

Internet Appendix for “Monetary Policy and Reaching for Income”

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In the Internet Appendix we provide:

- a detailed description of the data used in our empirical analyses
- a micro-foundation of the living off income constraints used in our general equilibrium model
- a quantification of the reaching-for-income effect for aggregate consumption and investment

I. List of Variables

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

Mutual Fund Data

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

II. Micro-Foundation of Living Off Income

This section discusses possible micro-foundations of the living-off-income rule. Financial advisors usually suggest that this rule helps investors discipline their consumption and savings. For instance, [Kennon \(2016\)](#) writes that “*One way you can avoid the temptation to dip into your seed corn is to use what I call a central collection and disbursement account. Doing so results in the dividends, interest, profits, rents, licensing income, or other gains you see being deposited into a bank account dedicated to disbursements, not the brokerage accounts or retirement trusts that hold your investments... It erects a barrier between you and your principal... Never forget this rule: Don’t sacrifice what you want (in the long term) for what you want right now.*” [Owens \(2016\)](#) provides similar justification.

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

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

$$\max_{\{C_\tau, \theta_\tau\}_{\tau=t}^{T-1}} u(C_t) + \mathbb{E}_t \sum_{\tau=t}^T \beta \delta^{\tau+1-t} u(C_{\tau+1}) \quad (\text{IA1})$$

subject to the dynamic budget constraint

$$W_{t+1} = (W_t - C_t)R_{p,t+1}(\theta_t), \quad \theta_t^\top \mathbf{1} = 1, \quad (\text{IA2})$$

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

In equation [\(IA1\)](#), the parameter β captures the intensity of the agent’s present bias, that is, the extent to which the agent values immediate rewards at the expense of long-term intentions. When $\beta < 1$, the agent’s preferences are time-inconsistent. At any time t the discount rate between *any* two periods from $t+1$ onward is δ , but the discount rate from t to $t+1$ is $\beta\delta < \delta$. This implies that the agent consistently plans to be patient in the future (when the discount rate is δ), but as the future arrives, he changes his mind and becomes impatient, discounting the immediate future at a rate of $\beta\delta$. This in turn implies that the

agent plans to save in the future but, as the future arrives, he systematically reneges on his promise and consumes more than he would have done if he were able to commit to his original plan.¹

In the presence of time-inconsistent preferences, commitment may become valuable to the agent. A prevalent commitment device in this situation is to use current income to discipline consumption, as suggested by the popular advice “live off income, do not dip into the principal.” Financial advisors usually suggest that investors direct the interest and dividend income into a bank account for daily consumption while keeping their principal in a brokerage account that is inconvenient for immediate or impulsive spending.”² Motivated by this practice, we allow the agent in our model to *choose* to adopt the consumption rule of living off income:³

$$0 \leq C_{t+1} \leq I_{t+1}(\theta_t), \quad t = 0, \dots, T - 2, \quad (\text{IA3})$$

where $I_{t+1}(\theta_t)$ is the income generated by portfolio θ_t at time $t + 1$, that is, the sum of dividends and interest. The constraint in equation (IA3) imposes that future consumption C_{t+1} cannot exceed the income $I_{t+1}(\theta_t)$ generated by the portfolio inherited from time t . Therefore, the current “self” can constrain the future “self” by choosing a portfolio θ_t that delivers at time $t + 1$ level of income that constrains future consumption.

Note that the income constraint is isomorphic to an infinite transaction cost if the agent were to sell its assets to finance consumption. It is also worth noting that the agent faces no transaction cost to rebalance the portfolio. The difference in transaction costs between consumption-motivated selling and portfolio rebalancing aims to capture, in a stylized manner, the difference in frequencies between these two actions. In practice, changes in short-term interest rates occur very infrequently. Therefore, even if investors lock their savings in relatively illiquid brokerage accounts, it would not be very costly to rebalance their portfolios occasionally to make the income streams align with the consumption needs. In contrast, if they were to sell their assets regularly to finance consumption,

¹A smaller value of β implies a more severe present bias while $\beta = 1$ corresponds to the time-consistent case.

²As an example, consider the following quote that appeared in the popular financial advice website *The Balance*: “One way you can avoid the temptation to dip into your seed corn is to use what I call a central collection and disbursement account. Doing so results in the dividends, interest, profits, rents, licensing income, or other gains you see being deposited into a bank account dedicated to disbursements, not the brokerage accounts or retirement trusts that hold your investments [....] It erects a barrier between you and your principal” (Kennon, 2016).

³Note that the constraint does not bind in the last period $t = T$ because, in a finite-horizon problem without bequest, the agent has to consume his entire wealth.

transaction costs would be quite high. Therefore, it would not be unreasonable to assume low transaction costs for portfolio rebalancing and high transaction costs for consumption-motivated selling as embodied by our income constraint. A more realistic model would introduce transaction costs explicitly and allow for a difference in the frequency of interest rate changes and consumption. Nevertheless, we think an income constraint is a much simpler way to capture this idea, which could be easily embedded into more complicated macro models.

One may worry that the lack of transaction cost in portfolio rebalancing could undermine the commitment device mechanism. This is not the case in our model because (1) the portfolio composition only affects future consumption but not current consumption, and (2) when a hyperbolic discounting agent plans for the future, it is not subject to the present bias. To illustrate this idea, we plot the time discount factor of a hyperbolic discount agent in Figure IA.1. As shown in the upper panel, if the agent is currently at time 0, the time discount factor is $\beta\delta$ between zero and one but becomes δ afterward. Although the agent wants to consume more right now (say \$1.2), it would like to consume less and save more in the future because the time discount factor between time 1 and 2 is δ instead of $\beta\delta$. Therefore, the agent can choose to hold a portfolio that generates only \$1 of income. As shown in the lower panel, when time 1 comes and the agent becomes impatient again, it can only consume at most \$1 of current income. Therefore, introducing an additional transaction cost in the portfolio choice decision is not necessary given that we have already assumed an infinite transaction cost in the consumption decision.

So far, we have shown how the consumption rule can limit the overconsumption of the hyperbolic agent. At the same time, however, the consumption rule limits the flexibility of the agent to adjust consumption to ex-post portfolio returns. When the agent wants to consume more because of high portfolio returns, portfolio income inefficiently caps consumption. In other words, the agent faces a trade-off between commitment and flexibility. The following proposition characterizes the solution of the problem (IA1) to (IA3) for an investor with CRRA preferences.

Proposition 1. *Let us consider an investor with CRRA preferences, $u(C) = C^{1-\gamma}/(1-\gamma)$, with $\gamma > 1$ the coefficient of relative risk aversion, and an asset market consisting of N assets with return vector R_t and dividend yield vector Y_t . Let $i_t \equiv I_t/W_t$ denote the income-to-wealth ratio at time t . Then the optimal portfolio, θ_t^* , and consumption, C_t^* , that solve the problem (IA1) to (IA3) for $t = 0, \dots, T-1$ are given by*

$$\theta_t^* = \arg \max_{\theta_t} B_t(\theta_t) \quad (\text{IA5})$$

$$C_t^* = \xi_t^*(i_t) W_t, \quad (\text{IA5})$$

where $B_t(\theta_t)$ is given by

$$\frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_t \left[\frac{R_{p,t+1}^{1-\gamma}(\theta_t)}{1-\gamma} \kappa_{V,t+1}(i_{t+1})^{1-\gamma} \right], \quad (\text{IA6})$$

In equation (IA6), $R_{p,t+1}(\theta_t) = \theta_t^\top R_{t+1}$ is the portfolio return, i_{t+1} is the next-period income-to-wealth ratio,

$$i_{t+1} = \frac{Y_{p,t+1}(\theta_t)}{R_{p,t+1}(\theta_t)}, \quad t = 0, \dots, T-1, \quad (\text{IA7})$$

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

$$\kappa_{V,t+1}(i_{t+1}) = \begin{cases} ((\xi_{t+1}^*)^{1-\gamma} + \delta(1 - \xi_{t+1}^*)^{1-\gamma} B_{t+1}(\theta_{t+1}^*)^{1-\gamma})^{\frac{1}{1-\gamma}}, & \text{for } t = 0, \dots, T-2 \\ 1, & \text{for } t = T-1 \end{cases}. \quad (\text{IA8})$$

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

$$\xi_t^*(i_t) = \min \left\{ i_t, \frac{x_t}{1+x_t} \right\}, \quad \text{where } x_t \equiv (\beta\delta)^{-\frac{1}{\gamma}} B_t(\theta_t^*)^{\frac{\gamma-1}{\gamma}} > 0. \quad (\text{IA9})$$

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

$$J_t(W_t, i_t) = W_t^{1-\gamma} \frac{\kappa_{J,t}(i_t)^{1-\gamma}}{1-\gamma}, \quad (\text{I10})$$

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

$$\kappa_{J,t}(i_t) = \left((\xi_t^*)^{1-\gamma} + \beta\delta(1 - \xi_t^*)^{1-\gamma} B_t(\theta_t^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}. \quad (\text{IA11})$$

Proof: We solve the problem (IA1)–(19) backwards starting at time $t = T-1$. The agent has one period left and, because of quasi-hyperbolic discounting in (IA1), his short-term discount rate is $\beta\delta$. The state variables are represented by the agent's wealth W_{T-1} and

income I_{T-1} . We denote by $J_{T-1}(W_{T-1}, I_{T-1})$ the agent's value function

$$J_1(W_{T-1}, I_{T-1}) = \max_{\{0 \leq C_{T-1} \leq I_{T-1}, \theta_{T-1}\}} \left\{ \frac{C_{T-1}^{1-\gamma}}{1-\gamma} + \beta \delta \mathbb{E}_{T-1} \left[\frac{W_T^{1-\gamma}}{1-\gamma} \right] \right\}, \quad (\text{IA12})$$

where

$$W_T = (W_{T-1} - C_{T-1}) R_{p,T}(\theta_{T-1}). \quad (\text{IA13})$$

Let $\xi_1 \equiv C_{T-1}/W_{T-1}$ and $i_{T-1} \equiv I_{T-1}/W_{T-1}$. Then we can re-express problem (IA12)–(IA13) as

$$J_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \max_{\{0 \leq \xi_{T-1} \leq i_{T-1}, \theta_{T-1}\}} \left\{ \frac{\xi_{T-1}^{1-\gamma}}{1-\gamma} + \beta \delta (1 - \xi_{T-1})^{1-\gamma} \frac{B_{T-1}(\theta_{T-1})^{1-\gamma}}{1-\gamma} \right\}, \quad (\text{IA14})$$

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

$$\frac{B_{T-1}(\theta_{T-1})^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_{T-1} \left[\frac{R_{p,T}^{1-\gamma}(\theta_{T-1})}{1-\gamma} \right]. \quad (\text{IA15})$$

Note that $B_{T-1}(\theta_{T-1}) > 0$ for all values of γ . In the optimization (IA14), the optimal portfolio θ_{T-1}^* is independent of the consumption choice ξ_{T-1} and is given by

$$\theta_{T-1}^* = \arg \max \mathbb{E}_{T-1} \left[\frac{R_{p,T}^{1-\gamma}(\theta_1)}{1-\gamma} \right]. \quad (\text{IA16})$$

From (IA15), the optimization in (IA16) is equivalent to

$$\theta_{T-1}^* = \arg \max B_{T-1}(\theta_{T-1}). \quad (\text{IA17})$$

Taking the first-order condition with respect to ξ_{T-1} in (IA14), we obtain that the unconstrained consumption ξ_{T-1}^{unc} is given by

$$(\xi_{T-1}^{\text{unc}})^{-\gamma} = \beta \delta (1 - \xi_{T-1}^{\text{unc}})^{-\gamma} B_{T-1}^{1-\gamma}, \quad (\text{IA18})$$

or

$$\xi_{T-1}^{\text{unc}} = \frac{x_{T-1}}{1 + x_{T-1}}, \quad \text{where } x_{T-1} \equiv (\beta \delta)^{-\frac{1}{\gamma}} B_{T-1}(\theta_{T-1}^*)^{\frac{\gamma-1}{\gamma}} > 0. \quad (\text{IA19})$$

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

$$\xi_{T-1}^* = \min \left\{ i_{T-1}, \frac{x_{T-1}}{1 + x_{T-1}} \right\}. \quad (\text{IA20})$$

From (IA14), the value function $J_{T-1}(W_{T-1}, i_{T-1})$ is then

$$J_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \frac{(\kappa_{J,T-1}(i_{T-1}))^{1-\gamma}}{1-\gamma}, \quad (\text{IA21})$$

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

$$\kappa_{J,T-1}(i_{T-1}) = \left((\xi_{T-1}^*)^{1-\gamma} + \beta\delta(1 - \xi_{T-1}^*)^{1-\gamma} B_{T-1}(\theta_{T-1}^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}. \quad (\text{IA22})$$

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

$$J_{T-2}(W_{T-2}, I_{T-2}) = \max_{\{0 \leq C_{T-2} \leq I_{T-2}, \theta_{T-2}\}} \left\{ \frac{C_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta \mathbb{E}_{T-2} \left[\frac{C_{T-1}^{1-\gamma}}{1-\gamma} + \delta \frac{W_T^{1-\gamma}}{1-\gamma} \right] \right\}. \quad (\text{IA23})$$

Under the optimal consumption and portfolio policy, the term in the above expression is the continuation value from time $t = T - 1$ onward. From the above analysis, we infer that the continuation value is of the form (IA12), where $\beta\delta$ is replaced by δ . Hence, using (IA21) we can express the continuation value as

$$V_{T-1}(W_{T-1}, i_{T-1}) = W_{T-1}^{1-\gamma} \frac{(\kappa_{V,T-1}(i_{T-1}))^{1-\gamma}}{1-\gamma}, \quad (\text{IA24})$$

where

$$\kappa_{V,T-1}(i_{T-1}) = \left((\xi_{T-1}^*)^{1-\gamma} + \delta(1 - \xi_{T-1}^*)^{1-\gamma} B_{T-1}(\theta_{T-1}^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}. \quad (\text{IA25})$$

We can then express the problem (IA23) recursively as follows:

$$J_{T-2}(W_{T-2}, I_{T-2}) = \max_{\{0 \leq C_{T-2} \leq I_{T-2}, \theta_{T-2}\}} \left\{ \frac{C_{T-2}^{1-\gamma}}{1-\gamma} + \beta\delta \mathbb{E}_{T-2} [V_{T-1}(W_{T-1}, i_{T-1}(\theta_{T-2}))] \right\}, \quad (\text{IA26})$$

where

$$W_{T-1} = (W_{T-2} - C_{T-2})R_{p,T-1}(\theta_{T-2}), \quad (\text{IA27})$$

and

$$i_{T-1}(\theta_{T-2}) = \frac{I_{T-1}}{W_{T-1}} = \frac{(W_{T-2} - C_{T-2})Y_{p,T-1}(\theta_{T-2})}{(W_0 - C_0)R_{p,T-1}(\theta_{T-2})} = \frac{Y_{p,T-1}(\theta_{T-2})}{R_{p,T-1}(\theta_{T-2})}. \quad (\text{IA28})$$

Using the definition of $V_{T-1}(W_{T-1}, i_{T-1})$ in (IA24) to (IA8), we obtain

$$J_{T-2}(W_{T-2}, i_{T-2}) = W_{T-2}^{1-\gamma} \max_{\{0 \leq \xi_{T-2} \leq i_{T-2}, \theta_{T-2}\}} \left\{ \frac{\xi_{T-2}^{1-\gamma}}{1-\gamma} + \beta \delta (1 - \xi_{T-2})^{1-\gamma} \frac{B_{T-2}(\theta_{T-2})^{1-\gamma}}{1-\gamma} \right\}, \quad (\text{IA29})$$

where

$$\frac{B_{T-2}(\theta_{T-2})^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_{T-2} \left[\frac{R_{p,T-1}^{1-\gamma}(\theta_{T-2})}{1-\gamma} \kappa_{V,T-1}(i_{T-1}(\theta_{T-2}))^{1-\gamma} \right], \quad (\text{IA30})$$

and $i_{T-1}(\theta_{T-2})$ is given in (IA28). In the optimization (IA29), the optimal portfolio θ_{T-2}^* is independent of the consumption choice ξ_{T-2} and is given by

$$\theta_{T-2}^* = \arg \max B_{T-2}(\theta_{T-2}). \quad (\text{IA31})$$

Taking the first-order condition with respect to ξ_{T-2} in (IA29) and following the same steps used at time $t = T - 1$ above, we obtain that the unconstrained consumption ξ_{T-2}^{unc} is given by

$$\xi_{T-2}^* = \min \left\{ i_{T-2}, \frac{x_{T-2}}{1 + x_{T-2}} \right\}, \quad \text{where} \quad x_{T-2} \equiv (\beta \delta)^{-\frac{1}{\gamma}} B_{T-2}(\theta_{T-2}^*)^{\frac{\gamma-1}{\gamma}} > 0. \quad (\text{IA32})$$

From (IA29), the value function $J_{T-2}(W_{T-2}, i_{T-2})$ is then

$$J_{T-2}(W_{T-2}, i_{T-2}) = W_{T-2}^{1-\gamma} \frac{(\kappa_{J,T-2}(i_{T-2}))^{1-\gamma}}{1-\gamma}, \quad (\text{IA33})$$

where

$$\kappa_{J,T-2}(i_{T-2}) = \left((\xi_{T-2}^*)^{1-\gamma} + \beta \delta (1 - \xi_{T-2}^*)^{1-\gamma} B_{T-2}(\theta_{T-2}^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}. \quad (\text{IA34})$$

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

$$J_t(W_t, i_t) = W_t^{1-\gamma} \max_{\{0 \leq \xi_t \leq i_t, \theta_t\}} \left\{ \frac{\xi_t^{1-\gamma}}{1-\gamma} + \beta \delta (1 - \xi_t)^{1-\gamma} \frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \right\}, \quad (\text{IA35})$$

with

$$\frac{B_t(\theta_t)^{1-\gamma}}{1-\gamma} \equiv \mathbb{E}_t \left[\frac{R_{p,t+1}^{1-\gamma}(\theta_{T-2})}{1-\gamma} \kappa_{V,t+1}(i_{t+1}(\theta_t))^{1-\gamma} \right], \quad (\text{IA36})$$

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

$$\kappa_{V,t+1}(i_{t+1}) = \left((\xi_{t+1}^*)^{1-\gamma} + \delta(1 - \xi_{t+1}^*)^{1-\gamma} B_{t+1}(\theta_{t+1}^*)^{1-\gamma} \right)^{\frac{1}{1-\gamma}}, \quad (\text{IA37})$$

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

As the proposition illustrates, the solution of the problem is recursive and proceeds backward, starting with the boundary condition (IA8) for the continuation value $\kappa_{V,T} = 1$. Comparing the continuation value from $t+1$ onwards, equation (IA8), and time- t certainty-equivalent wealth (IA11), we note that at each time t , the agent's discount factor for times $t + 1$ and onward is equal to δ while the discount rate between time t and $t + 1$ is equal to $\beta\delta$. Therefore, the consumption-wealth ratio chosen by the agent at time $t + 1$, ξ_{t+1}^* , will be higher than what the agent would have preferred at time t . This is the manifestation of time-inconsistency: the agent plans to save in the future, but as the future arrives, the agent consumes more than planned. Anticipating that the time- $t + 1$ self will become impatient at time $t + 1$, the time t self tries to affect the choice set of his future self through his current portfolio choice at time- t and the imposition of the self-control constraint (IA3).

To illustrate the solution derived in Proposition 1, we implement the model for the case of two risky assets and a risk-free asset. We assume that the two risky assets have identical binomial return distributions in each period, but differ in their dividend yields. We denote by H the risky asset with the higher dividend yield and by L the risky asset with the low dividend yield.⁴

The imposition of the self-control constraints, while allowing the current-self to discipline the consumption temptation of his future self, comes at the cost of limiting his flexibility. Figure IA.2 illustrates the trade-off between commitment and flexibility. We report time-1 consumption as a function of time-1 wealth for an agent with time-inconsistent preferences in the two-period example. The black line, C_1^{fc} , is the first-best consumption from the standpoint of the time-0 self obtained by setting $\beta = 1$ in the time-1 portfolio choice problem. The blue line, C_1^{unc} , is the consumption that will be chosen by the time-1 self. Note that $C_1^{\text{unc}} > C_1^{\text{fc}}$, indicating that, in the unconstrained case, the agent consumes more than the time-0 planned optimal consumption. The red line, C_1^{con} , is the consump-

⁴Specifically, we assume that the return on asset $j = H, L$ in each period is either $R_u^j = e^{\mu_j + \frac{1}{2}\sigma_j^2 + \sigma_j}$ or $R_d^j = e^{\mu_j + \frac{1}{2}\sigma_j^2 - \sigma_j}$. The probability distribution of outcomes is $\Pr(R_u^H, R_u^L) = \Pr(R_d^H, R_d^L) = (1 + \rho)/4$ and $\Pr(R_u^H, R_d^L) = \Pr(R_d^H, R_u^L) = (1 - \rho)/4$. We assume that $\mu_H = \mu_L$ and $\sigma_H = \sigma_L$. We take the gross risk-free rate $R^F = 1 + r^F$ and the dividend yields $Y_H > Y_L$ to be constant over time.

tion of an agent who commits to consume no more than the portfolio income. The income from the portfolio is the dashed-dotted line, I_1 , set to unity in the figure. Intuitively, the self-control constraint reduces the over consumption problem in low-wealth states but limits the flexibility of choosing high consumption in high-wealth states. The trade-off between the benefit and cost of the self-control constraint depends on the severity of the over-consumption problem and the value of flexibility.

Figure IA.3 shows the time-0 certainty equivalent wealth, κ_J , from equation (IA11). We assume that the agent faces a *current* self-control constraint at time 0, and consider three possible cases for time-1 consumption: (i) unconstrained, κ_J^{unc} , (ii) constrained, κ_J^{con} , and (iii) first-best case, κ_J^{fc} . For each case we report the certainty-equivalent wealth as the value of the present bias parameter β varies. A low value of β corresponds to a high level of distortion in consumption induced by time inconsistency, while $\beta = 1$ represents the time-consistent case. The black line, κ_J^{fc} , shows the first-best-case certainty-equivalent wealth. When time-inconsistency is severe (low β), the constrained certainty-equivalent wealth, κ_J^{con} , is *higher* than the unconstrained one, κ_J^{unc} , while the opposite is true if the time-inconsistency is less severe (β close to one). This implies that it is optimal for an agent to commit to a self-control constraint if he has a strong tendency to overconsume due to high present-time bias, that is, low β .

Figure IA.4 repeats the analysis of Figure IA.3 and reports certainty equivalent wealth as a function of stock return volatility. Intuitively, flexibility is more valuable when volatility is high, and therefore a constraint is more harmful. Consistent with this intuition, the certainty equivalent wealth in the presence of a self-control constraint is higher than the unconstrained case for low levels of return volatility but lower than the unconstrained case for high levels of return volatility.

In summary, the analysis in this section provides a potential micro-foundation for the consumption rule of living off income by showing that this rule can be an *optimal* commitment device for an agent with a hyperbolic discounting preference. Other frictions or behavioral biases may also lead to such a consumption rule. For example, before 1975, the NYSE set large minimum trade commissions that were almost always binding (Jones, 2002).⁵ The rule of living-off-income is a plausible response to such high transaction costs.

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

While transaction costs are too low to provide a plausible explanation for the living-off-income rule of thumb, we cannot exclude that such a rule became established in the fixed-commission period and that investors continue to follow it despite being suboptimal.⁶ Another related explanation is that using current income streams to finance consumption reduces the “mental effort” involved in liquidating asset positions constantly. Regardless of the fundamental reasons underlying the consumption rule of living off income, as long as some investors follow such a rule, interest rates will have an impact on portfolio allocations and the risk premium, even in an economy in which prices are fully flexible.

III. A Quantification of the Reaching for Income Effect

In this section, we provide two back-of-the-envelope calculations to assess the effect of reaching for income on aggregate consumption and investment.

A. Reaching for Income and Aggregate Consumption

The change in consumption of an agent who lives off income following a change in interest rates can be derived in our model by assuming that the income constraint (20) binds and differentiating with respect to the nominal interest rate $r_t^{\$,F}$. This derivation yields the following decomposition of the consumption response to interest rate changes:

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

In our model, the magnitude of the direct effect in equation (1) depends on the weight $\theta_{A,t}^F$ of short-term bonds in the portfolio of income-consuming investors. To quantify this effect, we take the aggregate household financial portfolio as a proxy for the weights of deposits and short-term bonds in the portfolio of income-consuming investors. This is likely to underestimate the direct effect if the income-consuming investors hold more of these investments than the average investor. Using the Financial Accounts of the United States from 1991 to 2017, we estimate that deposits, money market funds, and short-term bonds account for around 16% of aggregate households’ portfolio. Given that the

⁶We thank Terry Odean for pointing this out to us.

consumption-to-savings ratio, $C_t/(W_{t-1} - C_{t-1})$, is 19% over this sample period, the direct effect of a 1% *reduction* in fed funds rate to consumption is

$$-\frac{16\%}{19\%} = -0.8\%. \quad (2)$$

The direct effect refers to changes in deposits and short-term bonds, which represent 16% of the overall household portfolio. The indirect rebalancing effect in equation (1) refers to the remaining 84% of the overall portfolio, whose income yields do not directly depend on the short-term interest rate. We estimate the indirect effect as follows.

1. We estimate the relative share of high-income versus low-income assets in the portfolios of income-consuming investors. Because the Financial Accounts data do not contain such a decomposition, we approximate it by using the fraction of assets under management of high-income mutual funds versus low-income mutual funds, which is 9.4% and 90.6% in the data.
2. We use these fractions to calculate the portfolio weights of high- and low-income assets. Given an 84% aggregate portfolio weight of these two assets, the portfolio weight of high-income assets $\theta_{A,t}^H$ is $9.4\% \times 84\% = 8\%$ and the portfolio weight of low-income assets $\theta_{A,t}^L$ is $90.6\% \times 84\% = 76\%$.
3. We use the impulse response function of mutual fund flows obtained in Section I to estimate the change in the portfolio weights of the high- and low-income assets, $d\theta_{A,t}^H$ and $d\theta_{A,t}^L$ induced by a change in interest rates. As shown in Panel A of Figure 4, following a 1% reduction in the fed funds rate, investors increase the holding of high-income equity funds by 7% over three years. Given that, as computed in step 2, high-income assets account for 8% of the portfolio, a 7% relative increase in the holding of high-income equity funds translates into a change $d\theta_{A,t}^H$ of $7\% \times 8\% = 0.56\%$ in the portfolio weight. Similarly, the impulse response in panel A of Figure 4 shows that following a 1% reduction in the fed funds rate, investors increase their holding of low-income equity funds by 1.8% over three years. Given that, as computed in step 2, the high-income assets account for 76% of the portfolio, a 1.8% increase in the holding of low-income equity funds translates into a change $d\theta_{A,t}^L$ of $1.8\% \times 76\% = 1.37\%$ in the portfolio weight.

4. We approximate the income yields of high-income and low-income assets, dp_t^H and dp_t^L , using the asset-weighted average income yield of high- and low-income mutual funds, which, in our sample, are 5.7% and 2.4%, respectively. We approximate the income yields of deposits and short-term bonds, $r_t^{S,F}$, using the average interest rate of money aggregate M2, which is equal to 1.5% in our sample.
5. Using our sample estimate of the consumption-to-saving ratio $C_t/(W_{t-1}-C_{t-1}) = 19\%$, we obtain that the indirect effect of a decrease in the fed funds rate due to portfolio rebalancing is equal to

$$\frac{0.56\% \times (5.7\% - 1.5\%) + 1.37\% \times (2.4\% - 1.5\%)}{19\%} = +0.2\% \quad (3)$$

Combining the direct (-0.8%) and indirect ($+0.2\%$) effects, we obtain that a 1% reduction in the fed funds rate reduces the consumption of living-off-income investors by 0.6%. The effect on aggregate consumption depends on the fraction of these investors in the population. In our individual investor sample, this fraction is around 40%, a value that is broadly consistent with 25% to 50% range provided by existing literature (see, for example, [Kaplan, Violante, and Weidner \(2014\)](#) and [Campbell and Mankiw \(1989\)](#)). Assuming that 40% of investors live off income, we estimate that a 1% decrease in the fed funds rate may induce, through the reaching-for-income channel, a decrease of $0.6\% \times 40\% = 0.24\%$ in aggregate consumption.

B. Reaching for Income and Capital Reallocation

We use a simple Q-theory framework to infer investment opportunities of each firm from their market-to-book ratios. Assuming that firms have decreasing returns to scale in the level of installed capital K_t , firm value $V(K_t)$ is given recursively by

$$V(K_t) = \max_{I_t} Z_t K_t^\alpha - I_t + \frac{1}{1+r} V(K_{t+1}), \quad 0 < \alpha < 1, \quad (4)$$

subject to capital accumulation and depreciation

$$K_{t+1} = (1 - \delta)K_t + I_t, \quad (5)$$

where I_t is the investment level, Z_t is the capital productivity level, r is the cost of capital, and δ is the depreciation rate. From (4) to (5), we obtain that the steady-state level of

capital, K^* , is

$$K^* = \left(\frac{\alpha Z^*}{r + \delta} \right)^{\frac{1}{1-\alpha}}, \quad (6)$$

where Z^* denotes the long-run average productivity.

Because of decreasing returns to scale, the marginal productivity of capital $\alpha Z_t K_t^{\alpha-1}$ decreases as capital grows towards its steady-state level. Hence, the marginal productivity of capital is larger for young firms, whose current capital is low, than for mature firms. This implies that, in this setting, young firms optimally reinvest profits while mature firm pay out dividends. The market-to-book ratio is given by

$$\frac{V(K)}{K} = 1 - \delta + \frac{r + \delta}{\alpha r} \left(r \left(\frac{K}{K^*} \right)^{\alpha-1} + (1 - \alpha) \left(\frac{K}{K^*} \right)^{-1} \right), \quad (7)$$

where $\frac{K}{K^*}$ denotes the ratio of the current to steady-state capital level. Because of decreasing returns to scale, $\alpha < 1$ and hence, by equation (7), the market-to-book ratio is decreasing in $\frac{K}{K^*}$.

Using this simple framework, we can calibrate the effect of the reaching-for-income channel on aggregate investment. In 2017 the average market-to-book ratios for non-dividend-paying and dividend-paying firms in the COMPUSTAT database were 2.60 and 2.31, respectively. This result implies that nondividend-paying firms have better investment opportunities than dividend-paying firms. Following [Cooper and Haltiwanger \(2006\)](#), we set $\alpha = 0.7$, $\delta = 7\%$, and $r = 5\%$. Using equation (7) and equation (6), we can infer the implied long-run productivity level, Z^* , from the observed market-to-book ratios.

With this calibration, we perform a simple counterfactual experiment to assess the effect of reaching for income on the level of the steady-state capital K^* . To do so, we use the fact that, as documented in Figure 5 of Section II, a 1% reduction in the fed funds rate is associated with a 2.6% change in the relative valuation of dividend-paying and nondividend-paying firms. Keeping dividends D constant in the Gordon growth valuation model, $V = \frac{D}{r}$, we have that a change in valuation approximately equals the percentage change in the cost of capital, that is, $d \log V \approx -d \log r$. Using $r = 5\%$ for the cost of capital, the estimated 2.6% change in relative valuation from Figure 5 corresponds to changes in the relative cost of capital of $2.6\% \times 5\% = 0.13\%$. In our sample, the share of assets of dividend-paying firms is 70%. Therefore, to keep the value-weighted average cost of capital of the full sample at the baseline 5% level, we assume that, as a result of reaching for income,

the cost of capital of dividend-paying firms decreases by $70\% \times 0.13\% = 9\text{bps}$ and that of nondividend-paying firms increases by $30\% \times 0.13\% = 4\text{bps}$. Using this approximation, our estimate suggests, that through the reaching-for-income channel, a 1% decrease in the fed funds rate decreases the aggregate investment by 0.024% compared to a counterfactual setting without reaching-for-income investors.

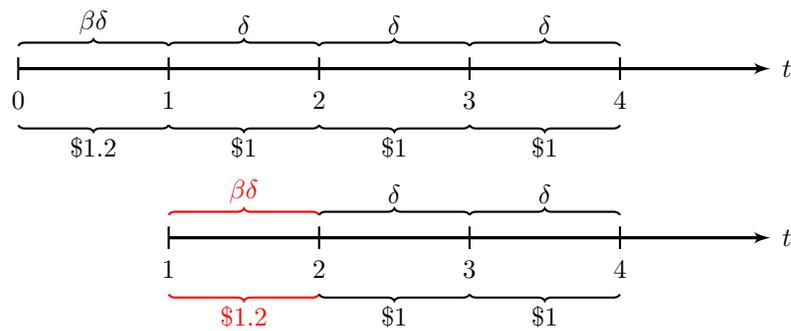


Figure IA.1. Time discount factors of hyperbolic preference. The figure shows the time discount factors of hyperbolic preference. The upper graph corresponds to the agent at time 0 and the lower graph to the agent at time 1.

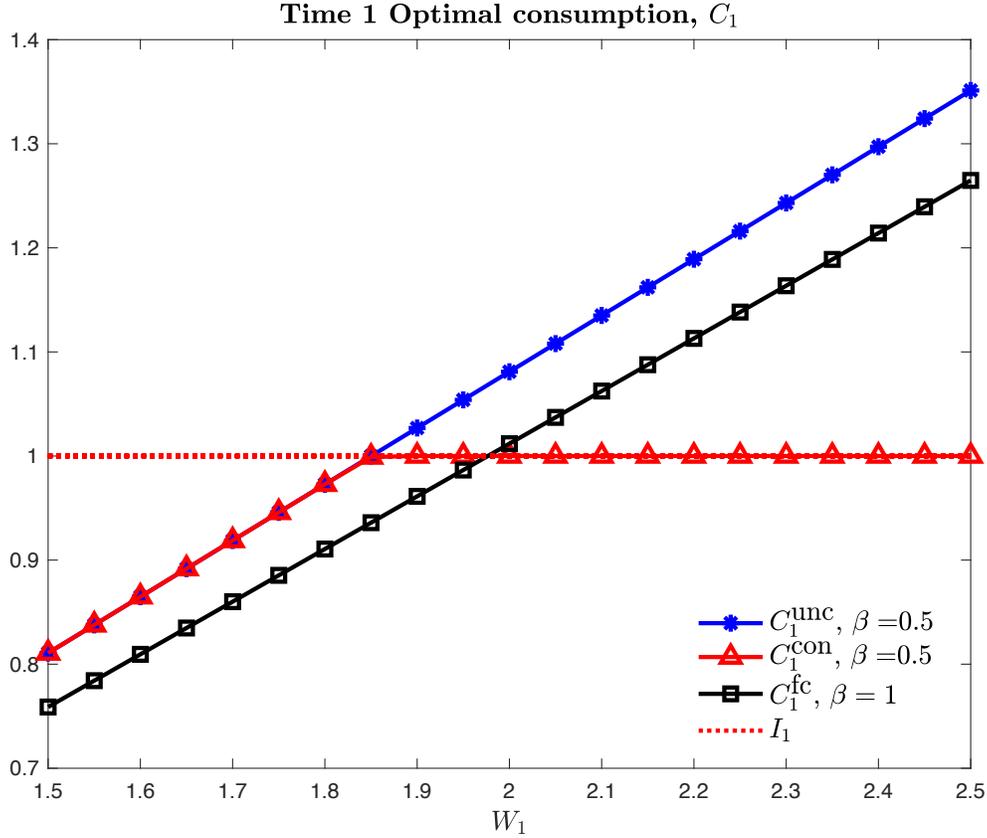


Figure IA.2. Consumption with a self-control constraint. The figure plots the optimal time-1 consumption as a function of the time-1 wealth of the two-period version of the problem described in Proposition IA.1. C_1^{unc} , C_1^{con} , and C_1^{fc} refer, respectively, to the consumption of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is, $\beta = 1$ in the time-1 portfolio choice problem. $I_1 = 1$ is the income from the portfolio. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, and $\beta = 0.5$. We assume that the distribution of asset returns is binomial, as discussed in footnote IA.4, with parameters $\sigma_L = \sigma_H = 0.4$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.11$, and $R_f = 0.01$. Asset H has a dividend yield of $Y_H = 0.7$ and asset L has a dividend yield of $Y_L = 0.5$.

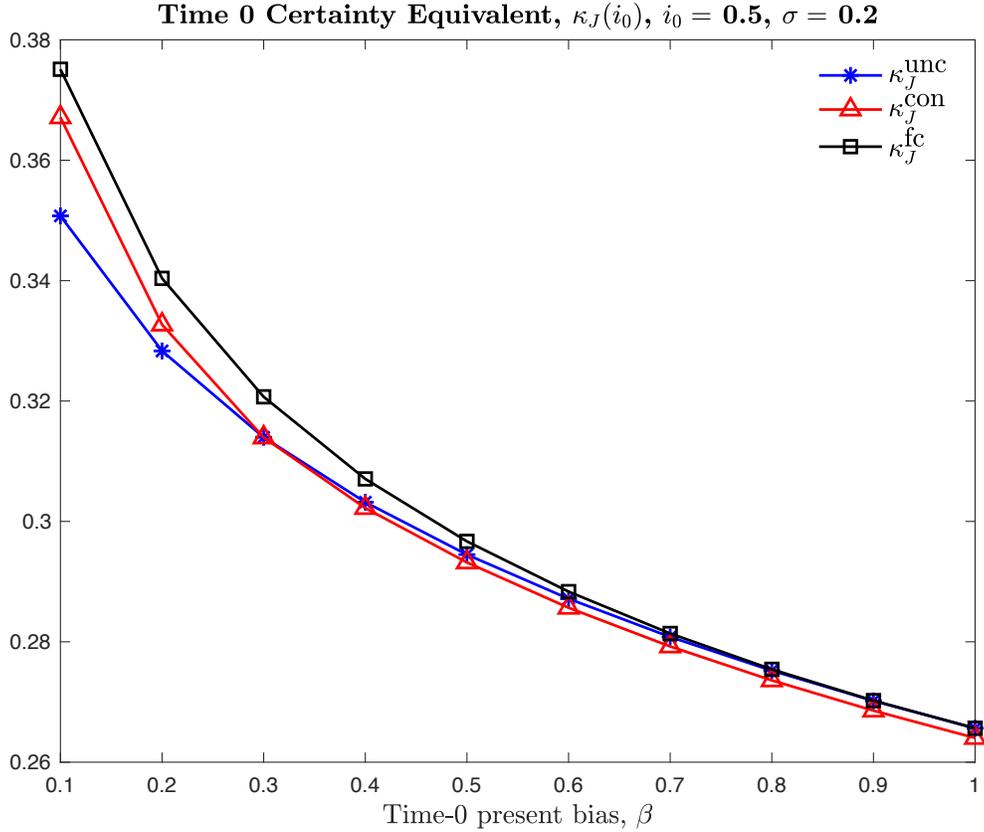


Figure IA.3. Certainty-equivalent wealth and time-inconsistency. The figure plots the time-0 certainty-equivalent wealth as a function of the time-inconsistency parameter, β , for the two-period version of the problem described in Proposition IA.1. κ_J^{unc} , κ_J^{con} , and κ_J^{fc} refers, respectively, to the time-0 certainty-equivalent wealth of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is, $\beta = 1$ in the time-1 portfolio choice problem. Preferences parameter values: $\gamma = 3$ and $\delta = 0.98$. We assume that the distribution of asset returns is binomial, as discussed in footnote IA.4, with parameters $\sigma_L = \sigma_H = 0.2$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.11$, and $R_f = 0.01$. Asset H has a dividend yield of $Y_H = 0.7$ and asset L has a dividend yield of $Y_L = 0.5$.

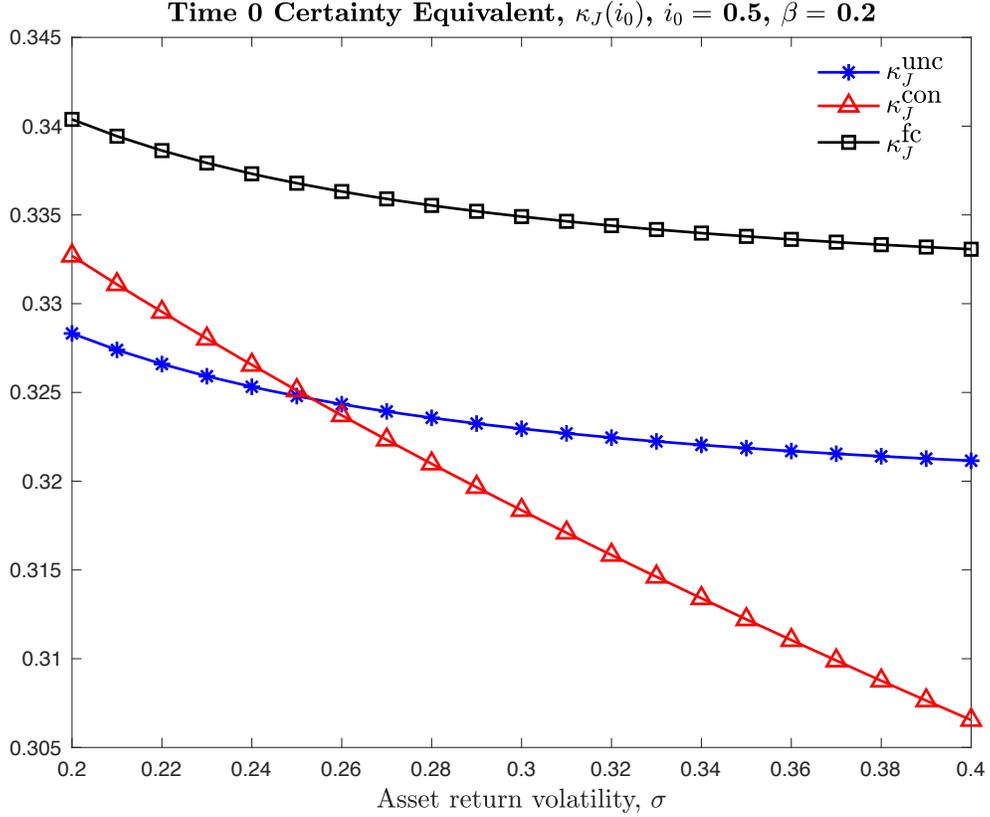


Figure IA.4. Certainty-equivalent wealth and return volatility. The figure plots the time-0 certainty-equivalent wealth as a function of the stock return volatility parameter, $\sigma_L = \sigma_H$, for the two-period version of the problem described in Proposition IA.1. κ_J^{unc} , κ_J^{con} , and κ_J^{fc} refer, respectively, to the time-0 certainty-equivalent wealth of an agent without a self-control constraint, with a self-control constraint, and with full commitment power, that is, $\beta = 1$ in the time-1 portfolio choice problem. Preferences parameter values: $\gamma = 3$, $\delta = 0.98$, and $\beta = 0.2$. We assume that assets log returns have identical volatility $\sigma = \sigma_L = \sigma_H$, correlation $\rho = 0.5$, $\mu_H = \mu_L = 0.11$, and $R_f = 0.01$. Asset H has a dividend yield of $Y_H = 0.7$ and asset L has a dividend yield of $Y_L = 0.5$.

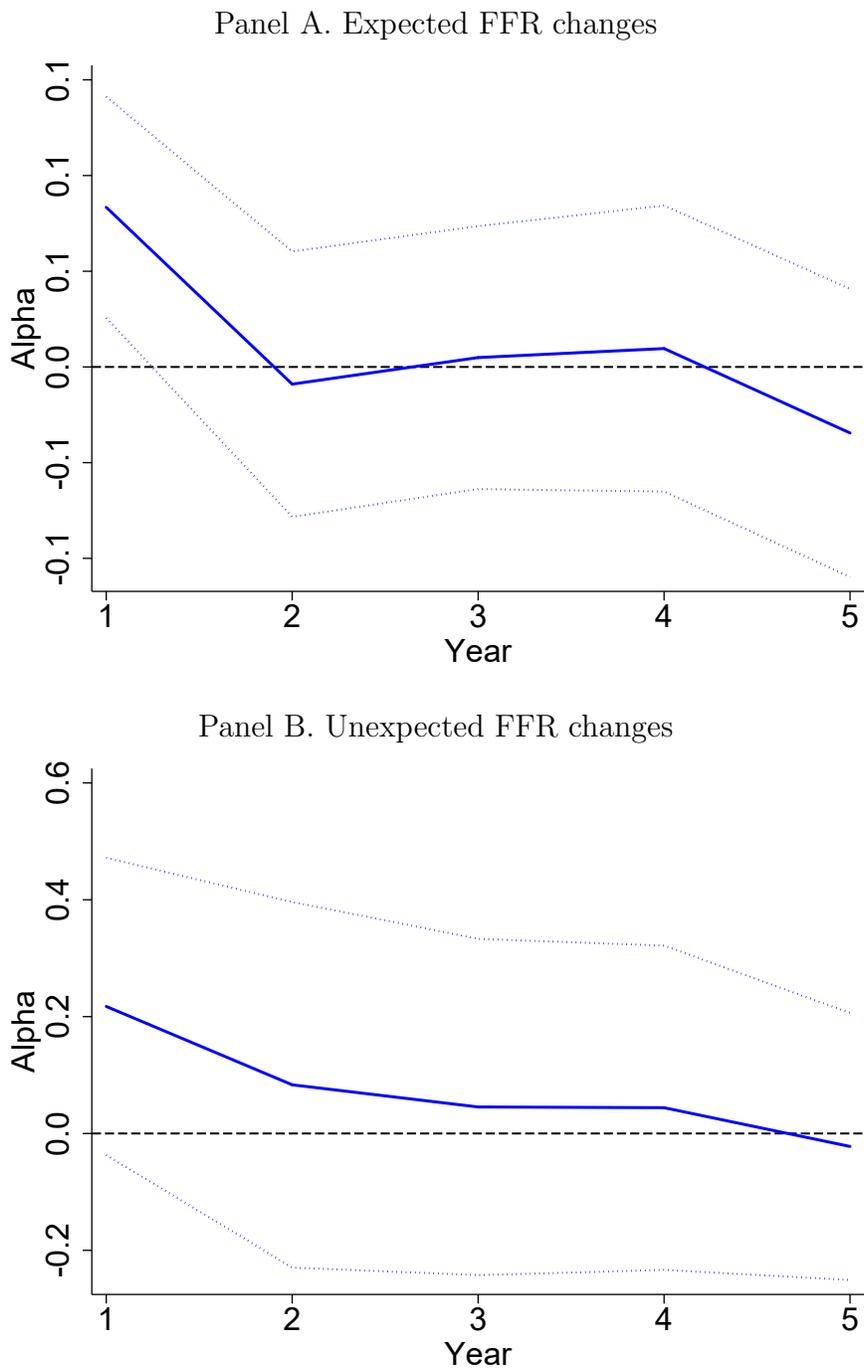


Figure IA.5. Impulse response of dividend strip returns to changes in the fed funds rate. The solid lines in each panel plot the impulse response ($\beta_{i,h}$ from regression (11)) of the Fama-French five-factor alphas of the dividend strips to a negative 1% expected/unexpected shock to the fed funds rate. Panel A uses the expected fed funds rate changes. Panel B uses the unexpected fed funds rate changes. The dotted lines represent 95% confidence intervals. The sample period is from June 1990 to June 2008.

Table IA.1
Stock Holdings: Continuous Measure

This table reports coefficient estimates from the panel regression,

$$\Delta Holding_{i,j,t+6} = \beta \Delta FFR_t \times High Div_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t},$$

where $\Delta Holding_{i,j,t+6}$ is the six-month change in stock i 's position in account j scaled by the average of holding of this stock in the same account over the same period, ΔFFR_t is the three-year change in the fed funds rate leading up to month t , $High Div_{i,t}$ is a dummy variable that equals one if the income yield of a stock is in the top decile for a given month, and zero 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 three-year change in the fed funds rate ($\Delta FFR_t * High Repurchase_{i,t}$), market beta and its interaction with the three-year change in the fed funds rate ($\Delta FFR_t * Beta_{i,t}$), book-to-market ratio and its interaction with the three-year change in the fed funds rate ($\Delta FFR_t * BM_{i,t}$), past one-year and three-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 of the stock positions in the LBD data from 1991 to 1996. Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels. Standard errors are clustered by month.

	(1)	(2)	(3)
	$\Delta Holding$	$\Delta Holding$	$\Delta Holding$
$\Delta FFR * High Dividend$	-0.131*** [0.0421]	-0.124*** [0.0431]	-0.117** [0.0568]
$\Delta FFR * High Repurchase$	-0.105*** [0.0357]	-0.0843** [0.0386]	-0.141*** [0.0511]
$\Delta FFR * Beta$	-0.0450** [0.0177]	-0.0460** [0.0177]	-0.0482** [0.0188]
$\Delta FFR * BM$	0.0815*** [0.0191]	0.0844*** [0.0222]	0.0749** [0.0315]
Stock Characteristics	Yes	Yes	Yes
Demographics	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes
Stock F.E.	No	Yes	Yes
Household F.E.	No	No	Yes
Observations	1,721,239	1,721,053	1,720,932
Adj. R^2	0.0003	0.0578	0.0745

Table IA.2
Stock Holdings: Alternative Horizons

This table reports coefficient estimates from panel regression (6),

$$Net\ Buy_{i,j,t+6} = \beta \Delta FFR_t \times High\ Div_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t},$$

where $Net\ Buy_{i,j,t+6}$ is a categorical variable defined in equation (1) that indicates whether the holding of stock i by household j increases or decreases from month t to $t+6$, ΔFFR_t is one-year (column (1)) or two-year (column (2)) change in the fed funds rate leading up to month t , $High\ Div_{i,t}$ is a dummy variable that equals one if the income yield of a stock is in the top decile for a given month, and zero 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 change in the fed funds rate ($\Delta FFR_t * High\ Repurchase_{i,t}$), market beta and its interaction with the change in the fed funds rate ($\Delta FFR_t * Beta_{i,t}$), book-to-market ratio and its interaction with the change in the fed funds rate ($\Delta FFR_t * BM_{i,t}$), past one-year and three-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 of the stock positions in the LBD data from 1991 to 1996. Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels. Standard errors are clustered by month.

	(1)	(2)
	1-year	2-year
$\Delta FFR * High\ Dividend$	-0.846*** [0.290]	-0.902*** [0.181]
$\Delta FFR * High\ Repurchase$	-0.139 [0.186]	-0.103 [0.118]
$\Delta FFR * Beta$	-0.184*** [0.0235]	-0.0464*** [0.0142]
$\Delta FFR * BM$	0.851*** [0.0385]	0.573*** [0.0244]
Stock Characteristics	Yes	Yes
Demographics	Yes	Yes
Time F.E.	Yes	Yes
Observations	2,080,708	2,080,708
Adj. R^2	0.0011	0.0012

Table IA.3
Projected Changes in Local Deposit Rates

This table reports coefficient estimates from panel regression (7),

$$Net\ Buy_{i,j,m,t+6} = \beta \Delta Dep\ Rates_{m,t} \times High\ Div_{i,t} + \gamma' X_{i,j,t} + \varepsilon_{i,j,t},$$

where $Net\ Buy_{i,j,m,t+6}$ is a categorical variable defined in equation (1) that 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 three-year change in deposit rates leading up to month t . $High\ Div_{i,t}$ is a dummy variable that equals one if the dividend yield of a stock is in the top decile for a given month and zero otherwise, $X_{i,j,t}$ is a set of control variables including high repurchase dummy and its the interaction with the three-year change in deposit rates ($\Delta Dep\ Rates_{m,t} * High\ Repurchase_{i,t}$), market beta and its interaction with the three-year change in deposit rates ($\Delta Dep\ Rates_{m,t} * Beta_{i,t}$), book-to-market and its interaction with the three-year change in deposit rates ($\Delta Dep\ Rates_{m,t} * BM_{i,t}$), past one-year and three-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) uses the actual deposit rates. Column (2) uses the projected deposit rate changes by multiplying the fed funds rate change with the region's deposit-rate sensitivity (Drechsler et al., 2017). Column (3) further use the local banking sector HHI as instruments for the region's deposit-rate sensitivity. Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Standard errors are clustered by month.

	(1)	(2)	(3)
	Actual rates	Deposit rate beta	Bank HHI
$\Delta\ Dep\ Rates * High\ Dividend$	-2.734*** [0.330]	-3.898*** [0.933]	-4.142*** [0.963]
$\Delta\ Dep\ Rates * High\ Repurchase$	0.736 [0.463]	-0.752 [1.304]	-0.669 [1.344]
$\Delta\ Dep\ Rates * Beta$	0.402*** [0.121]	-0.293 [0.291]	-0.319 [0.302]
$\Delta\ Dep\ Rates * BM$	0.124 [0.114]	-1.058*** [0.329]	-1.041*** [0.339]
Stock Characteristics	Yes	Yes	Yes
Household F.E.	Yes	Yes	Yes
Time-MSA F.E.	Yes	Yes	Yes
Observations	1,450,101	1,450,101	1,450,101
Adj. R^2	0.1008	0.1006	0.1006

Table IA.4
Mutual Fund Flows: Excluding Dot-Com Bubble Period

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

	All		Retail		Institution	
	(1) Equity	(2) Bond	(3) Equity	(4) Bond	(5) Equity	(6) Bond
$\Delta \text{ FFR} \times \text{High Income}$	-0.129*** [0.033]	-0.070** [0.029]	-0.134** [0.052]	-0.134*** [0.038]	-0.070 [0.046]	-0.066 [0.050]
$\Delta \text{ FFR} \times \text{Volatility}$	0.012 [0.016]	-0.109*** [0.018]	0.042* [0.021]	-0.055** [0.024]	0.005 [0.017]	-0.157*** [0.034]
$\Delta \text{ Tax} \times \text{High Dividend}$	-0.181*** [0.035]	0.002 [0.031]	-0.606 [0.531]	-0.108 [0.321]	-0.841** [0.344]	-0.084 [0.427]
Fund Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	740259	813174	357130	395794	265806	205299
Adj. R^2	0.0173	0.0114	0.0212	0.0145	0.0090	0.0065

REFERENCES

- Campbell, John Y., and N. Gregory Mankiw, 1989, Consumption, income, and interest rates: Reinterpreting the time series evidence, *NBER Macroeconomics Annual* 4, 185–216.
- Cooper, Russell W., and John C. Haltiwanger, 2006, On the nature of capital adjustment costs, *Review of Economic Studies* 73, 611–633.
- Drechsler, Itamar, Alexi Savov, and Philipp Schnabl, 2017, The deposits channel of monetary policy, *Quarterly Journal of Economics* 132, 1819–1876.
- Harris, Christopher, and David Laibson, 2001, Dynamic choices of hyperbolic consumers, *Econometrica* 69, 935–957.
- Jones, Charles M., 2002, A century of stock market liquidity and trading costs, Working paper, Columbia Business School.
- Kaplan, Greg, Giovanni L. Violante, and Justin Weidner, 2014, The wealthy hand-to-mouth, *Brookings Papers on Economic Activity* 2014, 77–138.
- Kennon, Joshua, 2016, Don't eat your seed corn: Never spend your principal if you want to be rich, <https://www.thebalance.com/dont-eat-your-seed-corn-357234>. Last accessed on February 9, 2018.
- Owens, Brett, 2016, How to make \$500,000 last forever, *Forbes*, November 2.