 1963–2016 period. Not surprisingly, retail investors generally do not capture this premium because they purchase high-yield assets too long after declines in the fed funds rate when prices have already risen in response to the rate change.

The "reaching-for-income" behavior has potentially important implications for monetary policy. We propose a stylized heterogeneous agent model to show that the preference for current income constitutes a new transmission channel of monetary policy. Unlike the standard representative-agent New Keynesian models (Woodford, 2011), prices are fully flexible in our model. The key friction is instead the presence of income-consuming investors. In our model, a reduction in the nominal interest rate depresses the income that agents receive from short-term bonds, constrains their consumption and leads them to tilt their portfolio towards higher income-yielding assets.

Our study has broad implications for aggregate consumption, capital allocation, dividend policy, and asset prices. First, in a standard representative agent New Keynesian model, low-interest-rate monetary policy usually has an expansionary effect on consumption. In our model, however, low interest rates could depress consumption for agents who live off income. This prediction is consistent with anecdotal evidence reported in Whitehouse (2011) that low interest rates force retirees to cut back their consumption. In a "back-of-the-envelope" quantification of this channel, we find that a 1% reduction in the fed funds rate could reduce aggregate consumption by 0.24% through our channel. Second, our findings suggest that monetary policy can have redistributive effects across firms that differ in their dividend policies. As a fall in interest rates drives up the demand for income, the cost of capital for mature firms that can pay steady dividends will decrease relative to young growing firms. If the investment opportunities of mature firms are inferior to those of young firms, such capital redistribution will dampen the stimulus effect of low-rate policy on aggregate investment. Third, a low interest rate can induce firms to initiate dividends to cater to income-consuming investors. This result suggests that the low-interest-rate environment that began in the 2000s could be a potential explanation for the "reappearing dividends" in the same period (Julio and Ikenberry, 2004; Michaely and Moin, 2017). Fourth, 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.[5] Such a policy leads to a general rebalancing from safe to risky assets and to a lower risk premium.

Our paper contributes to four strands of literature. The first strand studies 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.[6] 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, which are not necessarily riskier assets. 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. Our results on mutual fund flows are related to Lian et al. (2018), who document additional *aggregate* inflow into equity mutual funds when rates are low, which is consistent with the "reaching-for-yield" hypothesis. In comparison, we show that in the *cross-section* of equity mutual funds, high-income funds receive more inflows than low-income funds, which is consistent with "reaching-for-income" hypothesis.

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,[7] agency frictions,[8] or behavioral biases.[9] We provide evidence that the demand for dividends could be driven by individual investors who live off income. Our paper is closely related to Baker and Wurgler (2004a) who document strong variation over time in the demand for dividends but do not examine in detail the source of this time-variation. We suggest that the interest rate environment is an important driver. Our results are also related to Jiang and Sun (2019), who document independently that high-dividend equity funds experience additional inflows when interest rates fall, which seems to drive up the prices of high-dividend stocks. In addition to confirming their findings, we use investor-level data to investigate the underlying economic mechanism. Our analysis shows that such flows originate from investors who follow the rule of thumb of living off

[5]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%.

[6]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 et al. (2018).

[7]See. e.g., Bhattacharya (1979); John and Williams (1985); Miller and Rock (1985).

[8]See, e.g., Easterbrook (1984); Jensen (1986); Fluck (1998, 1999); Myers (1998); Gomes (2001); and Zwiebel (1996)).

[9]See, e.g., Shefrin and Statman (1984), Hartzmark and Solomon (2017).

income. Furthermore, we document that such flows patterns generalize to fixed-income assets such as bank deposits, money market funds, and bond funds. 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."[10] 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 the 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 et al. (2007) and Kaustia and Rantapuska (2012) find that investors usually only spend their dividends but rarely dip into capital. Di Maggio et al. (2019) employ Swedish data containing security level information on households' stock holdings and show that dividends have a much bigger effect on consumption than on capital gains. Graham and Kumar (2006) find that older investors with lower labor income hold stocks with higher dividend yields than younger investors with higher labor income. 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." Our evidence on reaching for income provides additional support on the existence of living-off-income investors.

Finally, our paper is related to the burgeoning literature on Heterogeneous Agent New Keynesian (HANK) models (Kaplan et al., 2014, 2018; Auclert, 2019). Similar to the HANK literature, our model features income-consuming investors who violate the permanent income hypothesis. The key difference is that while the HANK literature focuses on how income-consuming investors choose between liquid and illiquid assets, we focus on how income-consuming investors choose between high- and low-income assets. This leads to a new set of implications in the cross-section of assets that differ in income yields. Furthermore, we provide a potential micro-foundation to the rule-of-thumb of living off in-

[10] 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.

come based on hyperbolic discounting. Finally, we provide novel evidence on the existence of income-consuming investors using data on individual stock trading, mutual fund flows, and asset prices. By documenting this novel link between monetary policy and financial markets, our paper contributes to the literature on the financial channels of monetary transmission (Nagel, 2016; Drechsler et al., 2017a,b, 2018; Xiao, 2020).

The rest of the paper is organized as follows. In Section I, we provide evidence that low interest rates induce 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, capital reallocation, and risk-taking. Section V concludes. In the Online Appendix we provide: (i) a detailed description of the data used in our empirical analyses; (ii) a micro-foundation of the living-off-income constraints used in our general equilibrium model, and (iii) a quantification of the reaching for income effect for aggregate consumption and investment.

I. Reaching for Income: Evidence

In this section, we provide evidence on the effect of interest rates on 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).[11]

Individual portfolio holdings. This dataset includes monthly observations on portfolio holdings for 78,000 households between 1991 and 1996.[12] For each household, we observe the number of assets and asset types held in its portfolio. We restrict our analysis to common stock holdings and focus on a smaller subset of 19,394 households for whom

[11] Appendix A contains a detailed description of the variables used in our analysis.

[12] This dataset was used first by Barber and Odean (2000).

we have demographic information. Panel A of Table I reports summary statistics for the demographics of account holders: 16% of account holders are retirees; 58% are homeowners; 42% are married; 56% are male; 64% hold at least a bank card; and 49.9% own at least one vehicle. The median net worth of an account holder is $100,000, which, assuming an average annual income yield of 5%, implies a monthly income of about $400. The magnitude of this income stream suggests that living off income is a viable strategy for the median household in the sample.

Next, using data from CRSP, we calculate a dividend yield for each stock based on the dividends paid over the past 12 months. We classify a stock as a "high income yield" stock if it belongs to the top decile of the dividend yield distribution, across all stocks in CRSP, in a given month. We use a categorical variable Net $\text{Buy}_{i,j,t+6}$ to indicate whether the holding of stock i by household j increases or decreases from month t to $t+6$. Net $\text{Buy}_{i,j,t+6}$ 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.[13]

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

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

Panel B of Table I reports summary statistics for portfolio holdings. The income 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 income yield across the stocks in our merged sample is 2.1%, and the 90th percentile income yield is 5.7%.

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,

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

[13] In Table C.1 of the Online Appendix, we use a continuous measure of portfolio adjustment. Our results are robust to this alternative measure.

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.

Fed funds rate. In most of our analysis, we use the level of the fed funds rate (FFR) retrieved from the Federal Reserve Economic Data (FRED) website as a proxy for the income from short term debt instruments. To sharpen the identification, in some specifications we also use *unexpected* monetary policy shocks constructed from changes in the fed funds futures price on FOMC announcement dates, as in Bernanke and Kuttner (2005).[14]

Local deposit rates. To construct measures of local 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 are then defined as the weighted average of the deposit rates of the 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. Methodology

In this section, we describe the conceptual framework we use to test the "reaching-for-income" hypothesis. Holding the risk-return trade-off constant, we are interested in testing whether income yield has an additional effect on assets' demand. Formally, we can

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

think of the portfolio weight θ of an asset as determined by the following equation:

$$\theta = \lambda y + \phi(r^e - r) + \gamma' X \tag{3}$$

where y is the income yield of the asset; r^e is the expected return; r is the risk-free rate; and X is a vector of risk loadings. According to standard portfolio choice theory, the split between income vs. capital gain does not matter, so λ should be zero. However, investors who follow the rule-of-thumb of living off income want to maintain an income stream that matches their consumption needs. For those investors, the coefficient λ can be interpreted as the Lagrange multiplier of an income constraint, similar to the one we consider in the model of Section III. When this constraint is binding, λ is positive.

One way to test this hypothesis is to estimate a cross-sectional regression of portfolio weights on income yields. However, if there are measurement errors in expected returns, then the coefficient of income yield could be biased by the correlation between income yields and expected returns in the cross-section of assets.

To address this challenge, we exploit the differential portfolio adjustment of high- vs. low-income assets in response to a change in the risk-free rate, r. The idea is that a decline in the risk-free rate leads to lower current income generated by bank deposits and bonds, which in turn tightens the current income constraint. As a result, the shadow value of income increases, and investors who live off income move into higher-income assets. The intuition underlying our tests is analogous to a difference-in-differences regression, as we illustrate in the following table:

$\theta_{s,t}$	$s = H$	$s = L$	$\theta_{H,t} - \theta_{L,t}$
$t = 1$	$\lambda_1 y_H + \phi(r_H^e - r_1) + \gamma' X_H$	$\lambda_1 y_L + \phi(r_L^e - r_1) + \gamma' X_L$	$\lambda_1(y_H - y_L) + \phi(r_H^e - r_L^e) + \gamma'(X_H - X_L)$
$t = 2$	$\lambda_2 y_H + \phi(r_H^e - r_2) + \gamma' X_H$	$\lambda_2 y_L + \phi(r_L^e - r_2) + \gamma' X_L$	$\lambda_2(y_H - y_L) + \phi(r_H^e - r_L^e) + \gamma'(X_H - X_L)$
$\theta_{s,2} - \theta_{s,1}$	$(\lambda_2 - \lambda_1) y_H + \phi(r_2 - r_1)$	$(\lambda_2 - \lambda_1) y_L + \phi(r_2 - r_1)$	$(\lambda_2 - \lambda_1)(y_H - y_L)$

Suppose the risk-free rate decreases by 1% from time 1 to time 2. We compare the portfolio weight of a high-dividend stock, θ_H, and low-dividend stock, θ_L, before and after the rate change. We define λ_t as the Lagrange multiplier of the income constraint at time t and r_t as the risk-free rate at time t. The first difference, $\theta_{H,t} - \theta_{L,t}$, removes the effect of the risk-free rate on the excess returns of the risky assets. The second difference $\theta_{s,2} - \theta_{s,1}$, removes the difference in the expected return and risk loading of each stock. Therefore, the difference-in-differences estimator corresponds to the product of the changes in the

Lagrange multiplier of the income constraint and the difference in income yields:

$$(\theta_{H2} - \theta_{L2}) - (\theta_{H1} - \theta_{L1}) = (\lambda_2 - \lambda_1) \times (y_H - y_L) \approx \underbrace{\frac{\partial \lambda}{\partial r}}_{\substack{\text{Diff-in-diffs} \\ \text{estimate}}} \times (r_2 - r_1) \times (y_H - y_L). \quad (4)$$

A negative value of the above difference-in-differences estimate implies that a decrease in the risk-free rate increases the Lagrange multiplier of the income constraint: $\partial\lambda/\partial r < 0$.

B.2. 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 (i.e., 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:

$$W_{j,t} = -\left[(A_{j,t} - A_{j,t-1}) - (G_{j,t} + D_{j,t})\right], \quad (5)$$

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. If there are no withdrawals, then the change in the account balance $A_{j,t} - A_{j,t-1}$, corresponds to the sum of the capital gains and the current income, $G_{j,t} + D_{j,t}$ and, therefore, according to equation (5), net withdrawals $W_{j,t}$ will be zero. Assuming that these withdrawals are not reinvested in other assets 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 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 result 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.[15] 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 result 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 homeownership 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.

[15] 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.3. 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 tilt their portfolio towards high-dividend assets to compensate for the lower interest income they receive on deposits and bonds.

We begin by examining how the relative current income of bonds and stocks varies over time. Figure 2 plots the time series of the fed funds rate, dividend yield of the aggregate U.S. stock markets, and interest rate of 3-month certificates of deposit. The figure shows that the income yield of short-term debt instruments strongly co-moves with the fed funds rate, while the equity dividend yield does not. Thus, during periods of low interest rates, equities become relatively more attractive as a source of current income. In particular, while the ultra-low interest rates of the most recent decade have lowered income from certificates of deposit to almost zero, the equity dividend yield has risen slightly.

Given that low interest rates reduce the income from short-term debt instruments, some investors may reach for income by shifting their portfolios 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 that pay high current income, such as high-dividend stocks.

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, ΔFFR_t, and its interaction with the high-dividend dummy, $\Delta\text{FFR}_t \times \text{High Div}_{i,j,t}$.[16] 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 homeownership, marital status, and gender of the holder of account j; and (iii) household fixed effects, stock fixed

[16] Our analysis in section C shows that investors appear to respond to interest-rate changes up to three years after an initial change (see Figure 4). Therefore, we consider a three-year horizon in the construction of the variable ΔFFR, as it seems to capture the most salient effects of interest-rate change on portfolio flows. Our results are robust to alternative horizons in the construction of ΔFFR as shown in Table C.2 of the Online Appendix.

effects, and time fixed effects. Formally, we estimate the following regression:

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

where the $X_{i,j,t}$ is a vector of control variables. The coefficient β 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 β.

Table IV presents the results. The estimated coefficient β is negative and statistically significant. We include household fixed effects and stock fixed effects cumulatively from Columns 2 to 3 to absorb unobservable shocks in stock and household level. The magnitude of the coefficient estimates is stable across the different specifications.

One may worry that changes in the fed funds rate also affect the risk-return trade-off of the stocks. However, this would not mechanically drive our results. As discussed in Section B.1, our identification comes from the differential changes in the portfolio weights of two risky assets. In other words, a reduction in the risk-free rate only makes risky assets more attractive relative to risk-free assets, but it does not necessarily make high-dividend stocks more attractive than low-dividend stocks unless investors care about the income stream of high-dividend stocks.

Another possible concern affecting the interpretation of our results is that high-dividend stocks may differ from low-dividend stocks in multiple dimensions. Companies that pay out dividends are often more mature and tend to be in relatively acyclical industries such as utilities.[17] 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 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. 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 a 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

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

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. Second, we directly control for the growth prospects and cyclicality 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, and 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.

B.4. Identifying Reaching-for–Income Effects through Local Bank Deposit Rates

A common challenge in studying the impact of interest rate changes is the difficulty in isolating these effects from other confounding macro factors. 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 of the fed fund rate 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 the fed funds rate. Third, the rich cross-sectional variation in local deposit rates allows us to filter out other macroeconomic shocks.

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 $\text{Buy}_{i,j,t+6}$ defined in equation (1) on: (i) the three-year changes in local deposit rates in MSA m, $\Delta\text{Dep Rates}_{m,t}$; 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 (6) and their interactions with changes in local deposit rates. We further include household fixed effects, time×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:

$$\text{Net Buy}_{i,j,m,t+6} = \beta \Delta \text{Dep Rates}_{m,t} \times \text{High Div}_{i,t} + \gamma' X_{i,j,m,t} + \varepsilon_{i,j,m,t}. \tag{7}$$

The estimated coefficient β (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 β, 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 of 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, where, as discussed in Section B.3, we define as withdrawers individuals who have an above-median frequency of withdrawing their dividend income rather than reinvesting it. As shown in Table III, withdrawers usually have low labor income and tend to live off their financial income. Therefore, interest rates are more likely to affect their portfolio allocations significantly. 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.

A possible concern in the interpretation of these results is that variation in local deposit rates may lead to different investment opportunities across regions. Notice, however, that such differences are accounted for by the inclusion of time×MSA fixed effects in all the specifications we consider in Table III. Furthermore, time×MSA fixed effects also absorb any unobservable local shocks such as local inflation or changes in state taxes. A related concern is that local deposit rates could be endogenous to local asset demand. To address this concern, in Table C.3 of the Online Appendix, we use a region deposit-rate sensitivity (Drechsler et al., 2017a) to compute the projected changes in deposit rates due to changes in the fed funds rate. Specifically, we first measure the sensitivity (beta) of each bank deposit rates to the fed funds rate over a sample period spanning from 1994 to 2017. We then calculate each region's deposit-rate sensitivity as the weighted average of the deposit-rate sensitivity of banks which operate in each region, using the share of deposits as the weight. Next, we calculate the projected changes in local deposit rates in our sample period by multiplying the fed funds rate change with the region's deposit-rate sensitivity.

Finally, we interact the projected changes in local deposit rates with the high-dividend dummy and report the result in Column 2 of Online Appendix Table C.3. In Column 3, we further instrument the deposit rate sensitivity using the local banking Herfindahl-Hirschman Index (HHI). We find that our results are robust to the use of projected changes in local deposit rates instead of actual deposit rates.

C. Evidence from Mutual Fund Flow Data

To better assess 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 interest rate changes on mutual fund flows using two separate approaches. First, we examine the impulse response functions of stock and bond mutual fund holdings to changes in the fed funds rate. Second, we use panel regressions to analyze the response of flows to interest rate changes. 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

Because changes in interest rates alter 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 function of mutual fund flows to the current and lagged changes in the fed funds rate, ΔFFR. 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 interest rate changes on mutual fund flows. A related challenge is the difference between 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 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 through the following regression model:

$$\text{Flow}_{i,t+h+1} = \beta_h \Delta\text{FFR}_{t,t-12} + \gamma' X_{i,t} + \varepsilon_{i,t+h}, \tag{8}$$

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 funds 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 include fund characteristics such as past fund returns, fund return volatility, fund expenses, and the log of fund assets under management. To control for market volatility, we also include the 1-year change in the CBOE Volatility Index (VIX) and the 1-year lagged level of VIX .

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 regression (8) separately for high- and low-income funds and for different forecast horizons, from 1 year to 5 years. The sum of the coefficients, $\sum_{h=1}^{n} \beta_h$, represents the cumulative fund flows up to n years following a 1% change in the fed funds rate. Our sample includes monthly observations for all domestic mutual funds from 1991 to 2016 at a monthly frequency.

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

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. There are two potential reasons for this slow persistent response: (i) investors are likely to adjust their portfolios only periodically,[18] and (ii) investors may be holding bonds that were issued before a change in interest rates. Income yields, therefore, may change slowly as the bonds gradually mature and are replaced by newly issued bonds. Consistent with this conjecture, the inflows to high-income bond funds reverse in the long run.

It is worth noting that changes in the fed funds rate could be driven by economic growth and inflation in addition to pure unexpected policy shocks. Although we use unexpected monetary policy shocks to identify reaching-for-income behavior in this section, our results apply to all variation in interest rates irrespective of the source of variation.[19] In other words, investors will reach for income as long as the level of fed funds rate decreases, irrespective of whether such interest rate changes originate from an excessively accommodative monetary policy.

C.2. Evidence from Panel Regressions

To complement the evidence on fund flow dynamics from the previous section, in this section, we estimate the following panel regression:

$$\text{Flows}_{i,t+1} = \beta \Delta \text{FFR}_t \times \text{High Income}_{i,t} + \gamma' X_{i,t} + \varepsilon_{i,t+1}, \tag{9}$$

where $\text{Flows}_{i,t+1}$ denotes the monthly fund flows into fund i and $\Delta \text{FFR}_t \times \text{High Income}_{i,t}$ the interaction of the high-income dummy and the three-year changes in the fed funds rate. The set of control variables $X_{i,t}$ includes fund returns, fund return volatility, 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 alleviate 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. We are interested in the coefficient of the interaction term, β, which measures the

[18]The slow response to interest rate change is not necessarily inconsistent with the evidence that individual investors trade frequently as interest rate news may be less salient than other news.

[19]In Figure C.5 of the Online Appendix, we show that both expected and unexpected policy changes lead to similar results.

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 rates lead investors to reach for income, we should expect a negative value for the coefficient β.

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, β, in regression (9) 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 × 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 × 36 months) cumulative increase in assets under management for high-income bond funds over three years, compared to low-income bond funds. These magnitudes are consistent with the findings in Figure 4 and are obtained after controlling for the fund return volatility and its interaction with changes in the fed funds rate. Controlling for volatility alleviates 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 β is statistically significant only for retail, but not for institutional funds, indicating that only retail investors tend 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 exhibit a strong preference for dividends despite the irrelevance of dividend policy in perfect capital markets with rational agents (Miller and Modigliani, 1961). If institutional frictions (e.g., asymmetric information and agency issues) 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, in contrast to retail investors, institutional investors do not reach for income. To the extent that retail investors are likely to be more vulnerable to behavioral biases than institutional investors, our results lend support to theories that explain the dividend puzzle as a departure from investor rationality.

A caveat to the above discussion is that retail and institutional share classes may not cleanly measure retail and institutional holdings because some institutional share classes could be in 401k plans held by individuals who face high costs to withdraw before retirement. Therefore, the fact that there is no reaching for income in institutional shares may not always reflect differences between individuals and institutions.

C.3. Robustness

To assess the robustness of the results reported in Table VI we consider: (i) the effect of nominal vs. real federal fund rates; (ii) an alternative definition of high-dividend funds; (iii) changes in the slope of the term structure (term spreads); (iv) the symmetry of the effect of rate increases and decreases; and (v) a longer sample dating back to 1961 with annual data.

Column 1 of Table VII investigates whether reaching for income is more sensitive to low nominal interest rates or low real interest rates. To this end, we include the interaction between the high-income dummy with changes in the real fed funds rate in our baseline regression, equation 9. We find that although both coefficients are statistically significant, the response to changes in nominal rates is two times larger than real rates. This evidence suggests that investors appear to suffer from "money illusion" in that they think about current income in nominal terms.

Column 2 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.[20] 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.[21] Under this classification, we find that a reduction

[20]For instance, a Pittsburgh-based asset management company, Federated, manages a fund called Federated Strategic Value Dividend Fund. As reported in its 2017 prospectus, this fund "seeks a higher dividend yield than that of the broad equity market."

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

in the fed funds rate is associated with significantly larger flows into funds whose names allude to a high-income focus.

Column 3 of Table VII includes an interaction term between the changes of the term spread, defined as the difference between the ten-year Treasury yield and the fed funds rate, and the high-income dummy. In our baseline results reported in Table VI, we only consider changes in short-term interest rates. To account for the possibility that long-term interest rate changes may induce investors to reach for income, we re-estimate regression (9) by including an interaction term between the changes of the term spread and the high-income dummy. 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 4 of Table VII separately estimates 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 5 of Table VII extends the analysis to a sample ranging from 1961 to 2016 and available only at an annual frequency. Our result is robust over this longer sample period.[22]

II. Asset Pricing Implications of Reaching for Income

In the last section, we established that investors who live off financial income reach for income after a reduction 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 the interest rate environment and asset prices. We hypothesize that, by increasing the demand for dividends, a reduction in interest rates increases the valuation of high-dividend-yield stocks relative to that of low-dividend-yield stocks. Specifically, in Section A we analyze variations in the aggregate "dividend premium/discount" with changes in the fed funds rate. 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.

[22]Another concern is that the boom and bust of the 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. Interest Rates 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 changes in interest rates. 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 and non-dividend-paying stocks at a given point in time. We then relate the dividend premium to the level of interest rates.

Figure 5 plots the annual change in the dividend premium 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 firms versus non-dividend paying firms. The estimated slope coefficient is significant at the 1% level.[23]

B. Interest Rates and Dividend-Yield Sorted Portfolio Returns

To formally test whether, following a drop in the fed funds rates, stocks with a high dividend yield outperform stocks with a low dividend yield, we divide our 1963–2016 sample period into rising and declining interest rate periods, based on the one-year change in the fed funds rate leading up to month t, ΔFFR_t.[24] 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 lagged changes in the fed funds rate, dividend-yield sorted portfolios do exhibit significant risk-adjusted excess returns. Specifically, following a decrease in the fed funds rate, high-dividend portfolios have positive and significant alphas, while low-dividend portfolios have negative and significant alphas. Following an increase in the fed funds rate, the opposite pattern occurs. This result suggests that other market partici-

[23] We determine significance levels using Newey-West standard errors with 4 lags.

[24] Note that in Section I we use a three-year horizon, instead of a one-year horizon, to construct the fed funds rate change ΔFFR_t used to estimate portfolio adjustment regressions. The reason for choosing a shorter horizon in this section is to accommodate the fact that the impact of rate changes on asset prices may be short-lived due to adjustments in the supply of high-income assets. The different time horizon used to construct the measure of rate changes reflects the difference in timing between portfolio adjustments and asset price impact, as illustrated by the timing of the return realizations we discuss in Section C.

pants do not seem to fully anticipate the rebalancing of living-off-income investors. If such rebalancing were fully anticipated, asset prices would adjust at the time of the interest rate changes.

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 for 1963–2016, 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.[25]

C. Timing of the Return Realizations

To understand the timing of the realization of excess returns following interest rate changes, we estimate the following predictive regressions over the period 1963–2016:

$$\alpha_{i,t+h+1} = \beta_{i,h}\Delta\mathrm{FFR}_{t,t-12} + \varepsilon_{i,t+h+1}, \quad h = 0, 12, \ldots, 48, \tag{10}$$

where $\alpha_{i,t+h+1}$ is the excess return of holding the dividend-sorted portfolio i from time $t+h$ to $t+h+1$; $\Delta\mathrm{FFR}_{t,t-12}$ is the change in the fed funds rate from time $t-12$ to t. We estimate the model (10) 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 ΔFFR in (10).[26]

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. In contrast, 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 vanish or even turn

[25]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.

[26]This choice should bias our analysis against finding any excess return because investors may have anticipated some of the changes in the fed funds rate.

negative after year 3. This result is consistent with the hypothesis that the demand pressure dissipates as the supply of these assets adjusts in the long run.[27]

The analysis supports the conjecture that, following a negative shock to fed funds rate, retail investors reach for yield and, in doing so, 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 for this hypothesis in the data. Comparing the timing of the realization of excess returns in Figure 7 with 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 illustrate this point, we construct a lagged version of the trading strategy discussed in Section B. Specifically, we define "dividend strategy (lag n)" as a comparable dynamic long-short strategy, 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 time. Using Equation (8), we first estimate β_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.

One may also worry that dividend yield not only measures how much income a stock delivers but also predicts higher expected future returns. Therefore, our findings could

[27]In Section IV, we find that some firms cater to the increasing demand for dividends by initiating dividends when the fed funds rate decreases.

be driven by investors' demand for assets with higher expected returns instead of higher current income. This alternative hypothesis is unlikely to drive our results because of two reasons. First, in our tests, we control for stocks' exposure to risk factors that predict returns. As shown by Fama and French (1993), the excess returns of dividend-yield sorted portfolios are statistically indistinguishable from zero once these risk factors are controlled. Second, our results hold conditionally: high-dividend portfolios outperform when the fed funds rate declines and underperform when the fed funds rate rises. This result is conceptually different from the *unconditional* predictive relationship between dividend yields and expected returns.

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 both the underlying driver and the empirical measure of our dividend premium differ from the dividend interim return. Specifically, the dividend month premium of Hartzmark and Solomon (2013) is mainly driven by tax-exempt investors who actively capture dividends around a 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 level of interest rates, the buying pressure for high-dividend stocks in dividend payment month is always present. In contrast, our dividend premium is likely 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, in our analysis, the dividend premium can turn into a dividend *discount*, as shown Table VIII. Second, in Hartzmark and Solomon (2013), the buying pressure for high-dividend stocks during a dividend-payment month is short-lived, as it typically dissipates over 40 days after the ex-dividend day. This result is consistent with tax-exempt investors are capturing dividends around the short window between the dividend announcement date and the ex-dividend date and liquidating their position afterward. In contrast, we find that fund flows following changes in interest rates are persistent for several years. This result is more in line with retail investors slowly adjusting their portfolios in response to changes in interest rates.

D. Interest Rates and Dividend Strips Returns

So far, we have provided evidence from dividend sorted portfolios. In this section, we extend our analysis and consider dividend strips returns. Dividend strips are claims that pay dividends on the stock index up to a certain period (Van Binsbergen et al., 2012). These assets provide a sharp test for the reaching-for-income hypothesis because they are exactly the current income streams that investors would like to receive. To this purpose, we estimate the following predictive regressions of excess returns of a long position in dividend strips

$$\alpha_{t+h+1} = \beta_h \Delta \text{FFR}_{t,t-12} + \varepsilon_{t+h+1}, \quad h = 0, 12, \ldots, 48, \tag{11}$$

where α_{t+h+1} is the excess return of the long dividend strategy constructed by Van Binsbergen et al. (2012) from time $t+h$ to $t+h+1$.[28] The excess return is calculated using the five-factor model of Fama and French (2016). The sample period is from 1996 to 2009. The results are reported in Figure 8. The upper panel shows that, following a decrease in the fed funds rate, dividend strips exhibit positive alphas in year 1. The positive alpha becomes insignificant starting from year 2. The lower panel of Figure 8 zooms in the first year and shows that the positive alpha disappears around 10 months after the change in fed funds rate. These findings suggest an increase in demand for income streams following a decrease in the fed funds rate, which dissipates subsequently. These findings are consistent with the patterns of the high dividend-yield portfolio returns in Figure 7.

In Figure C.5 of the Online Appendix, we further separate the changes in the fed funds rate into expected and unexpected changes following Bernanke and Kuttner (2005). Our results from mutual fund flows show that investors respond to changes in interest rates with a lag. Therefore, the distinction between expected and unexpected changes in the fed funds rates should be irrelevant because both types of information will be available to investors as they adjust their portfolio after a change in the fed funds rate. Consistent with this conjecture, we find that both expected and unexpected changes in the fed funds rate lead to positive excess returns for dividend strips.

In summary, the empirical analysis of the previous two sections suggests that the reaching-for-income effect causes certain types of investors to rebalance towards high-income assets after a drop in interest rates. Furthermore, the change in demand for dividend-paying assets following an interest rate change does not appear to be fully antici-

[28] We obtain the dividend strip returns from the Online Appendix of Van Binsbergen et al. (2012).

pated by the market and leads to temporary positive excess returns to high-income stocks and bonds for the three years following the change. Rather than benefiting from this rate change, retail investors continue to rebalance towards high-income assets long after asset prices have risen in response to demand pressure. As a result, the reaching for income behavior of these investors exposes them to aggregate losses in their portfolios.

III. A Model of Reaching for Income

We now analyze the equilibrium implications of reaching for income in a model economy in which a fraction of investors follow the rule-of-thumb of living off income.[29] The model shows how "living off income" can lead to the reaching for income behavior and the return predictability in response to changes in interest rates 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, that is, at each time $t = 1, 2$, the dividend growth can take values u^j or d^j at each time with

$$u^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 + \sigma_j}, \quad \text{and} \quad d^j = e^{\mu_j - \frac{1}{2}\sigma_j^2 - \sigma_j} \quad j = L, H. \tag{12}$$

The high dividend-yield asset has a *lower* dividend growth rate than the low dividend-yield asset, that is, $\mu_H < \mu_L$. We assume that the joint probability distribution of the dividend growth rates of of the two assets at times $t = 1, 2$ is given by

$$\Pr(u^L, u^H) = \Pr(d^L, d^H) = \frac{1}{4}(1 + \rho), \quad \text{and} \quad \Pr(u^L, d^H) = \Pr(d^L, u^H) = \frac{1}{4}(1 - \rho), \tag{13}$$

[29]The Online Appendix B provides a possible microfoundations of the living-off-income rule based on quasi-hyperbolic discounting an agents' self-control motives. In this setting, we show that a living-off-income consumption rule can be an optimal commitment device to limit the tendency to over-consume.

with correlation ρ.[30] Denoting by P_t^j the price of asset $j \in \{H, L\}$ at time t, we have that the one period return $\tilde{R}_{j,t_1}$ is given by

$$\tilde{R}_{j,t+1} = \frac{D_{t+1}^j + P_{t+1}^j}{P_t^j}, \quad j = H, L. \tag{14}$$

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

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

$$\max \mathbb{E}_0 \left[\sum_{t=0}^{2} \delta^t u(C_{h,t}) \right], \tag{15}$$

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

$$C_{h,t} = W_{h,t} - n_{h,t}^F P_t^F - n_{h,t}^L P_t^L - n_{h,t}^H P_t^H \tag{16}$$

$$W_{h,t+1} = n_{h,t}^F D_{t+1}^F + n_{h,t}^L (D_{t+1}^L + P_{t+1}^L) + n_{h,t}^H (D_{t+1}^H + P_{t+1}^H), \tag{17}$$

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:

$$W_{h,0} = \omega_h (S^F D_0^F + S^L (D_0^L + P_0^L) + S^H (D_0^H + P_0^H)), \tag{18}$$

where ω_h denotes agent h's initial share of total wealth.[31]

[30] The choice of the joint probability distribution in equation (13) guarantees that the correlation between the dividend growth of asset H and L is indeed equal to ρ.

[31] In the numerical analysis that follows we set $\omega_h = 0.5$, $h = A, B$, that is, each set of agent is endowed with the same share of each of the assets.

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, and monetary policy is completely exogenous. 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 neutral: any change in the nominal interest rates is canceled by an equal change in the inflation rate π_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 nominal friction in the model that renders money non-neutral. As a consequence, monetary policy affects real asset prices.

"Living off income". Agent A follows a rule-of-thumb of living off income and suffer from "money illusion" in that they think of income in nominal terms. Formally, agent A's nominal consumption $C_{A,t}^{\$}$ is bounded by the current income available at time $t = 0, 1$:

$$C_{A,t}^{\$} \leq n_{A,t-1}^{F} \underbrace{\left(\Pi_t - P_{t-1}^{\$,F}\right)}_{\text{Nominal interest income}} + n_{A,t-1}^{L} D_t^{\$,L} + n_{A,t-1}^{H} D_t^{\$,H}, \tag{19}$$

where $C_{A,t}^{\$} = C_{A,t}\Pi_t$ is the consumption in terms of time t dollars and Π_t is the time-t price level. Because the bond has a real dividend of 1 at time t, the nominal dividend of the bond is Π_t at time t. $P_{t-1}^{\$,F}$ is the nominal price of the short-term bond at time $t-1$. The term $\Pi_t - P_{t-1}^{\$,F}$ represents the nominal interest income. 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 (19) affects the agents *real* consumption/savings ratio.

Proposition 1. *Let Π_t denote the time-t price level. Then income constraint (19) on nominal consumption is equivalent to a constraint on the ratio of real consumption to real savings, that is,*

$$\frac{C_{A,t}}{W_{A,t-1} - C_{A,t-1}} \leq \theta_{A,t-1}^{F} r_t^{\$,F} + \theta_{A,t-1}^{L} dp_t^{L} + \theta_{A,t-1}^{H} dp_t^{H}, \tag{20}$$

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

$$\theta_{A,t}^{j} = \frac{n_{A,t}^{j} P_t^{j}}{W_{A,t} - C_{A,t}}, \tag{21}$$

$dp_t^j = \frac{D_t^j}{P_{t-1}^j}$ *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 A.

The expression of the constraint (20) 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. Because of the presence of investors who follow the nominal consumption rule (19), monetary policy has a real effect on our otherwise frictionless economy. The nominal consumption rule implies that investors exhibit "nominal illusion": they think about income in nominal terms. This assumption is motivated by our finding in Table VII that investors appear to respond more to changes in nominal rates instead of real rate changes.[32]

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 (15) subject to (16), (17), and (19) and markets clear

$$n_{A,t}^F + n_{B,t}^F = S^F \quad (22)$$

$$n_{A,t}^L + n_{B,t}^L = S^L \quad (23)$$

$$n_{A,t}^H + n_{B,t}^H = S^H. \quad (24)$$

Consumption. We first examine the effect of monetary policy on consumption. Figure 9 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 the absence of the income constraint, real consumption is independent of the nominal interest rate. In other words, monetary policy is neutral for consumption-savings decisions. 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

[32]Instead of assuming money illusion in the constraint (20) we could have imposed a real income constraint as in Campbell and Mankiw (1989) and Kaplan et al. (2018). In this case, however, one would need a different type of nominal friction, e.g., price stickiness, to make monetary policy non-neutral.

rates reduces real interest rates and hence has an expansionary effect on consumption. In contrast, our result formalizes the intuition that low-interest-rate monetary policy may have *contractionary* effects on the consumption of investors who live off their income from savings.[33]

Notice that the contractionary effect on consumption is not mechanical. The income-consuming investors could rebalance their portfolio towards higher-income assets. However, such rebalancing 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.

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 assets have the same risk-return trade-off but differ in their dividend yield.[34] Figure 10 illustrates the agents' portfolio holdings of the high- and low-dividend stocks at time $t = 0$ for each level of nominal interest rates. 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

[33]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). It is difficult to reconcile this behavior with the conventional channel based on intertemporal substitution, which would predict an increase in consumption when rates fall.

[34]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 $\mu_H = \mu_L = 0.07$, 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 (20) we assume that the dividend yield $dp^H = 0.8$ and $dp^L = 0.01$

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. 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 11 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 the constrained equilibrium, however, the reaching-for-income behavior of type-A's agents bids up the price of the high dividend yield asset (H) relative to that of the low-dividend yield asset (L) and gives rise to a higher dividend premium. These findings are qualitatively consistent with our empirical finding in Figure 5.[35]

In our model, monetary policy affects the *risk premium* of assets. This result is in contrast to standard representative agent 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 study the financial channel of monetary policy transmission.[36] The channel featured here can be incorporated in the standard New Keynesian framework by introducing (i) multiple assets with various level of current income yields; and, (ii) living-off-income households in the spirit of constraint (19). Our model is also related to the growing literature on Heterogeneous Agent New Keynesian (HANK) Models (Kaplan et al., 2014, 2018; Auclert,

[35]Notice, however, that in our stylized setting, the variations in the dividend premium are small relative to the large changes in the risk-free rate. 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.

[36]See Drechsler, Savov, and Schnabl (2017b) for a survey of the literature on the financial channels of monetary policy.

2019). The key difference is that the HANK literature usually focuses on asset liquidity while we focus on income yields.

IV. Implications of Reaching for Income

The previous section shows that in a model in which some investors follow the consumption rule of living off income, optimal portfolio choices and equilibrium asset prices exhibit patterns that are consistent with our empirical finding in Sections I and II. In this section, we discuss the relevance of these effects for aggregate consumption, capital allocation, portfolio diversification, and investors' risk-taking behavior.

Aggregate consumption. In the model of Section III, we show that low-interest-rate monetary policy may have contractionary effects on the consumption of investors who live off their income from savings. Here we conduct a "back-of-the-envelope" quantification to assess the magnitude of this effect. Assuming that the constraint in equation (20) binds and differentiating with respect to the nominal interest rate $r_t^{\$,F}$, we obtain that the change in consumption of an agent who lives off income following a change in the interest rates, can be decomposed as follows:

$$d\ln C_{A,t} \times \frac{C_{A,t}}{W_{A,t-1} - C_{A,t-1}} = \underbrace{\theta_{A,t}^F}_{\text{direct effect}} + \underbrace{d\theta_{A,t}^H \left(dp_t^H - r_t^{\$,F}\right) + d\theta_{A,t}^L \left(dp_t^L - r_t^{\$,F}\right)}_{\text{portfolio rebalancing}}, \tag{25}$$

The first term on the right-hand-side of equation (25) is the direct effect: when the Fed lowers interest rates, the current income from deposits and short-term bonds falls. The second term is the portfolio rebalancing effect: as interest rates fall, investors who reach for income increase the weight of higher-income assets. We estimate the magnitude of these two effects using the aggregate households' balance sheets and the impulse response of mutual fund flows estimated in Section I. Section C of the Online Appendix provides details of the calculation. We find that the direct effect of a 1% reduction in the fed funds rate on the consumption of living-off-income investors is −0.8%, and the indirect effect is +0.2%. Therefore, assuming that 40% investors live off income, the overall effect on the aggregate consumption through this channel is around $-0.24\% = (-0.8\% + 0.2\%) \times 0.4$. As a benchmark, Boivin et al. (2010) estimate that the overall impulse response of consumption to a 1% decrease in the fed funds rate is around 1-2%. Therefore, our "back-of-the-envelope" calculations suggest that the reaching for income channel is quantitatively important. It is worth emphasizing, however, that this quantification is not suitable for welfare analysis as it does not account for the expansion in labor demand, the main focus of Kaplan et al. (2014), or other general equilibrium effects.

Aggregate investment. Our model shows that monetary policy can affect the relative cost of capital for dividend-paying and non-dividend-paying firms. Because dividend-paying and non-dividend-paying firms likely face different investment opportunities, changes in their relative cost of capital may have implications on aggregate investment. In Section C of the Online Appendix, we provide a back-of-envelope assessment of this effect using a standard neoclassical q-theory model of investment applied to the universe of firms in the COMPUSTAT database.

We assess that, in a scenario where agents reach for income, the aggregate investment rate is 0.024% lower than in a counterfactual scenario in which reaching for income is absent. As a benchmark, Boivin et al. (2010) estimate that a 1% decrease in the fed funds rate increases investment by around 1.5%. Therefore, our analysis suggests that the reaching-for-income channel *dampens* the sensitivity of aggregate investment to monetary policy by around $1.6\%(= 0.024\%/1.5\%)$. The intuition is as follows. In an economy with reaching-for-income investors, dividend payers benefit from a reduction in their cost of capital when the Fed lowers interest rates. However, to the extent that high dividend-paying firms have few growth opportunities, the additional boost in investments is likely to be small. At the same time, non-dividend paying firms experience a relative increase in their cost of capital as investors shift to dividend payers. This effect dampens the stimulus effect of low interest rates on investment. To the extent that non-dividend paying firms are rich in growth opportunities, this dampening effect on investments is likely to have a large impact in terms of foregone investment. Combining these two effects, we find that, following a rate cut, the reaching for income channel dampens the increase in the aggregate investments.

It is worth noting that we are not suggesting low interest rates will reduce the investment of low-dividend firms because the direct effect of lower interest rates on the cost of capital is likely to dominate the opposite effect of reaching for income. Our analysis suggests that low-dividend firms will invest relatively less than in a *counterfactual* scenario in which there is no reaching for income.

Catering. In Section II, we show that low-interest rates will lead to a higher valuation of dividend-paying stocks. Catering to such demand, firms may initiate dividends to boost their share prices. We find suggestive evidence of this in the data. Figure 13 plots the level of the fed funds 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 satisfy the excess demand as asset prices of dividend-paying firms still rise. A possible reason is that, for some firms, it is costly to change their dividend payout policy, e.g., Lintner (1956). The finding that low-interest-rates induce firms to initiate dividends also provides a possible explanation for the reappearing dividends after the 2000s, as documented by Julio and Ikenberry (2004) and Michaely and Moin (2017).

Portfolio under-diversification. Low interest-rates may lead to under-diversification of investors' portfolios. As Figure 10 shows, a fully diversified portfolio in our model would have equal weights in both the high- and low-dividend stocks. However, as low-interest-rates depress interest income, reaching-for-income investors overweight high-dividend stocks and underweight low-dividend stocks. In the data, stocks that pay a high dividend usually concentrate on 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 a low rate environment, "reaching-for-income" investors move from short-term debt instruments into equities to capture the higher income yield provided by the equities. This portfolio rebalancing results in the increased portfolio volatility in low rate environment for the reaching-for-income investors that is illustrated in Figure 12.

Furthermore, as 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 assets to overall portfolio risk.

Finally, low interest rates may spur "financial alchemy" aimed at generating income from assets that are not naturally income producing. For instance, some financial advisors recommend option funds that write call options against their stock positions (e.g., Baldwin (2011)). This strategy allows the funds to transform capital gain into a constant stream of the option premium, which can be distributed as income to fund investors.[37] Relatedly, Jiang and Zhu (2016) document that mutual funds enhance their current income streams using credit default swaps (CDS). Such "financial alchemy" helps to meet investors' demand for current income, although it might also expose investors who do not fully understand the underlying risks of these strategies to undesirable risks.

V. Conclusion

Miller and Modigliani (1961) show that rational investors should be indifferent between the splits between current income and capital gain. In contrast to this principle, we find 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 low-interest-rate periods 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 interest-rate reductions, and reversals following interest-rate hikes, implying strong shifts in investors' demand. We also find that changes in interest rates significantly affect 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 that shows the reaching-for-income behavior has important implications for monetary policy. By influencing the interest income from deposits and short-term bonds, monetary policy may affect consumption, portfolio choice, and asset prices even in an economy in which prices are fully flexible. This channel is outside the standard representative agent New Keynesian framework in which the key friction is price stickiness.

[37] For example, the Eaton Vance Tax-Managed Global Diversified Equity Income Fund uses this strategy to generate an income yield of 13.3% in recent years.

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 an 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 worth is the total self-reported net worth when the household opened its first account at this brokerage. Account balance is the total value of the account as of January 1991. *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* is a categorical variable that indicates the labor income of the account holder. *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. *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.

Panel A: Demographics

	mean	sd	p10	p25	p50	p75	p90
Net Worth	732.587	15442.037	37.000	74.500	100.000	250.000	500.000
Account Balance	32.775	115.900	1.520	4.357	10.047	24.716	67.985
Retiree	0.158	0.365	0.000	0.000	0.000	0.000	1.000
Labor Income	4.028	3.356	0.000	0.000	5.000	7.000	8.000
Home Owner	0.577	0.494	0.000	0.000	1.000	1.000	1.000
Married	0.419	0.493	0.000	0.000	0.000	1.000	1.000
Male	0.564	0.496	0.000	0.000	1.000	1.000	1.000
Bank Card	0.640	0.480	0.000	0.000	1.000	1.000	1.000
Vehicles	0.492	0.822	0.000	0.000	0.000	1.000	2.000

Panel B: Portfolio

	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

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.

	(1) All	(2) All	(3) Male	(4) Female
Retiree	0.258***	0.258***	0.251***	0.271***
	[0.040]	[0.040]	[0.048]	[0.075]
Labor Income	-0.018**	-0.018**	-0.024**	0.025
	[0.008]	[0.008]	[0.011]	[0.018]
Home Owner	0.061	0.061	0.089	0.018
	[0.055]	[0.055]	[0.069]	[0.107]
Married	0.013	0.013	0.045	0.030
	[0.041]	[0.041]	[0.045]	[0.113]
Bank Card	0.005	0.005	-0.019	0.017
	[0.043]	[0.043]	[0.082]	[0.052]
Vehicles	0.026	0.026	0.042**	-0.075
	[0.020]	[0.020]	[0.021]	[0.070]
Occupation F.E.	No	Yes	Yes	Yes
Observations	19,394	19,394	11,442	7,952
Pseudo R-squared	0.0021	0.0021	0.0030	0.0024

Table IV: Stock Holdings and Fed Funds Rates

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

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

where $\textit{Net Buy}_{i,j,t+6}$ 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 $t+6$. ΔFFR_t represents the three-year change in the fed funds rate leading up to month t; $\textit{High Div}_{i,t}$ 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 ($\Delta FFR_t * \textit{High Repurchase}_{i,t}$), market beta and its interaction with the 3-year change in the fed funds rate ($\Delta FFR_t * \textit{Beta}_{i,t}$), book-to-market ratio and its interaction with the 3-year change in the fed funds rate ($\Delta FFR_t * BM_{i,t}$), 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 month.

	(1) Net Buy	(2) Net Buy	(3) Net Buy
Δ FFR*High Dividend	-0.789**	-0.958***	-0.631*
	[0.371]	[0.352]	[0.331]
Δ FFR*High Repurchase	-0.218	-0.135	-0.140
	[0.191]	[0.192]	[0.220]
Δ FFR*Beta	-0.249***	-0.196***	-0.0320
	[0.0669]	[0.0607]	[0.0641]
Δ FFR*BM	0.231**	0.172**	0.165*
	[0.0888]	[0.0851]	[0.0889]
Stock Characteristics	Yes	Yes	Yes
Demographics	Yes	Yes	Yes
Time F.E.	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	0.0029	0.0957	0.1145

Table V: Local Deposit Rates and Stock Holdings

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

$$\text{Net Buy}_{i,j,m,t+6} = \beta \Delta \text{Dep Rates}_{m,t} \times \text{High Div}_{i,t} + \gamma' X_{i,j,m,t} + \varepsilon_{i,j,m,t}$$

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 $t+6$. $\Delta Dep\ Rates_{m,t}$ 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; $X_{i,j,m,t}$ is a set of control variables including high repurchase dummy and its the interaction with the 3-year change in deposit rates ($\Delta Dep\ Rates_{m,t} * High\ Repurchase_{i,t}$), market beta and its interaction with the 3-year change in deposit rates ($\Delta Dep\ Rates_{m,t} * Beta_{i,t}$), book-to-market ratio and its interaction with the 3-year change in deposit rates ($\Delta Dep\ Rates_{m,t} * BM_{i,t}$), 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 month.

	(1) All	(2) Withdrawers	(3) Non-Withdr.
Δ Dep Rates*High Dividend	-2.734***	-3.094***	-0.909
	[0.330]	[0.342]	[1.168]
Δ Dep Rates*High Repurchase	0.736	0.680	1.109
	[0.463]	[0.499]	[1.176]
Δ Dep Rates*Beta	0.402***	0.330**	0.637**
	[0.121]	[0.138]	[0.261]
Δ Dep Rates*BM	0.124	0.157	0.0484
	[0.114]	[0.129]	[0.246]
Stock Characteristics	Yes	Yes	Yes
Household F.E.	Yes	Yes	Yes
Time-MSA F.E.	Yes	Yes	Yes
Observations	1,450,101	1,158,596	289,321
Adj. R-squared	0.1008	0.0993	0.0926

Table VI: Mutual Fund Flows, Fed Funds Rates, and Income Yields

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

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

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

	All		Retail		Institution	
	(1)	(2)	(3)	(4)	(5)	(6)
	Equity	Bond	Equity	Bond	Equity	Bond
Δ FFR*High Income	-0.128***	-0.054*	-0.142***	-0.101***	-0.066	-0.067
	[0.032]	[0.030]	[0.048]	[0.038]	[0.044]	[0.048]
Δ FFR*Volatility	0.012	-0.134***	0.043**	-0.081***	0.012	-0.154***
	[0.014]	[0.017]	[0.019]	[0.022]	[0.016]	[0.033]
Δ Tax*High Dividend	-0.203***	-0.018	-0.193	0.152	0.033	-0.061
	[0.030]	[0.030]	[0.207]	[0.171]	[0.161]	[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	0.0171	0.0125	0.0212	0.0210	0.0089	0.0064

Table VII: Mutual Fund Flows: Robustness

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

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

where $Flow_{i,t}$ represents flows into mutual fund i at time t; ΔFFR_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,* $\Delta FFR \times$ *Volatility,* $\Delta Tax \times$ *High Dividend, Return, Size, Turnover,* and *Expense. Return* is fund return over the preceding month; *Volatility* is the standard deviation of fund returns for the past year; ΔTax is the difference between the maximum individual income tax rate and the capital gain tax rate; *Size* represents the assets under management (log); and *Expense* represents the expense ratio. Column 1 uses fund names to classify high income. Column 2 includes the interaction term with both the nominal and real FFR. Column 3 adds the interaction term between the high-income dummy with the change in term spreads. Column 4 separately estimate the effect of rate increase and rate reduction. Column 5 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) Real	(2) Name	(3) Term	(4) Asymmetry	(5) Long Sample
Δ FFR*High Income	-0.106***	-0.158***	-0.481***		-0.052**
	[0.025]	[0.025]	[0.094]		[0.026]
Δ Real FFR*High Income	-0.033**				
	[0.015]				
Δ Term Spread*High Income			-0.457***		
			[0.123]		
FFR Increase*High Income				-0.138**	
				[0.064]	
FFR Decrease*High Income				-0.123**	
				[0.047]	
Fund Controls	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes
Objective F.E.	Yes	Yes	Yes	Yes	Yes
Observations	1887323	1887323	1887323	1887323	223116
Adj. R-squared	0.0115	0.0110	0.0112	0.0114	0.0684

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

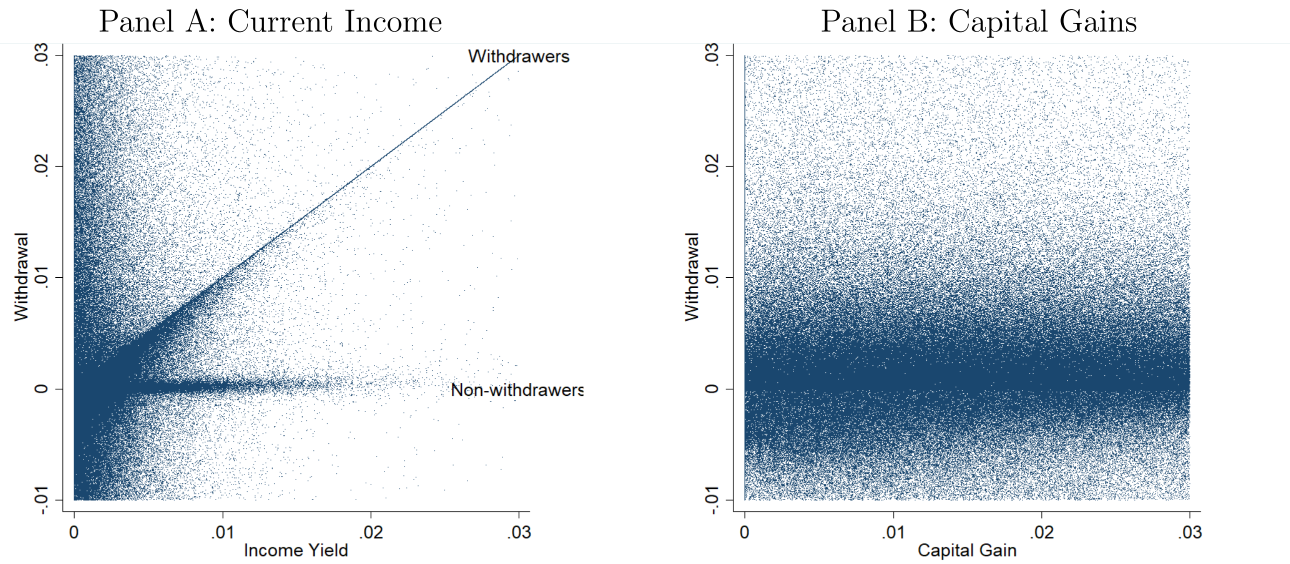

Figure 1: Current Income, Capital Gains, and Net Withdrawals

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.

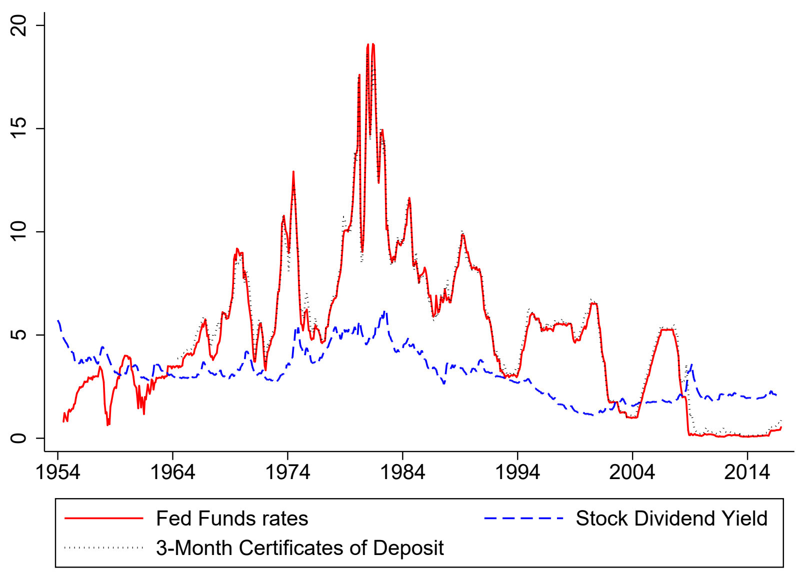

Figure 2: Dividend Yields, Deposit Rates, and Fed Funds Rate

This figure shows the aggregate U.S. stock market dividend yield, the interest rates of 3-month certificates of deposit, 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 the fed funds rate are retrieved from the FRED database of the St. Louis Fed.

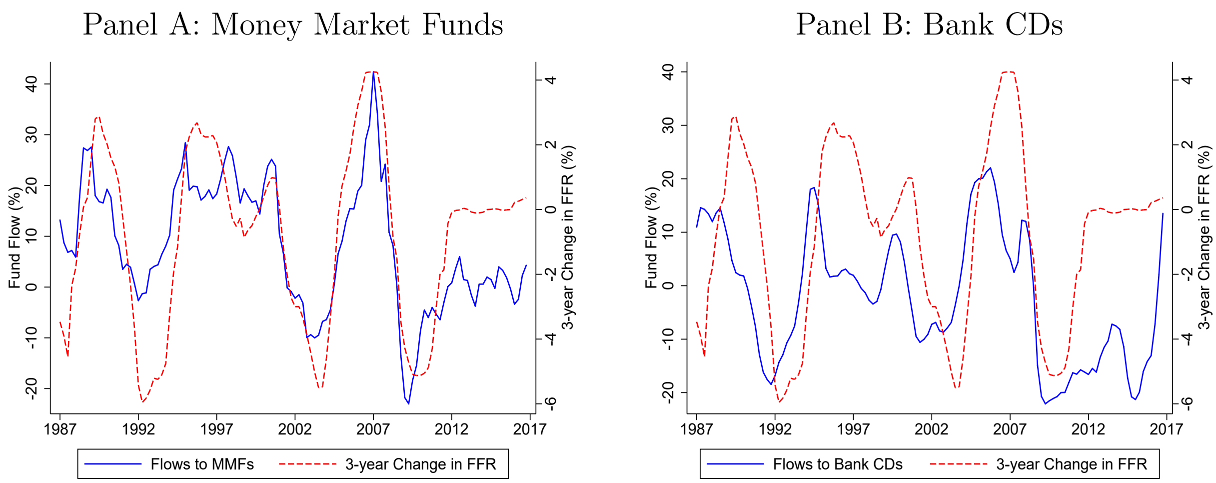

Figure 3: **Fund Flows to Money Market Funds and Bank CDs**

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.

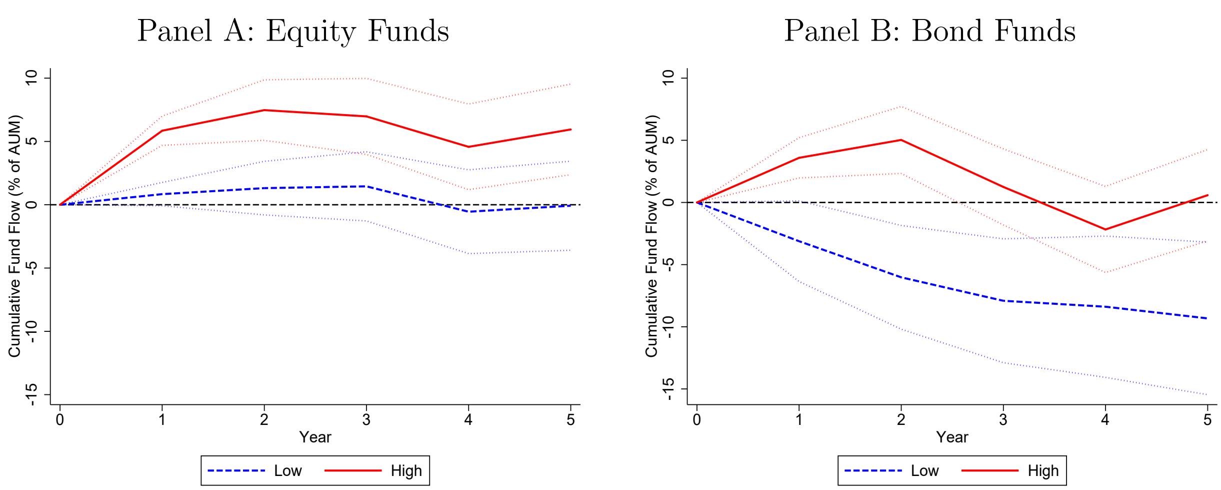

Figure 4: **Impulse Response of Fund Flows to Changes in the Fed Funds Rate**

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 (8). The estimation sample includes the domestic mutual funds in the United States from 1991 to 2016.

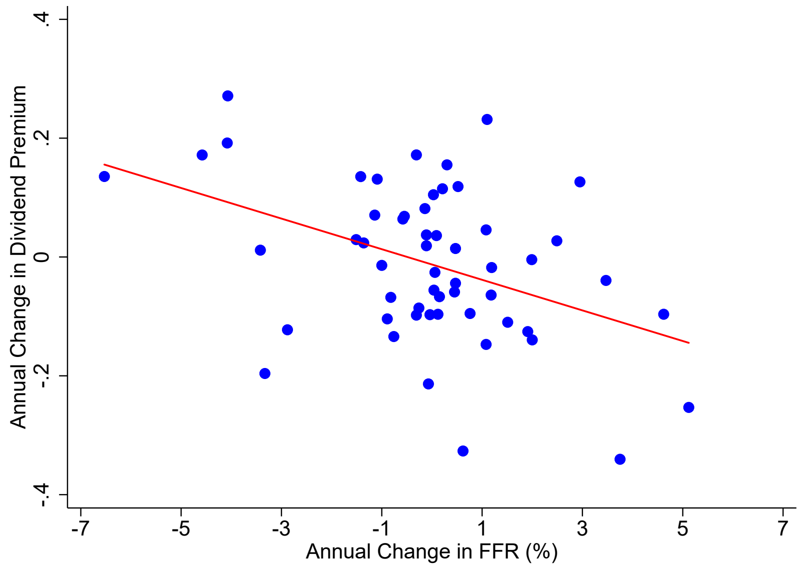

Figure 5: Changes in the Dividend Premium and the Fed Funds Rate

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.

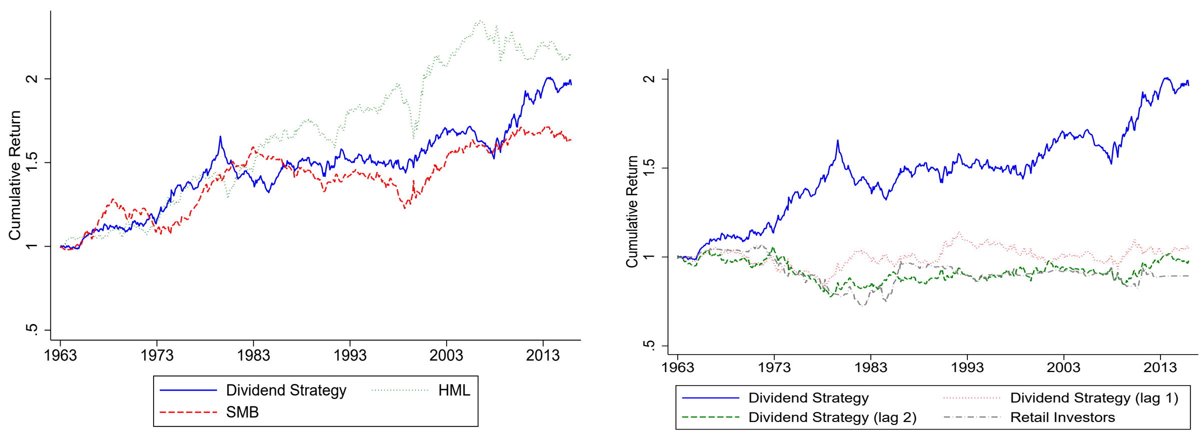

Figure 6: Cumulative Return of the Dividend Strategy

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 mimics 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%.

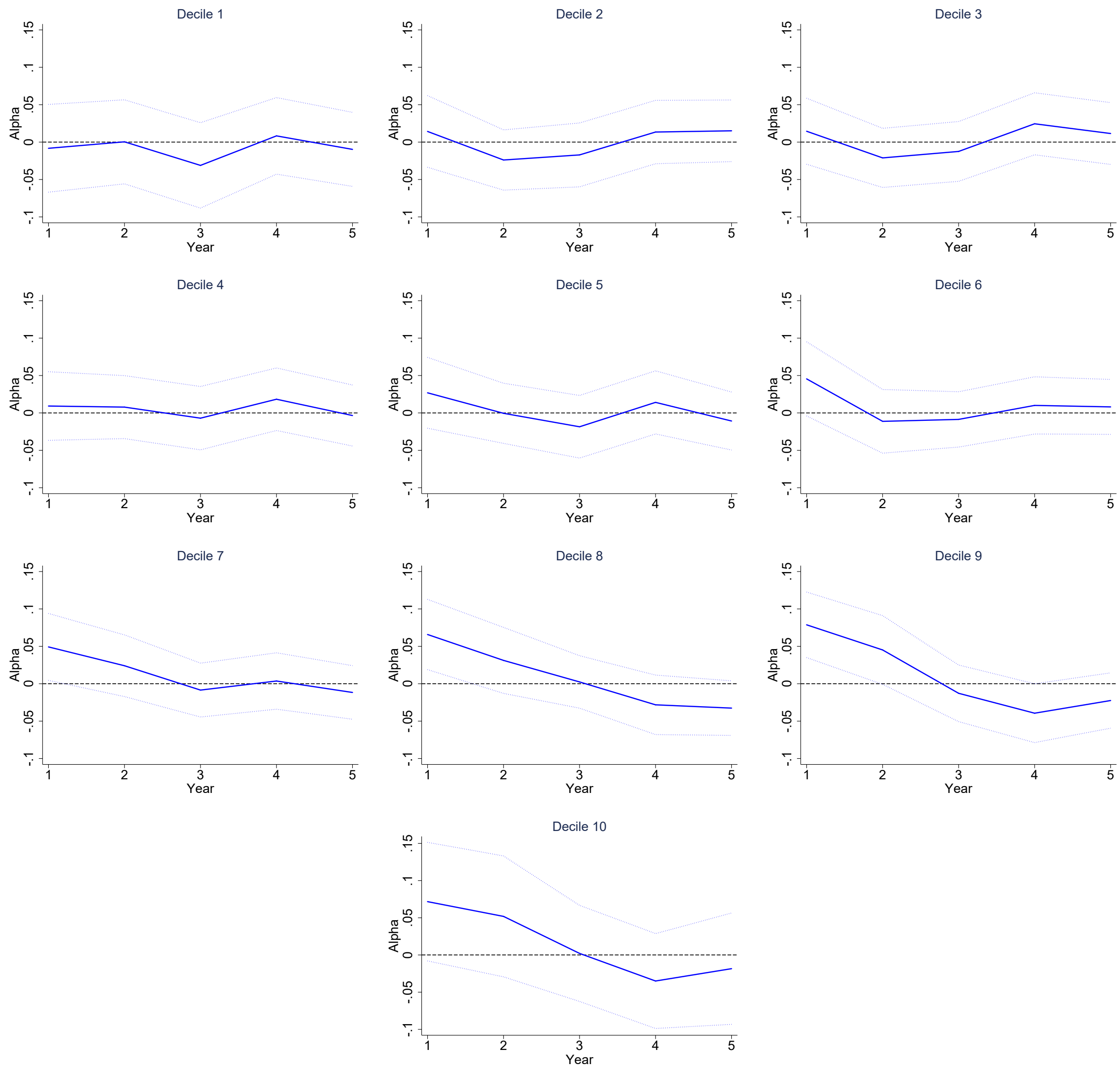

Figure 7: **Impulse Response of Excess Returns of Dividend-sorted Portfolios**

The solid lines in each figure plot the impulse response ($\beta_{i,h}$ from regression (10)) 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.

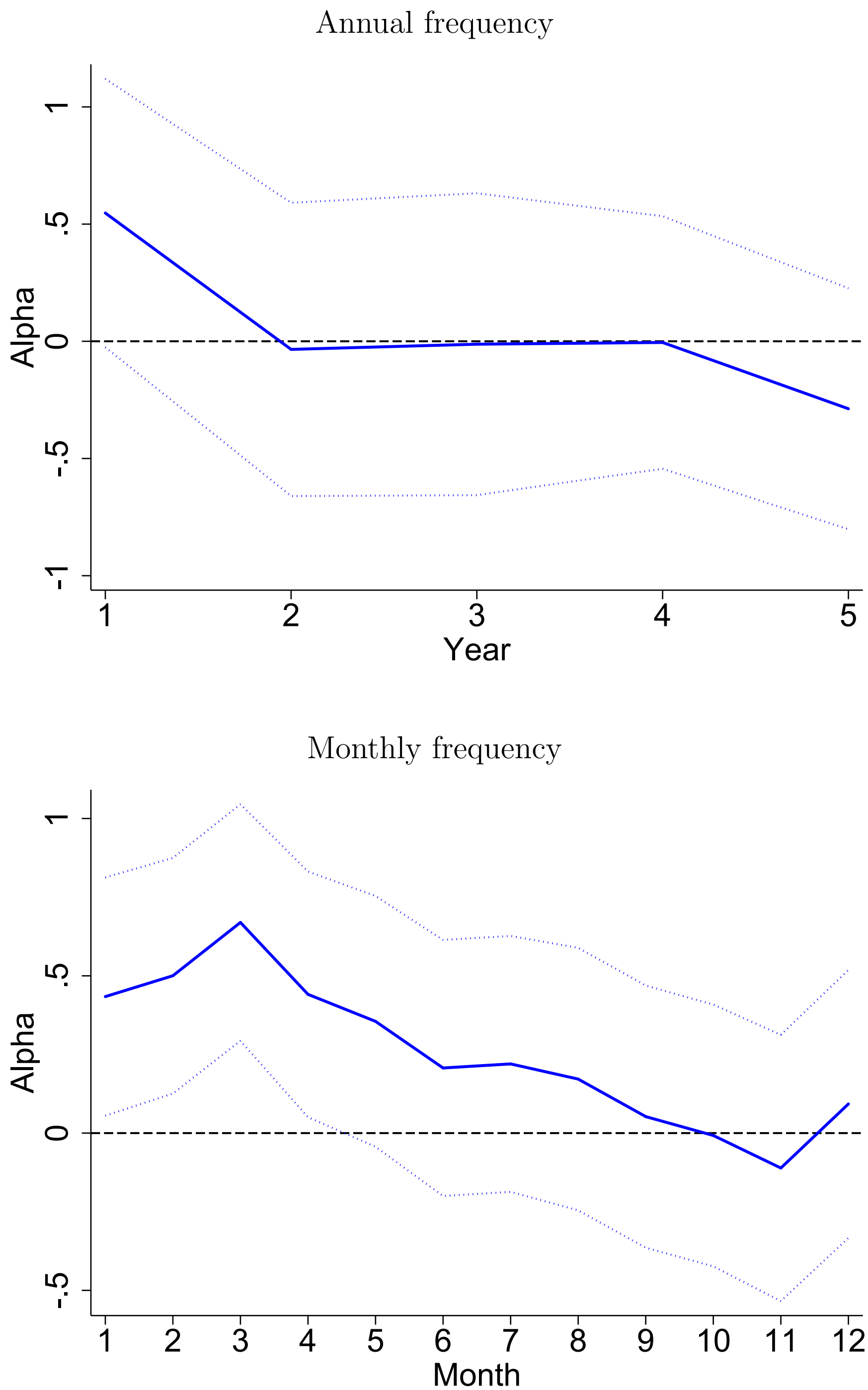

Figure 8: **Impulse Response of Excess Returns of Dividend Strips**

The solid lines in each figure plot the impulse response ($\beta_{i,h}$ from regression (11)) of the Fama-French 5-factor alphas of the dividend strips to a negative 1% shock on the fed funds rate. The upper panel has a horizon of 5 years with an annual frequency. The lower panel has a horizon of 1 year with a monthly frequency. The dotted lines represent 95% confidence intervals. The sample period is from June 1989 to Oct 2009.

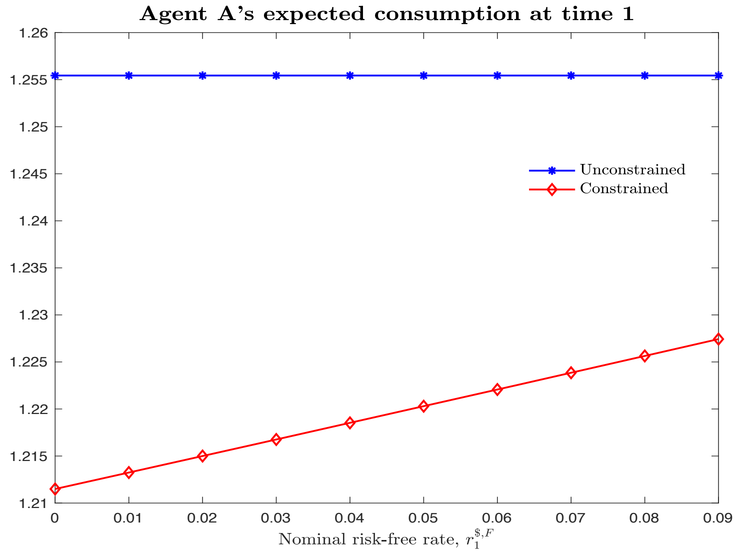

Figure 9: **Monetary Policy and Consumption**

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 $\mu_L = 0.04$.

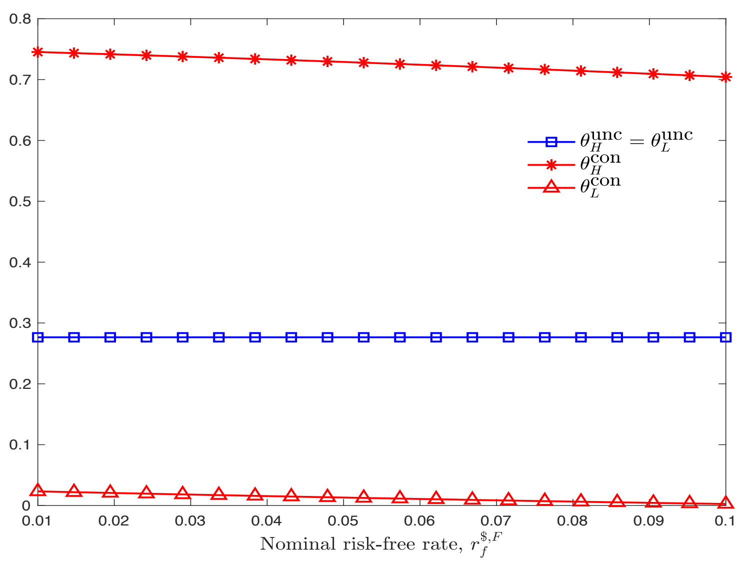

Figure 10: **Monetary Policy and Portfolio Holdings**

The figure reports portfolio holdings as a function of the nominal interest rate. For illustrative purposes we take asset returns as given. The portfolio (θ_H, θ_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 $\mu_H = \mu_L = 0.07$, 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 (20) we assume that the dividend yield $dp^H = 0.8$ and $dp^L = 0.01$. The agent has risk aversion parameter is $\gamma = 3$ and time preference parameter $\delta = 0.98$.

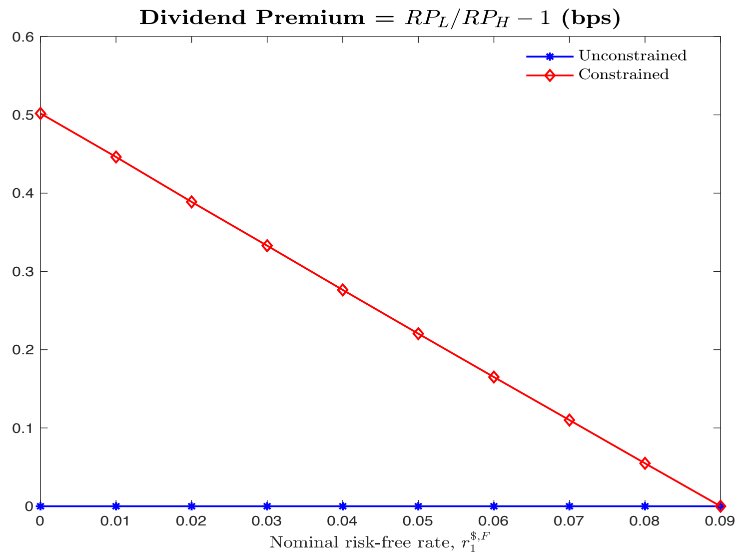

Figure 11: Monetary Policy and Dividend Premium

The figure reports the dividend premium as a function of the nominal risk-free rates in the general equilibrium model of two agents. 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 $\mu_L = 0.04$. Initial aggregate endowment: $\omega_A = \omega_B = 0.5$. The dividend premium is 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.

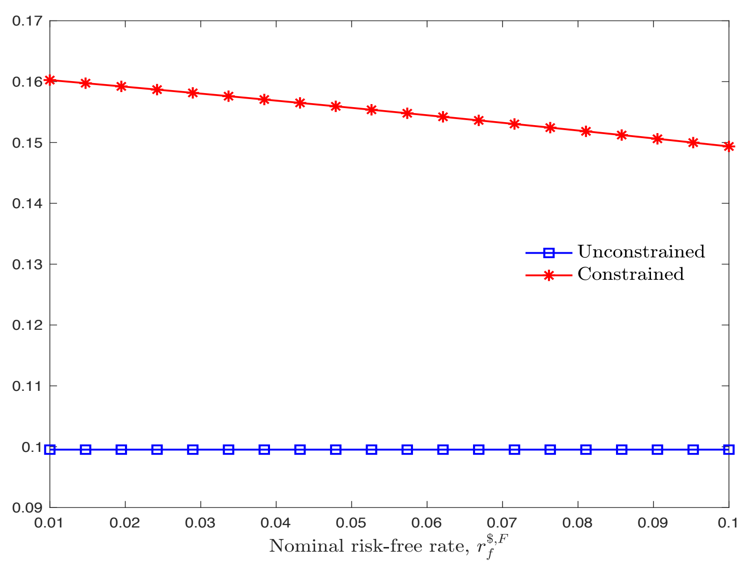

Figure 12: Monetary Policy and Portfolio Volatility

The figure reports the volatility of the time-0 portfolio as as a function of the nominal interest rate. For illustrative purposes we take asset returns as given. 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 $\mu_H = \mu_L = 0.07$, 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 (20) we assume that the dividend yield $dp^H = 0.8$ and $dp^L = 0.01$. The agent has risk aversion parameter is $\gamma = 3$ and time preference parameter $\delta = 0.98$.

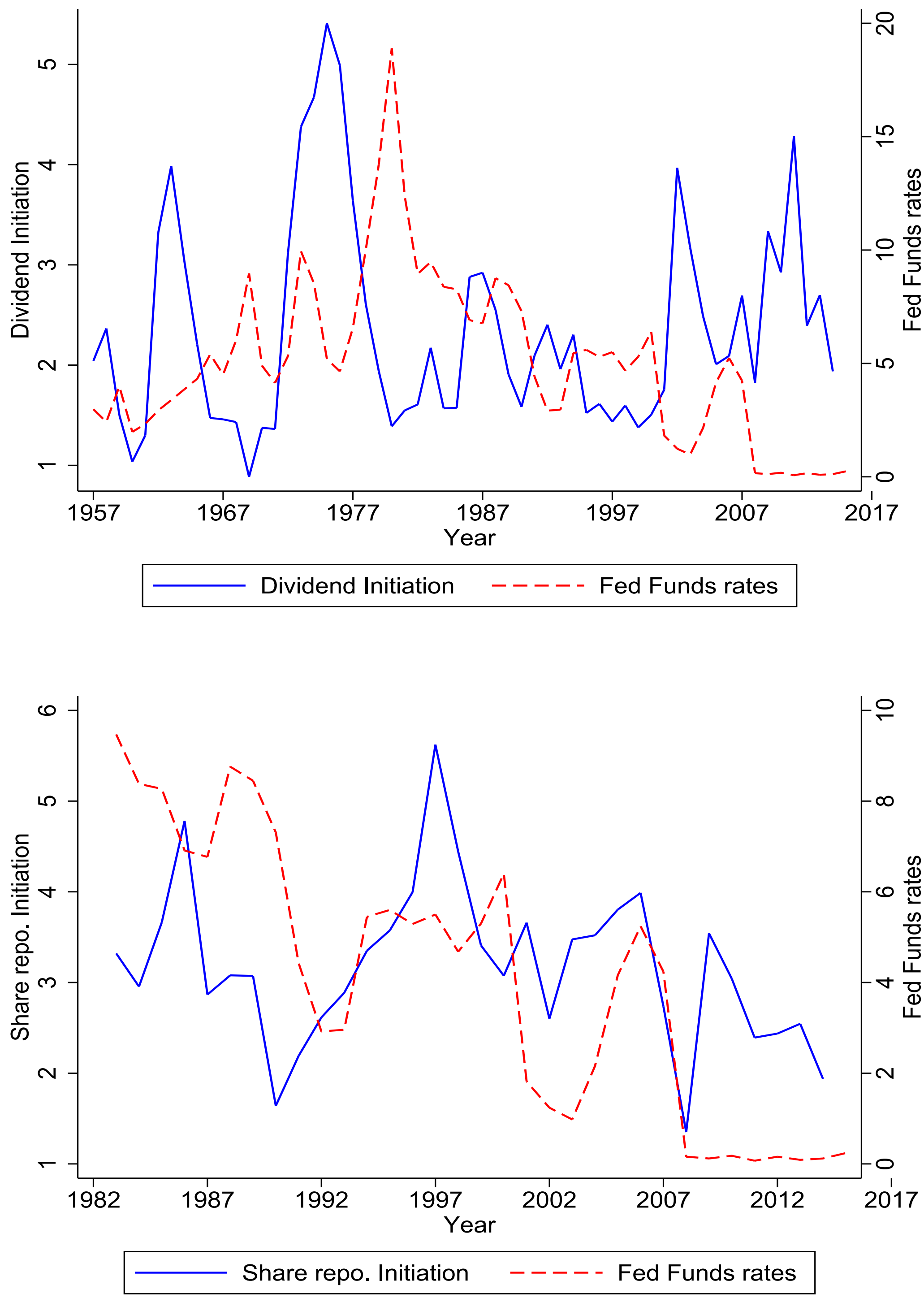

Figure 13: Dividend Initiations and the Fed Funds Rate

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. Proof of Proposition 1:

Using the definition of portfolio weights (21), we can express the nominal constraint (19) as follows

$$C_{A,t}\Pi_t \leq \left(W^{\$}_{A,t-1} - C^{\$}_{A,t-1}\right)\left[\theta^F_{A,t-1}\frac{\Pi_t - P^{\$,F}_{t-1}}{P^{\$,F}_{t-1}} + \theta^L_{A,t-1}\frac{D^{\$,L}_t}{P^{\$,L}_{t-1}} + \theta^H_{A,t-1}\frac{D^{\$,H}_t}{P^{\$,H}_{t-1}}\right] \quad \text{(A1)}$$

$$= \left(W^{\$}_{A,t-1} - C^{\$}_{A,t-1}\right)\left[\theta^F_{A,t-1}\left(R^{\$,F}_t - 1\right) + \theta^L_{A,t-1}\frac{D^{\$,L}_t}{P^{\$,L}_{t-1}} + \theta^H_{A,t-1}\frac{D^{\$,H}_t}{P^{\$,H}_{t-1}}\right] \quad \text{(A2)}$$

where

$$R^{\$f}_t \equiv \frac{\Pi_t}{P^{\$,F}_{t-1}} = \frac{1}{P^F_{t-1}\frac{\Pi_{t-1}}{\Pi_t}} = R^F_t\frac{\Pi_t}{\Pi_{t-1}}, \quad \text{(A3)}$$

where R^F_t denotes the time-t real risk free rate $R^F_t = 1/P^F_{t-1}$. Transforming the income constraint in real terms using the price levels Π_t and Π_{t-1}, using (A3), and simplifying yields:

$$C_{A,t} \leq \left(W_{A,t-1} - C_{A,t-1}\right)\left[\theta^F_{A,t-1}\left(R^F_t - \frac{\Pi_{t-1}}{\Pi_t}\right) + \theta^L_{A,t-1}\frac{D^L_t}{P^L_{t-1}} + \theta^H_{A,t-1}\frac{D^H_t}{P^H_{t-1}}\right]. \quad \text{(A4)}$$

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

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

When inflation is small, $\frac{\Pi_{t-1}}{\Pi_t} \approx 1 - \pi_t$, and therefore the income yield of bonds in (A4) is the *net* nominal interest rate, that is,

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

Using this approximation in (A4), we obtain that the nominal income constraint (19) can be written as a function of the nominal interest rate $r^{\$,F}_t$ and risky assets' real dividend yields $dp^j_t = D^j_t/P_{t-1}$, $j = H, L$, that is,

$$\frac{C_t}{W_{t-1} - C_{t-1}} \leq \theta^F_{t-1}r^{\$,F}_t + \theta^L_{t-1}dp^L_t + \theta^h_{t-1}dp^H_t. \quad \text{(A5)}$$

∎