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Mistakes in Future Consumption, High MPCs Now[†]

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In a canonical intertemporal consumption model, future consumption mistakes (in response to saving changes) lead to higher current marginal propensities to consume (MPCs). These mistakes increase the value of changing current consumption relative to changing saving, as additional saving will not be spent optimally. Various behavioral biases can cause these mistakes, such as inattention, present bias, diagnostic expectations, and near-rationality (epsilon-mistakes). This result helps explain the empirical puzzle of high-liquidity consumers' high MPCs. In my approach, predictions of sophistication (anticipation of future mistakes) can be derived independently of the underlying biases. (*JEL* D15, D91, E21)

There is increasing consensus that behavioral biases play an important role in explaining consumption behavior. For example, recent evidence shows that consumers exhibit high marginal propensities to consume (MPCs) away from liquidity constraints (Parker 2017; Kueng 2018; Fagereng, Holm, and Natvik 2021).[1] It is hard for the canonical liquidity constraints–based models to explain this evidence, which points toward behavioral explanations.

But it is unclear whether there are robust, consistent predictions on how behavioral biases impact MPCs. There are many potential behavioral biases in intertemporal consumption problems, such as inattention (Sims 2003; Maćkowiak and Wiederholt 2015; Gabaix 2014, 2016), present bias (Laibson 1997; Angeletos et al. 2001), mental accounting (Shefrin and Thaler 1988; Thaler 1990), diagnostic expectations (Bianchi, Ilut, and Saijo 2023), and imperfect problem-solving (Ilut and Valchev

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[1] Stephens and Unayama (2011), Olafsson and Pagel (2018), Ganong and Noel (2019), and McDowall (2020) also find that high-liquidity consumers display high MPCs.

2023). Economists face a challenge in selecting which behavioral biases to incorporate into the mainstream consumption model.

In this paper, I instead establish a high-MPC result independent of the exact behavioral bias. I show how anticipation of future mistakes in response to saving changes—that is, sophistication—leads to higher current MPCs.[2] To establish the high-MPC result, I introduce the approach of using behavioral wedges to capture how future consumption rules deviate from their optimal counterparts (Mullainathan, Schwartzstein, and Congdon 2012; Baicker, Mullainathan, and Schwartzstein 2015; Farhi and Gabaix 2020). I can then study the impact of future mistakes independent of specific biases. I show how this approach can nest many widely studied behavioral biases, such as inattention, present bias, diagnostic expectations, and near-rationality (epsilon-mistakes).

Why do future mistakes in response to saving changes (i.e., changes in asset balances) lead to higher current MPCs? These future mistakes diminish the value of changing saving relative to the value of changing current consumption. Anticipating these future mistakes, the consumer is less willing to adjust her saving and more willing to adjust her current consumption. Hence she displays higher current MPCs. This result is true no matter whether future consumption mistakes take the form of overreaction or underreaction to saving changes.

As an example, consider the response to a positive current income shock. If the consumer increases her saving, the additional saving will not be spent optimally because she cannot perfectly smooth increases in her future consumption. As a result, the value of increasing saving relative to the value of increasing current consumption diminishes. The consumer is then more willing to increase her current consumption and exhibits a higher current MPC.[3]

To isolate my mechanism, I first establish my high-MPC result in a simple example with quadratic utility. This clarifies that my high-MPC result does not arise from the precautionary saving motive. My high-MPC result extends to general concave utility, under an additional condition: mistakes in future consumption only take the form of mistakes in response to saving changes, while there are no mistakes in the absence of shocks. Many popular behavioral models satisfy this condition. For example, in models of beliefs-driven behavioral biases such as inattention and diagnostic expectations, belief mistakes only happen when the underlying fundamental deviates from the preshock default value (Sims 2003; Maćkowiak and Wiederholt 2015; Bianchi, Ilut, and Saijo 2023). As another example, present bias agents with access to a commitment device (Laibson 1997; Angeletos et al. 2001) can achieve optimal consumption through the commitment device in absence of the shock but not in response to it. Finally, I provide additional results regarding how future mistakes in response to saving changes can still lead to higher current MPCs even when the previous condition does not hold.

[2] This high-MPC result contrasts with the direct impact of current behavioral mistakes on current MPCs. The direct impact can lead to either higher MPCs (e.g., hyperbolic discounting) or lower MPCs (e.g., inattention).

[3] By the same token, for a negative current income shock, the value of decreasing saving is extra negative, again because her future selves cannot perfectly smooth their consumption decreases in response to the saving decrease. The consumer is then more willing to decrease her current consumption and again exhibits a higher current MPC.

The high-MPC result can be easily extended to the case of partial sophistication—that is, partial understanding of future mistakes. An interesting comparative statics result is that current MPCs increase with the degree of sophistication.

Beyond the specific application of MPCs, a goal of the paper is to illustrate that predictions of sophistication (i.e., the anticipation of future mistakes) can be studied independently of the underlying behavioral biases. The sophistication channel can be crucial in determining behavior, such as "doing it now or later" in O'Donoghue and Rabin (1999, 2001). There is also ample empirical evidence that consumers have a nontrivial degree of sophistication (e.g., Allcott et al. 2022; Carrera et al. 2022; Le Yaouanq and Schwardmann 2022).[4] But the impact of sophistication is often studied in the context of a *specific* mistake, typically present bias. Here, I instead study its behavioral impact more broadly, independent of the exact mistakes.

Related Literature.—The most related papers are Ilut and Valchev (2023) and Bianchi, Ilut, and Saijo (2023). They also develop behavioral explanations of high-liquidity consumers' high MPCs. Ilut and Valchev's (2023) theory is based on the consumer's imperfect problem-solving. The high-MPC result there comes from the consumer's difficulty in calculating her optimal consumption rule. But Ilut and Valchev (2023) focus on the naïveté case and do not study the impact of future mistakes on current consumption. Bianchi, Ilut, and Saijo (2023) instead generate high MPCs from diagnostic expectations. Though they predominantly focus on the naivete case, Bianchi, Ilut, and Saijo (2023) show that MPCs under sophistication are higher than MPCs under naïveté. Through the lens of my paper, this result arises because diagnostic expectations lead to mistakes in future consumption's response to saving changes in their model.[5]

Compared to the broader behavioral literature on intertemporal consumption (e.g., Laibson 1997; Maćkowiak and Wiederholt 2015; Matějka 2016; Gabaix 2016; Maćkowiak, Matějka, and Wiederholt 2023), the key difference is that my paper establishes predictions independent of specific behavioral biases. The early present bias literature (Laibson 1997; Angeletos et al. 2001) studies the sophistication case and incorporates the impact of future present bias on current consumption. But this channel is not the main focus of these papers.

Related are also Mullainathan, Schwartzstein, and Congdon (2012); Baicker, Mullainathan, and Schwartzstein (2015); and Farhi and Gabaix (2020). They use the wedge approach to conduct behavioral welfare analysis and study optimal policy with behavioral agents. I instead use the wedge approach to study a *positive* question, how sophistication impacts current MPCs independent of the specific behavioral biases.

[4] For example, in the context of present bias, Allcott et al. (2022) find that the degree of sophistication is close to one.

[5] Mullainathan (2002) and Azeredo da Silveira and Woodford (2019) generate high MPCs because consumers' expectation of future income overreacts to changes in current income. On the other hand, the channel in my paper leads to high MPCs even if consumers form rational expectations about their future incomes. Boutros (2022) shows that finite planning horizons can also generate high-liquidity consumers' high MPCs.

I. An Illustrative Example

I start with the simplest example of how future mistakes can lead to higher current MPCs. The consumer lives for three periods, $t \in \{0,1,2\}$. Her utility is given by

$$u(c_0) + u(c_1) + u(c_2), \tag{1}$$

where $u(\cdot):\mathbb{R} \to \mathbb{R}$ is strictly concave and increasing and the discount factor is one for simplicity. For illustrative purposes, I let $u(\cdot)$ be quadratic so the consumption rule is linear. The result will be generalized to the case with general concave utility in Section II.

The consumer can save and borrow through a risk-free asset with a gross interest rate $R = 1$. To isolate the friction of interest, she is not subject to borrowing constraints.

The question of interest is how consumption c_0 responds to an income shock Δ at $t = 0$—that is, the current MPC. For illustrative purposes, in this section, the shock Δ is the only source of income for the consumer. Without the shock, income in each $t \in \{0,1,2\}$ is normalized to zero and the initial wealth is also normalized to zero. Together, her intertemporal budget is given by

$$w_1 = \Delta - c_0 \quad \text{and} \quad w_2 = w_1 - c_1, \tag{2}$$

where w_t is the consumer's wealth/saving at the start of period t. Without the shock ($\Delta = 0$), optimal consumption at each period $t \in \{0,1,2\}$ is simply given by $\bar{c}_t = 0$.

Now let us turn to the consumer's consumption policy. In period $t = 2$, the consumer consumes her remaining saving:[6]

$$c_2(w_2) = w_2. \tag{3}$$

In period $t = 1$, the consumer's actual consumption rule is given exogenously by

$$c_1(w_1) = \frac{1}{2}(1 - \lambda_1)w_1. \tag{4}$$

Compared to the frictionless consumption rule $c_1^{Frictionless}(w_1) = (1/2)w_1$, λ_1 in (4) captures the mistake in response to changes in saving w_1. When $\lambda_1 > 0$, c_1 underreacts to w_1. When $\lambda_1 < 0$, c_1 overreacts to w_1. As illustrated shortly, this is the type of future mistake that leads to a higher MPC at $t = 0$.

I then study how the future mistake λ_1 impacts the current MPC at $t = 0$. To this end, I define $c_0^{Deliberate}(\Delta)$ which captures self $t = 0$'s optimal consumption taking her future consumption rules (3) and (4) as given:

$$c_0^{Deliberate}(\Delta) \equiv \arg\max_{c_0} u(c_0) + u(c_1(w_1)) + u(c_2(w_2)) \tag{5}$$

[6] Note that c_2 can be negative. This makes sure that the problem is always well defined.

subject to the budget (2). $c_0^{Deliberate}(\Delta)$ isolates the impact of future mistakes λ_1 because it is the consumption that the consumer would have chosen at $t = 0$ if she were not subject to any current mistake but took her future mistakes as given. I hence term it "deliberate consumption." The current MPC is then given by $\phi_0^{Deliberate} \equiv \partial c_0^{Deliberate}(\Delta)/\partial\Delta$.[7]

To better understand the intuition of the high-MPC result, I write (5) in a recursive form. Self 0 trades off between the utility of current consumption and the continuation value of saving:

$$c_0^{Deliberate}(\Delta) = \arg\max_{c_0} u(c_0) + V_1(w_1), \tag{6}$$

where $w_1 = \Delta - c_0$ as in (2) and $V_1(w_1)$ captures the continuation value function, defined based on future consumption rules in (3) and (4):

$$\begin{aligned} V_1(w_1) &\equiv u\big(c_1(w_1)\big) + u\Big(c_2\big(w_1 - c_1(w_1)\big)\Big) \\ &= u\Big(\frac{1}{2}(1 - \lambda_1)w_1\Big) + u\Big(\frac{1}{2}(1 + \lambda_1)w_1\Big). \end{aligned} \tag{7}$$

I can then establish the main result.

PROPOSITION 1:

(*i*) ***Excess Concavity of the Continuation Value:*** *The concavity of the continuation value function* $|V_1''| = (1/2)|u''|(1 + \lambda_1^2)$ *strictly increases with the future mistake* $|\lambda_1|$.

(*ii*) ***Higher Current MPCs:*** *The current MPC* $\phi_0^{Deliberate} = \dfrac{\frac{1}{2}(1 + \lambda_1^2)}{1 + \frac{1}{2}(1 + \lambda_1^2)}$ *strictly increases with the future mistake* $|\lambda_1|$.

PROOF OF PROPOSITION 1:

Based on the consumption rules in (3) and (4) and the definition of $V_1(w_1)$ in (7), we know that

$$V_1'(w_1) = \frac{1}{2}(1 - \lambda_1)u'\Big(\frac{1}{2}(1 - \lambda_1)w_1\Big) + \frac{1}{2}(1 + \lambda_1)u'\Big(\frac{1}{2}(1 + \lambda_1)w_1\Big).$$

Since u is quadratic, we know that u'' is a constant and

$$V_1'' = u'' \cdot \Big[\frac{1}{4}(1 - \lambda_1)^2 + \frac{1}{4}(1 + \lambda_1)^2\Big] = \frac{1}{2}u'' \cdot (1 + \lambda_1^2).$$

This proves the first part of Proposition 1. From (6), we know that

$$u'\big(c_0^{Deliberate}(\Delta)\big) = V_1'(w_1), \quad \text{with} \quad w_1 = \Delta - c_0^{Deliberate}(\Delta).$$

[7] $\phi_0^{Deliberate}$ does not depend on Δ because $c_0^{Deliberate}(\Delta)$ is linear. Later, V_1'' does not depend on w_1 because $V_1(w_1)$ is quadratic.

Taking a partial derivative with respect to Δ, we have

$$\phi_0^{Deliberate} = \frac{1}{2}\left(1 + \lambda_1^2\right)\left(1 - \phi_0^{Deliberate}\right) = \frac{\frac{1}{2}\left(1 + \lambda_1^2\right)}{1 + \frac{1}{2}\left(1 + \lambda_1^2\right)}.$$

This proves the second part of Proposition 1. ∎

Proposition 1 shows that the future consumption mistake in response to saving changes (a larger $|\lambda_1|$) leads to a higher current MPC $\phi_0^{Deliberate}$. The high-MPC result holds regardless of whether the future consumption mistake takes the form of underreaction ($\lambda_1 > 0$) or overreaction ($\lambda_1 < 0$). The result is independent of the exact behavioral causes of the future mistake λ_1.

To better understand the high-MPC result, note that the value of changing saving w_1 by ξ is[8]

$$V_1(\xi) - V_1(0) = u'(0) \cdot \xi - \frac{1}{2}|V_1''| \cdot \xi^2. \tag{8}$$

This value decreases with the future mistake $|\lambda_1|$ for any $\xi \neq 0$ because of the excess concavity in $|V_1''|$. Intuitively, because of the future mistake in response to saving changes, the consumer cannot perfectly smooth her future consumption responses to saving changes. The value of changing saving is then decreased (for both an increase in saving $\xi > 0$ and a decrease in saving $\xi < 0$).

On the other hand, the value of changing current consumption c_0 by ξ is

$$u(\xi) - u(0) = u'(0) \cdot \xi - \frac{1}{2}|u''| \cdot \xi^2, \tag{9}$$

independent of the future mistake $|\lambda_1|$.

Equations (8) and (9) together mean that the future mistake diminishes the value of changing saving relative to the value of changing current consumption. The consumer is then more willing to change her current consumption and exhibits a higher current MPC.

For example, consider a positive current income shock $\Delta > 0$. The value of increasing saving relative to the value of increasing current consumption diminishes because of the future mistake $|\lambda_1|$. The consumer is then more willing to increase her current consumption and exhibits a higher current MPC. By the same token, for a negative current income shock $\Delta < 0$, the value of decreasing saving in (8) is extra negative. The consumer is more willing to decrease her current consumption and again exhibits a higher current MPC.

The key to the high-MPC result is mistakes in the future consumption's *response* to saving changes. To see this more clearly, we can extend the consumption rule in (4) to

$$c_1(w_1) = \frac{1}{2}(1 - \lambda_1)w_1 - \bar{\lambda}_1, \tag{10}$$

[8] Without the shock ($\Delta = 0$), the consumption c_0 and the saving w_1 are simply given by zero. That is why the baseline values in (8) and (9) are $V_1(0)$ and $u(0)$.

which now allows two types of mistakes compared to the frictionless consumption rule $c_1^{Frictionless}(w_1) = (1/2)w_1$. First, same as in (4), λ_1 captures the mistake in response to changes in saving w_1. Second, (10) also allows the mistake in the overall consumption level in the absence of the shock ($\Delta = 0$). Specifically, $\bar{\lambda}_1$ captures how much the preshock ($\Delta = 0$) consumption level deviates from its frictionless level, 0. When $\bar{\lambda}_1 > 0$, the consumer underconsumes at $t = 1$. When $\bar{\lambda}_1 < 0$, the consumer overconsumes at $t = 1$. In the environment here, $\phi_0^{Deliberate}$ is solely a function of the mistake in response to saving changes, λ_1, but is independent of the mistake in the preshock consumption level, $\bar{\lambda}_1$.[9] Intuitively, the MPC is about how the consumer responds to the income shock Δ, so it is directly connected to how future consumption responds to saving changes, λ_1, instead of its overall level, $\bar{\lambda}_1$.

It is important to clarify that the high-MPC result in Proposition 1 does not come from the precautionary saving motive. This can be seen from Proposition 1 here because the quadratic utility here a fortiori shuts down the precautionary saving motive. See Section III for further discussion.

II. The Main High-MPC Result

In this section, I consider a standard intertemporal consumption and saving problem with general concave utilities. I study how future consumption mistakes in response to saving changes lead to higher current MPCs.

Utility, Budget, and Consumption Rules.—The consumer's utility is given by

$$U_0 \equiv \sum_{t=0}^{T-1} \delta^t u(c_t) + \delta^T v(a_T + y_T), \tag{11}$$

where c_t is her consumption in period $t \in \{0, 1, \ldots, T-1\}$, δ is her discount factor, $u(\cdot)$ captures the utility from consumption, and $v(\cdot): \mathbb{R} \to \mathbb{R}$ captures the utility from retirement or bequests. The final wealth $w_T = a_T + y_T$ is allowed to be negative since the utility from retirement or bequests $v(\cdot)$ is defined on the entirety of $\mathbb{R}$. This guarantees that even with consumption mistakes, the budget in (12) is always satisfied and the intrapersonal problem is always well defined.[10] Both $u(\cdot)$ and $v(\cdot)$ are strictly increasing and strictly concave.

The consumer can save and borrow through a risk-free asset and is subject to the budget constraints

$$a_{t+1} = R(a_t + y_t - c_t), \quad \forall t \in \{0, \ldots, T-1\}, \tag{12}$$

where y_t is her exogenous income in period t, a_t is her wealth (i.e., saving/borrowing) at the start of period t, and R is the gross interest rate on the risk-free asset.

[9] See online Appendix A for details.

[10] The final period does not play a special role: in Corollary 1, I show that the consumer's MPCs converge to simple limits when $T \to +\infty$.

To isolate the friction of interest, the consumer is not subject to any borrowing constraints. Her budget constraint (12) can then be rewritten as

$$w_{t+1} = R(w_t - c_t), \quad \forall t \in \{0, \ldots, T-1\}, \tag{13}$$

where $w_t = a_t + y_t + \sum_{k=1}^{T-t} R^{-k} y_{t+k}$ is her total wealth in period t, including her saving and the present value of her current and future income.

To study MPCs, I study how consumption at $t = 0$ responds to an income shock Δ at $t = 0$: $y_0 = \bar{y}_0 \to y_0 = \bar{y}_0 + \Delta$, or equivalently $w_0 = \bar{w}_0 \to w_0 = \bar{w}_0 + \Delta$, where I use a bar over a variable to capture its preshock value ($\Delta = 0$). For illustration purposes, I follow Chetty and Szeidl (2007) and let Δ be the only source of income uncertainty in the main analysis. Cases with gradual resolution of income uncertainty will be studied in Section III.

I use the widely adapted "multiple-selves" language as in Piccione and Rubinstein (1997) and Harris and Laibson (2001): self $t \in \{0, \ldots, T-1\}$ is in charge of consumption and saving at time t. I use $c_t(w_t)$ to denote self t's actual consumption rules, subject to behavioral mistakes.[11] For example, see (4) in Section I.

Isolating the Impact of Future Mistakes on Current Consumption.—The main focus of the paper is how future mistakes embedded in future consumption $\{c_t(w_t)\}_{t=1}^{T-1}$ affect the current MPC at $t = 0$. To isolate this channel, I introduce *deliberate* consumption $c_0^{Deliberate}(w_0)$ as in (5)—that is, the consumption that self 0 would have chosen given the utility (11) if she were not subject to any current mistakes but took future selves' mistakes in $\{c_t(w_t)\}_{t=1}^{T-1}$ as given. The following definition extends the notion of deliberate consumption to all $t \in \{0, \ldots, T-1\}$.

DEFINITION 1: *For each $t \in \{0, \ldots, T-1\}$, self t's deliberate consumption optimizes the consumer's utility in (11), taking future selves' actual consumption rules $\{c_{t+k}(w_{t+k})\}_{k=1}^{T-k-1}$ as given:*

$$c_t^{Deliberate}(w_t) \equiv \arg\max_{c_t} u(c_t) + \sum_{k=1}^{T-t-1} \delta^k u\big(c_{t+k}(w_{t+k})\big) + \delta^{T-t} v(w_T) \tag{14}$$

subject to the budget in (13).

Future Consumption Mistakes and Higher Current MPC.—With general concave utilities here, the high-MPC result in Proposition 1 remains true, under an additional condition: mistakes in future consumption only take the form of mistakes in response to saving changes, while there are no mistakes in the absence of the shock Δ. As studied in Section IV, many popular behavioral foundations satisfy this condition.

[11] For technical reasons, I also assume that u, v, and c_t are third-order continuously differentiable.

To formalize this condition, I use $\bar{c}_t$ and $\bar{w}_t$ to capture the preshock $(\Delta = 0)$ outcomes, satisfying $\bar{c}_t = c_t(\bar{w}_t)$ and $\bar{w}_{t+1} = R(\bar{w}_t - \bar{c}_t)$, for $t \in \{0, 1, \ldots, T-1\}$. The condition that there are no mistakes in the absence of the shock Δ means that

$$\text{(15)} \qquad \{\bar{c}_t\}_{t=0}^{T-1} \quad \text{maximize } (11) \text{ such that } (13) \text{ with } \quad w_0 = \bar{w}_0,$$

or equivalently $c_t(\bar{w}_t) = c_t^{Deliberate}(\bar{w}_t)$ for $t \in \{0, 1, \ldots, T-1\}$. Under (15), future consumption mistakes take the form of c_t inefficiently responding to changes in w_t. Similar to (4), I use λ_t to capture this mistake for $t \in \{1, \ldots, T-1\}$, defined as

$$\text{(16)} \qquad \phi_t = (1 - \lambda_t)\phi_t^{Deliberate},$$

where $\phi_t \equiv \partial c_t(\bar{w}_t)/\partial w_t$ captures how future self t's actual consumption responds to changes in w_t while $\phi_t^{Deliberate} \equiv \partial c_t^{Deliberate}(\bar{w}_t)/\partial w_t$ captures how future self t should have responded to changes in w_t. When $\lambda_t > 0$, future self t underreacts to changes in w_t. When $\lambda_t < 0$, future self t overreacts to changes in w_t. I now study how future mistakes in response to saving changes $\{\lambda_t\}_{t=1}^{T-1}$ lead to higher MPCs at $t = 0$.

PROPOSITION 2: *If (15) holds,* $\phi_0^{Deliberate} \equiv \frac{\partial c_0^{Deliberate}(\bar{w}_0)}{\partial w_0}$ *increases with each future mistake* $|\lambda_t|$, *for* $t \in \{1, \ldots, T-1\}$.

The intuition is exactly the same as in Proposition 1. Because of future mistakes in response to saving changes, future selves cannot perfectly smooth their consumption responses to saving changes and future consumption responses will concentrate in certain periods. The value of changing saving is then decreased relative to value of changing current consumption (for both a positive shock and a negative shock). The consumer is then less willing to adjust her saving and more willing to adjust her current consumption. Hence she displays higher current MPCs.

From Deliberate MPCs to Current MPCs.—Proposition 2 focuses on the deliberate MPC $\phi_0^{Deliberate}$, which isolates the impact of future mistakes on the current MPC. The deliberate MPC and self 0's own mistake λ_0 jointly determine the current actual MPC:

$$\phi_0 = (1 - \lambda_0)\phi_0^{Deliberate}.$$

There are two reasons why I focus on the deliberate MPC. First, the direct impact of λ_0 on the MPC ϕ_0 is well understood. Second, the direct impact depends on the specific bias under consideration. It can lead to either a higher MPC (e.g., present bias) or a lower MPC (e.g., inattention). I instead want to establish a high-MPC result independent of the underlying biases.

If one is interested in the total effects of behavioral biases on the current MPC, one can combine the direct impact of λ_0 with the impact of future mistakes $\{\lambda_t\}_{t=1}^{T-1}$ through the deliberate MPC $\phi_0^{Deliberate}$. If the studied behavior bias leads to overreaction (negative λs), both channels lead to higher MPCs. If the behavior bias leads to underreaction (positive λs), which channel dominates depends on the relative size of current mistake (λ_0) and future mistakes ($\{\lambda_t\}_{t=1}^{T-1}$). Interestingly, for the inattention interpretation studied in Section IV, it is likely that the consumer is currently attentive to a stimulus check ($\lambda_0 = 0$) but becomes inattentive to saving changes driven by the stimulus check over time ($\lambda_t > 0$ for $t \geq 1$). In this case, the impact of future inattention unambiguously translates into a higher current actual MPC.

III. Extensions and Numerical Illustrations

The $T \to \infty$ Limit.—The deliberate MPC $\phi_0^{Deliberate}$ in Proposition 2 converges to simple limits when all future selves share the same friction $\lambda_t = \lambda$ and the consumer's horizon T goes to infinity.

COROLLARY 1: *Consider the CRRA case with $u(c) = \left[c^{1-\gamma}/(1-\gamma)\right]$, $v(c) = \kappa\left[c^{1-\gamma}/(1-\gamma)\right]$, and (15). Let $\delta^{-\frac{1}{\gamma}}R^{1-\frac{1}{\gamma}} > 1$ and $\lambda_t = \lambda$ with $|\lambda| < \left(\delta^{-\frac{1}{\gamma}}R^{1-\frac{1}{\gamma}}\right)^{-\frac{1}{2}}$ for all $t \geq 1$. We have, for $T \to +\infty$,*

$$\phi_0^{Deliberate} \to \phi^{Deliberate} = \frac{\delta^{-\frac{1}{\gamma}}R^{1-\frac{1}{\gamma}} - 1}{\delta^{-\frac{1}{\gamma}}R^{1-\frac{1}{\gamma}}\left(1 - \lambda^2\right)}. \tag{17}$$

When $\lambda \to \left[\left(\delta^{-\frac{1}{\gamma}}R^{1-\frac{1}{\gamma}}\right)^{-\frac{1}{2}}\right]^-$, the deliberate MPC $\phi^{Deliberate}$ achieves its upper bound,

$$\lim_{\lambda \to \left[\left(\delta^{-\frac{1}{\gamma}}R^{1-\frac{1}{\gamma}}\right)^{-\frac{1}{2}}\right]^-} \phi^{Deliberate} = 1.$$

That is, when future selves' consumption mistakes are large enough, the current self 0 is so worried about her future selves' mistakes that she follows a simple rule of thumb: she consumes all changes in w_0. She is effectively "hand-to-mouth" with respect to shocks to w_0.

Gradual Resolution of Income Uncertainty and a Numerical Illustration.—With gradual resolution of income uncertainty, things are more complicated and an analytical characterization seems impossible. In practice, however, the high-MPC result in Proposition 2 continues to hold as long as a condition akin to (15) holds: there are no mistakes in future consumptions when incomes are realized at their median levels.

To illustrate, I conduct a numerical exercise in Figure 1. With gradual resolution of income uncertainty, it is clearer if I explicitly work with different components of the budget (12):

$$a_{t+1} = R\left(a_t + y_t - c_t\right),$$

where the random income $y_t \sim \log\mathcal{N}\left(0, \sigma^2\right)$ is drawn i.i.d. across each period $t \in \{0, \ldots, T-1\}$.[12] To illustrate the robustness of my result, I also introduce borrowing constraints: for all $t \in \{0, \ldots, T-1\}$,

$$a_{t+1} \geq \underline{a}.$$

[12] The income shock Δ considered previously can be viewed as a shock to y_0.

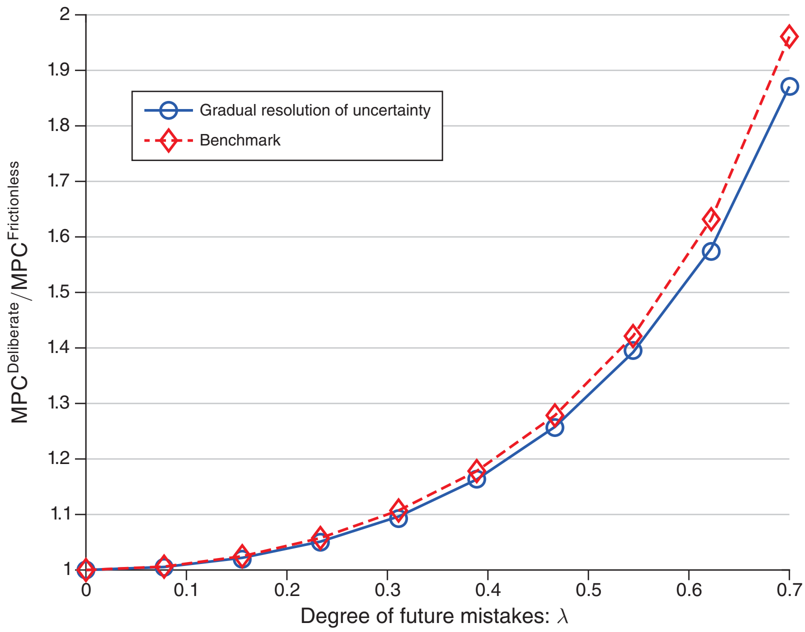

FIGURE 1. GRADUAL RESOLUTION OF UNCERTAINTY

In this environment, it is easier to write the consumption rule of each self $t \in \{0, \ldots, T-1\}$ as a function of cash on hand $x_t \equiv a_t + y_t$, $c_t(x_t)$. Similar to (15), I impose that there are no mistakes when the stochastic incomes are realized at their median levels. That is, for $t \in \{0, \ldots, T-1\}$, actual consumptions coincide with their deliberate counterparts

$$c_t(\bar{x}_t) = c_t^{Deliberate}(\bar{x}_t),$$

where $\bar{x}_{t+1} = R(\bar{x}_t - c_t(\bar{x}_t) + 1)$, for $t \in \{0, 1, \ldots, T-1\}$.[13]

Similar to (16), future consumptions respond inefficiently to saving changes

$$\phi_t = (1 - \lambda_t)\phi_t^{Deliberate}, \tag{18}$$

where $\phi_t \equiv \partial c_t(\bar{x}_t)/\partial x_t$ and $\phi_t^{Deliberate} \equiv \partial c_t^{Deliberate}(\bar{x}_t)/\partial x_t$ and λ_t captures self t's mistake. To extend (18) globally, for each $t \in \{1, \ldots, T-1\}$,

$$c_t(x_t) = \min\left\{-\frac{\underline{a}}{R} + x_t, c_t^{Deliberate}\left((1 - \lambda_t)x_t + \lambda_t \bar{x}_t\right)\right\}, \tag{19}$$

[13] Note that the median of y_t is one.

which makes sure that the consumer will not violate her borrowing constraints despite her mistakes.

From future selves' actual consumption rules $\left\{c_t(x_t)\right\}_{t=1}^{T-1}$, one can calculate current self 0's deliberate consumption $c_0^{Deliberate}(x_0)$ and find her MPC $\phi_0^{Deliberate}$ as usual. I numerically solved the following case: $T \to +\infty$; $u(c) = c^{1-\gamma}/(1-\gamma)$; $\gamma = 1.1$; $\sigma = 1$; $\delta = 0.902$; $R = 1.04$; $\underline{a} = 0$, and $\lambda_t = \lambda$. The values of γ, δ, and R are from Fagereng et al. (2021).

In Figure 1, I plot a high-liquidity consumer's $\phi_0^{Deliberate}/\phi_0^{Frictionless}$ as a function of λ.[14] I then compare it to $\phi_0^{Deliberate}/\phi_0^{Frictionless}$ calculated analytically in Corollary 1 without gradual resolution of uncertainty. We can see that the deliberate MPCs are very similar and the main lesson regarding how future mistakes in response to saving changes increase the current MPC is unchanged. In online Appendix B.2, I conduct robustness checks based on other parameterizations and the main lesson remains the same.

Partial Sophistication.—In the main analysis, for simplicity, I study the case of full sophistication. That is, I define the deliberate consumption (14) based on correct anticipation of future actual consumption rules and future mistakes. But the high-MPC result can also be extended to the case of partial sophistication—that is, partial understanding of future mistakes.

To illustrate, first notice that the main analysis can accommodate a more general interpretation if I redefine current self 0's deliberate consumption based on her perceived future consumption rules $\left\{\tilde{c}_t(w_t)\right\}_{t=1}^{T-1}$. I can then define self 0's perceived future mistakes $\left\{\tilde{\lambda}_t\right\}_{t=1}^{T-1}$ as how $\left\{\tilde{c}_t(w_t)\right\}_{t=1}^{T-1}$ deviate from what she deems optimal, an extension to (16). Proposition 2 can then be restated as how perceived future mistakes $\left\{\tilde{\lambda}_t\right\}_{t=1}^{T-1}$ increase the current MPC, $\phi_0^{Deliberate}$. See Corollary B.1 in online Appendix B.1.

One important example of how perceived future mistakes are determined is the case of partial sophistication in O'Donoghue and Rabin (1999, 2001). That is, the current self has a partial understanding of future mistakes and her perceived future mistake at t is given by:

$$\tilde{\lambda}_t = s\lambda_t, \tag{20}$$

where $s \in [0,1]$ captures the degree of current self 0's sophistication. There are two lessons. First, partial sophistication suffices for all qualitative results about how future mistakes increase current MPCs. Second, current MPCs increase with the degree of sophistication. This comparative statics prediction, formalized in Corollary B.2 in online Appendix B.1, can be empirically tested.

The Role of Perceived Dynamic Inconsistency.—The above reinterpretation also helps clarify what I mean by future "mistakes." The reason why these future mistakes impact current behavior is that the current self anticipates that her future selves

[14] Since I am focusing on the behavior away from liquidity constraints, I focus on a consumer with initial cash on hand $\bar{x}_0 = 50 \cdot E[y_t]$.

will deviate from what she deems optimal; she then adjusts her current consumption accordingly.[15] This can be seen from Corollary B.1 in online Appendix B.1 mentioned previously: the perceived future mistakes $\left\{\tilde{\lambda}_t\right\}_{t=1}^{T-1}$ that increase the current MPC are defined exactly as how the current self's perceived future consumption rules $\left\{\tilde{c}_t(w_t)\right\}_{t=1}^{T-1}$ deviate from what she deems optimal. In other words, the key element for the focused channel is a form of perceived dynamic inconsistency.

The Precautionary Saving Motive.—What happens if (15) is not satisfied and the consumer also exhibits future mistakes in the absence of the shock Δ? These mistakes generate an additional channel: the precautionary saving motive. But the precautionary saving motive is about how the dispersion of the levels of future consumption across states or time decreases the *level* of current consumption (increases the level of saving). This channel is different from my main high-MPC channel.[16,17]

I now use the simple three-period example in Section I to illustrate the precautionary saving channel within my framework. The consumer has a $t = 1$ consumption rule

$$c_1(w_1) = \frac{1}{2}w_1 - \bar{\lambda}_1, \tag{21}$$

where $\bar{\lambda}_1$ captures the mistake in the overall consumption level at $t = 1$ in the absence of the shock ($\Delta = 0$). When $\bar{\lambda}_1 > 0$, the consumer underconsumes at $t = 1$. When $\bar{\lambda}_1 < 0$, the consumer overconsumes at $t = 1$.

At $t = 2$, the consumer's consumption rule is then given by

$$c_2(w_2) = w_2 = w_1 - c_1(w_1) = \frac{1}{2}w_1 + \bar{\lambda}_1. \tag{22}$$

We can see that the mistake in the overall consumption level $\bar{\lambda}_1$ introduces the dispersion of consumption levels across time. With a "prudent" utility ($u''' > 0$), such dispersion will decrease the current consumption level and increase the current saving level.

PROPOSITION 3: *Consider the case with a prudent utility* ($u''' > 0$) *with* (21). *For each* Δ, $c_0^{Deliberate}(\Delta)$ *decreases with* $|\bar{\lambda}_1|$ *in a neighborhood of* $\bar{\lambda}_1 = 0$.

Compared to the main high-MPC result in Proposition 2, Proposition 3 has two key differences. First, Proposition 3 is about the level of current consumption $c_0^{Deliberate}(\Delta)$ instead of the MPC $\partial c_0^{Deliberate}(\Delta)/\partial\Delta$. Second, Proposition 3 is about the impact of future mistakes in the overall consumption level $\bar{\lambda}_1$ instead of future

[15] Consistent with the reinterpretation here, $\left\{c_t^{Deliberate}(w_t)\right\}_{t=1}^{T-1}$ defined in Definition 1 can be interpreted as the consumption that self 0 thinks is optimal at each future period $t \in \{1, \ldots, T-1\}$. This is because in the main analysis, self 0's perceived future consumption rules are given by actual future consumption rules $\left\{c_t(w_t)\right\}_{t=1}^{T-1}$. By the same token, future mistakes $\left\{\lambda_t\right\}_{t=1}^{T-1}$ defined in (16) can then be interpreted as how self 0's perceived future consumptions deviate from what she deems optimal.

[16] In the literature, the dispersion of the levels of future consumption behind the precautionary saving motive often comes from future uncertainty or liquidity constraints (Kimball 1990; Carroll 1997; Holm 2018). In my framework, such dispersion comes from future mistakes in the overall levels of consumption in the absence of the shock Δ.

[17] It is easy to see that my high-MPC result does not come from the precautionary saving motive from Proposition 1. The quadratic utility case there a fortiori shuts down the precautionary saving motive.

mistakes in response to saving changes λ_1. A rough intuition is this: the level of current consumption $c_0^{Deliberate}(\Delta)$ should be connected to future mistakes in the overall consumption level (Proposition 3). On the other hand, the MPC $\phi_0^{Deliberate}$ is about how the consumer responds to the income shock, so it is directly connected to how future consumption responds to saving changes (Proposition 2). Since this paper is about the MPC, the latter type of mistake plays a key role throughout.

A natural question is whether the precautionary saving motive driven by future mistakes in overall consumption level $\bar{\lambda}_1$ can also impact the current MPC. In theory, this is possible (Carroll, Holm, and Kimball 2021). Taking a derivative with respect to Δ of the FOC of the problem in (6), the current MPC is given by

$$(23) \qquad \frac{\partial c_0^{Deliberate}(\Delta)}{\partial \Delta} = \frac{V_1''\left(\Delta - c_0^{Deliberate}(\Delta)\right)}{u''\left(c_0^{Deliberate}(\Delta)\right) + V_1''\left(\Delta - c_0^{Deliberate}(\Delta)\right)}.$$

From Proposition 3, we know that the precautionary saving motive driven by $\bar{\lambda}_1$ will decrease $c_0^{Deliberate}(\Delta)$. Such a decrease in $c_0^{Deliberate}(\Delta)$ may impact the MPC in (23) through third-order effects when $u''' \neq 0$ and/or $V_1''' \neq 0$. This is a higher-order effect than the main high-MPC result. Unless mistakes in overall consumption level $\bar{\lambda}_1$ are big, this channel will not impact the MPC that much. See Figure B.4 in online Appendix B.3 for a numerical illustration.[18]

IV. Behavioral Foundations

The main results in the previous section do not depend on the exact causes of future mistakes. This section shows how my framework can accommodate many widely studied behavioral foundations, such as inattention, diagnostic expectations, present bias, and near-rationality (epsilon-mistakes).

Inattention.—My framework can accommodate inattention (e.g., Sims 2003; Gabaix 2014; Maćkowiak and Wiederholt 2015). Here, I follow the sparsity approach in Gabaix (2014) and let each self t's perceived w_t be given by

$$(24) \qquad w_t^p(w_t) = (1 - \lambda_t)w_t + \lambda_t w_t^d,$$

where $\lambda_t \in [0,1]$ captures self t's degree of inattention (a larger λ_t means more inattention) and w_t^d captures the default. It is standard to set the default w_t^d to be the preshock value $\bar{w}_t$ (Gabaix 2014). As a corollary of Proposition 2, future consumption mistakes in the form of inattention to saving changes $\{\lambda_t\}_{t=1}^{T-1}$ lead to higher current MPCs. This is Corollary B.3 in online Appendix B.5. Online Appendix B.5

[18] In applications, the essentially only possibility that future mistakes in overall consumption levels are large enough to matter for MPCs in (23) is that these mistakes take a multiplicative form—for example, $c_1(w_1) = c_1^{Deliberate}((1 - \Lambda_1)w_1)$, where $\Lambda_1 \neq 0$ captures a multiplicative mistake. See Proposition B.1 in online Appendix B.4 for a detailed discussion.

further discusses what forms of inattention lead to perceived dynamic inconsistency and lead to higher current MPCs.

Diagnostic Expectations.—Above, inattention leads to underreaction of future consumption in response to saving changes. Here, I study the case of diagnostic expectations, which leads to overreaction of future consumption in response to saving changes. Despite this difference, both types of future mistakes lead to higher current MPCs.

To illustrate, consider the three-period example with quadratic utility in Section I, similar to the setting in Bianchi, Ilut, and Saijo (2023). In the final period $t = 2$, as in (3), the consumer consumes all her remaining saving, $c_2(w_2) = w_2$. In the middle period $t = 1$, the consumer overreacts to changes in her saving because of diagnostic expectations:[19]

$$c_1(w_1) = \frac{1+\theta}{2+\theta} w_1 = \frac{1}{2}\left(1 + \frac{\theta}{2+\theta}\right) w_1, \tag{25}$$

where $\theta > 0$ measures the degree of overreaction in expectation. Online Appendix B.6 contains the detailed derivation of (25).

For such a consumer, higher saving w_1 triggers more vivid memories of good times and leads her to become overly optimistic about c_2. On the other hand, lower saving w_1 triggers more vivid memories of bad times and leads her to become overly pessimistic about c_2. Such diagnostic expectations are based on the representativeness heuristic of probabilistic judgments in psychology (Kahneman and Tversky 1972; Bordalo, Gennaioli, and Shleifer 2018; Bordalo et al. 2020).

In fact, this case is nested by the analysis in Section I: (25) is nested by (4) with $\lambda = -\theta/(2+\theta)$. As a corollary of Proposition 1, future diagnostic expectations lead to higher current MPCs. This result is related to Bianchi, Ilut, and Saijo (2023), which study how diagnostic expectations impact MPCs. In fact, Propositions 5 and 8 in Bianchi, Ilut, and Saijo (2023) show that MPCs under sophistication are higher than MPCs under naïveté. That is, the anticipation of future diagnostic expectations increases the current MPC. Viewed through the lens of my paper, this result arises because diagnostic expectations lead to future mistakes in response to saving changes. However, Bianchi, Ilut, and Saijo (2023) mostly focus on the case of naïveté.

Present Bias.—For present bias, the main high-MPC result in Proposition 2 nests the case with commitment devices—for example, the original Laibson (1997) and Angeletos et al. (2001). In this case, the consumer can put her saving in illiquid assets with costly withdrawals to avoid overconsumption driven by present bias and achieve optimal consumption in the absence of shocks. As a result, (15) holds. On the other hand, in response to shocks, the commitment device no longer prevents her from consuming suboptimally because of costly withdrawals from the illiquid assets. Together, the main high-MPC result applies and Corollary B.6 in online

[19] The case studied here is the "distant memory" $J \geq 2$ case in Bianchi, Ilut, and Saijo (2023). This means that the reference point for diagnostic expectations at $t = 1$ is invariant to outcomes at $t = 0$. In this case, the law of iterated expectations fails under sophistication, leading to a form of perceived dynamic inconsistency. That is, the $t = 0$ self anticipates that $t = 1$ behavior will deviate from what she deems optimal. As discussed previously, this is the key reason why future mistakes lead to higher current MPCs.

Appendix B.7 provides a full formalization. It is worth noting that both Laibson (1997) and Angeletos et al. (2001) study the sophistication case and incorporate the impact of future mistakes. However, these papers focus more on the impact of current present bias on current consumption.

For the case without access to illiquid assets as a commitment device (Barro 1999; Harris and Laibson 2001), present bias introduces both mistakes in response to saving changes (which lead to higher MPCs) and mistakes in overall consumption levels (which lead to the precautionary saving motive). When the utility function is not that concave ($EIS > 1$), the high-MPC channel I focus on in Proposition 2 dominates and future mistakes still unambiguously lead to higher MPCs. When the utility function is very concave ($EIS < 1$), the precautionary saving channel in Proposition 3 may dominate. See Corollary B.7 in online Appendix B.7 for details.

Near-Rationality and Epsilon-Mistakes.—The main mechanism studied in the paper focuses on mistakes in response to saving changes. A natural question is why the consumer may exhibit these mistakes. It turns out that if the consumer starts from a frictionless preshock outcome (15), the utility loss of mistakes in response to saving changes is small, second order. This is the "near-rationality" argument laid out by Cochrane (1989) and Kueng (2018) about the small welfare loss of inefficient responses to shocks.

This near-rationality result implies that the consumer may be prone to "epsilon-mistakes"—that is, stochastic mistakes that do not bias the consumer's response to saving changes in a particular way, such as $\lambda_t \overset{\text{i.i.d.}}{\sim} \mathcal{N}\left(0, \sigma_t^2\right)$ in (16). Corollary B.8 in online Appendix B.8 shows how these stochastic mistakes in response to saving changes increase current MPCs, even though these stochastic mistakes do not lead to on average overreaction or underreaction of future consumption.

An Intrahousehold Interpretation.—My result also accommodates an alternative intrahousehold interpretation. The unitary model of household spending has long been rejected, and it has been widely documented that the wife and husband exhibit different consumption behavior (Thomas 1990; Browning et al. 1994; Anderson and Baland 2002; Duflo 2003; Duflo and Udry 2004; Ashraf 2009). In the intertemporal setting, there is strong evidence that household consumption behavior fluctuates over time (Mazzocco 2007; Lise and Yamada 2019), depending on which spouse has a temporarily higher decision weight. From the lens of my model, this means that future consumption (e.g., determined by the husband) may deviate from what the current consumer (e.g., the wife) deems optimal. She then displays a higher MPC because from her perspective, future consumption will respond inefficiently to saving changes.

An Interpretation Independent of Specific Biases.—Beyond the specific biases studied above, let me provide another interpretation independent of specific biases. From her life experiences, the consumer knows that she has cognitive limitations and her future consumption may not respond efficiently to saving changes. With this knowledge and even without knowledge of the exact future mistakes, the consumer will exhibit a higher current MPC.

V. Conclusion

In this paper, I show how future consumption mistakes in response to saving changes lead to higher current MPCs. This channel is independent of liquidity constraints and helps explain the empirical puzzles on high-liquidity consumers' high MPCs. The main approach, using wedges to capture behavioral mistakes and deriving robust predictions of sophistication independent of the exact psychological cause of these mistakes, can be useful in many other contexts.

The key intermediate step to prove the high-MPC result is to establish the excess concavity of the continuation value function (e.g., Part 1 of Proposition 1). That is, mistakes in response to saving changes make saving changes extra costly. The same excess concavity can help explain other well-known puzzles in intertemporal decisions. For example, future mistakes in response to saving changes lead to higher risk aversion and help explain the equity premium puzzle. To see this, note that a consumer's degree of risk aversion is proportional to the second derivative of her value function, which is its concavity.

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