Windfall Income Shocks with Finite Planning Horizons

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Abstract

I study how the cognitive demands of financial planning shape household decisionmaking with respect to consumption out of windfall income shocks. I build a quantitative model of bounded rationality in which reoptimization is costly. Households respond to windfall income shocks by choosing a finite planning horizon over which to reoptimize, and the optimal planning horizon is increasing in wealth and the magnitude of the income shock. Calibrated to U.S. data, the model's distribution of consumption responses is consistent with three key facts: even highly liquid households have large consumption responses out of income shocks, the fraction of households with positive consumption responses increases with shock size, and conditional on responding, larger shocks generate smaller consumption responses.

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1 Introduction

Standard finance theory assumes households are sophisticated financial planners who maximize lifetime welfare. In reality, however, making financial plans is cognitively demanding. As a result, households routinely behave suboptimally relative to the fully rational benchmark in many domains, including stock market participation (Calvet, Campbell and Sodini, 2007), credit card borrowing (Agarwal, Chomsisengphet, Liu and Souleles, 2015), mortgage refinancing (Agarwal, Rosen and Yao, 2016), and default (Gerardi, Herkenhoff, Ohanian and Willen, 2018).

How do the cognitive demands of financial planning shape household decisionmaking? In this paper, I focus narrowly on the time horizon associated with making financial plans in response to unanticipated windfall income shocks. I develop and calibrate a quantitative model of bounded rationality in which intertemporal reoptimization is costly. In response to a windfall income shock, the household chooses a finite planning horizon over which to reoptimize, trading off the cognitive costs of financial planning relative to the benefits of consumption smoothing. I prove that the optimal horizon is increasing in income, wealth, and the size of the income shock.

The model jointly explains three empirical facts about how households respond to windfall income shocks. First, highly liquid households have large consumption responses that cannot be explained by borrowing constraints. Second, the fraction of households with a positive (non-zero) consumption response to a windfall income shock is increasing in the size of the shock. Third, conditional on a positive consumption response, larger shocks generate smaller consumption responses. These two facts, the positive extensive-margin and negative intensive-margin effects, cannot be explained by smooth and concave consumption functions.

The implications of the model extend beyond explaining only the response to windfall income shocks. Understanding how cognitive demands affect financial planning horizons is crucial for the design of financial products, the provision of financial advice, and the implementation of policies aimed at households. For example, the framework of bounded intertemporal rationality suggests that even wealthier households may benefit from products that reduce planning complexity. More broadly, the model provides a foundation for analyzing how cognitive constraints affect household portfolio choice and consumption decisions across the wealth distribution, complementing standard theories based purely on financial constraints.

I focus specifically on the planning horizon over which financial plans are made. Long planning horizons are important for financial stability and lifetime welfare, especially in

retirement and other important life events (Munnell, Sunden and Taylor, 2001). To study how households respond to windfall income shocks, this paper develops a model of endogenous financial planning horizons. Under full rationality, the response to every income shock, regardless of type or size, induces "infinite horizon" adjustment to lifetime consumption plans. This level of sophistication does not reflect the costs that households face in order to reason and make financial plans deep into the future. With bounded rationality, the response to an income shock includes not only new consumption plans, but an intentional decision regarding the "finite planning horizon" over which to reoptimize and deviate from existing plans.

To model this decision, I propose a new constrained-optimal mechanism: bounded intertemporal rationality (BIR). The mechanism combines two elements of bounded rationality, motivated in Section 2: mental accounting of windfall income shocks and costly reoptimization in response to such shocks. In response to a windfall income shock, the household reoptimizes over an endogenously selected planning horizon, returning afterwards to its original plans. The two-layer model endogenizes the two layers of decision making studied by psychologists, local and global processing, where a longer planning horizon corresponds to more cognitively demanding global processing (Navon, 1977; Forster and Dannenberg, 2010). Small income shocks optimally induce local thinking and less intertemporal smoothing, while large income shocks optimally induce global thinking and more consumption smoothing. In the limiting case, a sufficiently large shock induces lifetime reoptimization, as it would in the standard model.

The key object in the model is the planning cost function. When planning costs are zero, the household will always opt to smooth any income shock over the remainder of its lifetime. This choice is trivial because the marginal benefit of smoothing consumption over an additional period is strictly positive under standard preferences. Introducing planning costs generates a meaningful tradeoff between smoothing and planning, which induces shorter planning horizons. Planning costs represent the cognitive costs to form new plans and any cost to adjust away from existing plans. Thus, relative to no planning costs and full rationality in the standard model, the household in my model exhibits bounded intertemporal rationality.

Taking the model to the data, I calibrate the planning costs using the Generalized Method of Moments and Economic Stimulus Payments (ESPs) in 2008. Consistent with the model, households receiving smaller relatively sized payments had the largest consumption responses. Households in the first tercile received an ESP equal to approximately 11% of monthly income and spent all of it within three months of receipt. Households in this group were, on average, both the highest earners and most wealthy. On

the other hand, households in the third tercile received an ESP equal to roughly half of monthly income and spent only half of it within three months of receipt. These households had the lowest incomes and least liquid wealth, ruling out the standard borrowing constraint explanation.

Using these estimates as targets, I calibrate the planning costs and verify their validity using external data from Gelman (2021). I compare the distribution of consumption responses in the calibrated model to a household with full rationality in similarly calibrated one- and two-asset models to highlight the model's contribution in matching the empirical puzzles described above.

I then use the model as a laboratory to study applications of bounded intertemporal rationality to two real-world settings. First, I show how the fiscal authority can maximize the aggregate consumption response out of stimulus transfers if planning costs are taken as given. Using the actual 2008 stimulus program as a benchmark, reducing payments by \$300 to households in the middle 50% of the income distribution and increasing payments by \$600 to households in the lowest 25% of the income distribution increases the aggregate consumption response by almost 5 p.p. or 17.4%. This increase is driven mainly by smaller stimulus payments to middle-income households who now optimally choose shorter planning horizons.

Second, assuming bounded intertemporal rationality stems at least partially from a lack of financial literacy, I examine the welfare gains of an educational program that decreases planning costs. I show that a reduction in planning costs of 25% is equivalent to increasing windfall stimulus payments by 1.5 pp for constrained households and 2.1 pp for the wealthiest households. Welfare gains are larger for wealthier households because while the marginal utility of consumption is higher for poorer households, the marginal utility of smoothing consumption across additional periods is higher for wealthier households. As a result, while poorer households benefit more from windfall income shocks, it is wealthier households that benefit more from lower planning costs and additional intertemporal smoothing.

Literature This paper adds to a large literature that studies household finance and departures from perfect rationality. Campbell (2006) surveys the literature on household finance and discusses settings in which households make financial decisions that depart from full rationality but can be explained by frictions otherwise ignored in standard finance theory. Focusing on income shocks, Fuchs-Schuendeln and Hassan (2016) survey more than two dozen papers studying the consumption response of income shocks and conclude that "households tend to behave consistently with the Permanent Income Hypothesis when the stakes are high, that is, when dealing with large or repeated changes

in their income," while "for households that are not constrained, near-rationality is a likely candidate to explain their excess sensitivity to small anticipated income changes." I model finite planning horizons induced by reoptimization costs as the friction that generates near-rational behavior consistent with the empirical evidence.

This paper contributes a structural model to the behavioral household finance literature. Structural behavioral models, described in (DellaVigna, 2018), are useful for quantitatively analyzing the welfare costs and benefits of departing from the full rationality benchmark. In particular, with respect to income shocks, Cochrane (1989) shows that the welfare penalty of deviating from fully rational consumption behavior is typically small, motivating bounded rationality as a means of explaining households who set consumption equal to income (i.e., hand-to-mouth households). I focus specifically on bounded rationality with respect to making plans into the future, related to the ideas in Laibson (1997) and Gabaix (2019) that larger discounting of the future can generate larger propensities to consume. Relative to these papers, my contribution is to model the endogenous decision of precisely how much to discount the future, and how this decision can vary across households and depending on the shock.

My analysis on the consumption out of windfall income shocks contributes to a large literature that studies household heterogeneity and the marginal propensity to consume. My contribution is a mechanism that focuses on limits to financial planning instead of limits to borrowing. My mechanism generates large propensities to consume for households along the entire distribution of wealth. This is crucial for generating an aggregate marginal propensity to consume in line with the data, with the ultimate goal of studying the macroeconomic impact of household-level heterogeneity (Krueger, Mitman and Perri, 2016).

Since the aggregate marginal propensity to consume is simply the household consumption response function integrated over the distribution of households, increasing the aggregate response requires changes to one or both of these components. In this paper, I build a model in which the consumption response function varies by choice of planning horizon, and I calibrate the distribution of household wealth to match the data. Several other papers use behavioral mechanisms to change the consumption response function. Lian (2023) develops a general framework that can accommodate a number of behavioral frictions to generate large MPCs. Ilut and Valchev (2022) build a model in which the household is boundedly rational with respect to the endogenous state variables. Their focus is on the complexity of making decisions when, for example, a household receives an unusually large income shock that forces it to deviate from its typical behavior. Instead, I consider windfall income shocks that are non-fungible with typical income shocks and deposited into a separate mental account. As a result, even if the shock is small, households must reoptimize, and I focus on the complexity of this decision with respect to intertemporal substitution.

Most closely related to this paper is Graham and McDowall (Forthcoming), who build a model of mental accounts that nests the standard one-asset model with near-zero MPCs at one extreme and a hand-to-mouth consumption model at the other. My use of mental accounts is only to separate windfall income shocks that require reoptimization from typical income shocks that do not. In their model, preferences over an aversion to saving drives behavior, with higher aversion to saving generating larger MPCs out of any income shock. In my model, the household has standard preferences and chooses the planning horizon taking as given planning costs, and this endogenous decision will cause the MPC to vary depending on the shock.

On the other hand, most of the recent literature on aggregate MPCs features models with elements to directly or indirectly increase the fraction of constrained households. Standard one-asset models, where the MPC is negatively correlated with total net wealth, struggle to match the aggregate MPC and distribution of household wealth. The seminal two-asset model of Kaplan and Violante (2014) matches both the distribution of household wealth by introducing a second illiquid asset and, by generating a larger mass of constrained households with low liquid wealth, a larger aggregate consumption response.¹ Building on these models, behavioral biases can also generate larger shares of constrained households. Present bias, modeled using either hyperbolic discounting (Maxted, Laibson and Moll, 2024) or temptation (Attanasio, Kovacs and Moran, 2024), generates a larger share of liquidity constrained households since illiquidity serves as a form of self-control. In conjunction with the two-asset structure from Kaplan and Violante (2014), these models amplify the impact of borrowing constraints and generate larger aggregate consumption responses. In my model, bounded rationality operates independently of borrowing constraints to generate large consumption responses for highly liquid households.

Outline Section 2 details motivating evidence for the mechanisms underlying the model of bounded intertemporal rationality. Section 3 presents a stylized version of the model to solidify intuition, Section 4 builds the full structural model, and Section 5 calibrates the planning costs that drive the model. Section 6 discusses the model's consumption response function, comparing it to the empirical evidence and other models in this literature. Section discusses the implications for the design of fiscal stimulus programs. Finally,

¹Households with low liquidity may be unable to borrow, or may simply have preferences that generate low levels of liquidity and high propensities to consume (Aguiar, Bils and Boar, 2024; Andreolli and Surico, 2021).

Section 8 concludes and proposes avenues for future research.

2 Motivating Evidence

This section motivates the two key mechanisms in the model: mental accounting and planning costs. Distinct mental accounts for windfall and typical income force the house-hold to reoptimize in response to windfall income shocks. Planning costs, which represent the cognitive demands on financial planning, are the constraint that bound rationality and generate finite planning horizons. Together, these features generate the model of bounded intertemporal rationality developed in the rest of the paper.

2.1 Windfall Income Shocks and Mental Accounting

Windfall income shocks are the focus of large and established literatures in both psychology and economics. They affect household financial behavior in several ways, from stock market participation (Briggs, Cesarini, Lindqvist and Östling, 2021) to debt repayment (Cookson, Gilje and Heimer, 2022) and bankruptcy (Hankins, Hoekstra and Skiba, 2011; Agarwal, Mikhed and Scholnick, 2019). Windfall shocks are distinct from "typical income shocks," which are associated with predictable fluctuations in household income and the focus of a large literature in economics. For example, in seminal work, Blundell, Pistaferri and Preston (2008) study consumption insurance against typical income shocks using longitudinal survey data, while, more recently, Ganong, Jones, Noel, Farrell, Greig and Wheat (2020) use a large panel of household-level microdata to study consumption insurance using instrumented labor demand shocks.

This paper focuses on the distinct mental accounts that households use to separate typical and windfall income (Thaler, 1990). Zhang and Sussman (2018) provide an overview of the literature on the impact of mental accounting on household financial planning in a variety of dimensions. Mental accounting breaks the fungibility of money, i.e., "the notion that money has no labels," and "in the context of the life-cycle theory, the fungibility assumption is what permits all the components of wealth to be collapsed into a single number" (Thaler, 1990). Empirically, Boehm, Fize and Jaravel (2025) implement a randomized experiment that distributed windfall income shocks to French households and conclude that their evidence "rejects standard rational models where agents treat money as fungible." In the model developed in this paper, windfall and typical income are nonfungible. The household has consumption and savings plans over typical income, but those plans cannot be applied to windfall income shocks, which necessitates reoptimization.

Two main criteria constitute a windfall income shock: anticipation and source. Arkes, Joyner, Pezzo, Nash, Siegel-Jacobs and Stone (1994) demonstrate that the unanticipated nature of windfalls is an important part of what separates them from anticipated or typical changes in income. In labeling anticipated shocks as typical or regular income shocks, it is important to note the use of "anticipated" in the economic, not statistical, sense. Statistically, an income shock is anticipated if the household assigns a nonzero probability to its realization. Economically, there are many events that are unanticipated despite having nonzero likelihoods of occurring. One classic example of a windfall income shock is the sudden death of a relative and the associated wealth inheritance. From a technical standpoint, the likelihood of a sudden death and early inheritance is strictly positive, but households neither fully internalize nor make plans for such events. In that sense, the income shock is unanticipated and is labeled as a windfall.

Arkes et al. (1994) and Fogel (1999) present evidence that the source or effort in acquiring additional income is another important determinant of windfall income shocks. They find that earned income is relegated to more utilitarian expenses, while unearned income is spent on more recreational expenses. For example, consider the case where a household earns an additional week of income due to a temporary and unanticipated increase in hours worked or wins a raffle equal to the same amount. In the latter case, the income is treated as a windfall since it is unearned.

Relatedly, the labels used to describe an income shock play a role in how they are mentally accounted for. Epley, Mak and Idson (2006) analyze the framing of tax rebate payments and find that referring to them as "bonuses" increases the propensity to consume, which can be attributed to a change in the way respondents mentally account for the extra income. Beatty, Blow, Crossley and O'Dea (2014) study the UK Winter Fuel Payment, a cash transfer with the label "fuel payment" in its name, and find that almost half of the payment was spent on fuel despite the fact that there was no monitoring or enforcement. The authors suggest this is the behavioral effect of labeling and estimate that only 3% of the payment would have been spent on fuel had there been no labeling effect.

Finally, an anticipated but unearned income shock may also be considered a windfall income shock. Again, the classic example of a windfall income shock is the receipt of a wealth bequest after the expected passing of an elderly or ill relative. Despite the anticipated nature of this shock, households treat the income differently from typical income because of the unusual source. Similarly, payments from the Alaska Permanent Fund may be considered annual windfall income shocks, despite the fact that they are "large, regular, predetermined, and salient payments" (Kueng, 2018).

2.2 Planning Costs and Finite Planning Horizons

The motivation for planning costs and finite planning horizons connects several strands of literature in psychology and economics. Financial planning costs are a modeling device used to reflect the cognitive demands associated with making and implementing financial plans, and the planning horizon is a primary choice of the financial plan that influences all other aspects. Motivated by the evidence, this paper focuses on the implications of connecting planning costs solely to planning horizons, while recognizing that this simplification abstracts from other potentially important determinants of planning costs.

2.2.1 Cognitive Demands of Financial Planning

Bosch-Rosa and Corgnet (2022) survey the burgeoning field of cognitive finance and document the many ways in which financial planning is a cognitively demanding task. With respect to windfall income shocks, there is significant mental effort required to process new information and make decisions (Reis, 2006; Ergin and Sarver, 2010), especially in dealing with unexpected changes in income (Browning and Collado, 2001) and their impact on financial plans and budgets (Ameriks, Caplin and Leahy, 2003). Lynch, Netemeyer, Spiller and Zammit (2010) construct a measure of the "propensity to plan" and assess its psychometric validity through a number of lab experiments. Focusing on financial plans, they show that the propensity to plan varies in both domain and scope, motivating the development of an endogenous propensity to plan. Importantly, cognitive frictions are distinct from other factors that affect household behavior. Enke, Graeber and Oprea (2023) present evidence that behavior induced by cognitive uncertainty is distinct from that induced by preferences, while Bernard (2023) finds that, controlling for liquidity and other observables, cognitive sophistication is an important determinant of consumption behavior.

I label the cognitive demand associated with making consumption and savings plans for windfall income shocks the "planning cost" of responding to the shock. Bounded rationality, developed in the information processing literature, typically imposes a cost on processing signals about an unknown random variable (Sims, 2003). Boundedly rationality has been used to study financial behavior of agents ranging from individual equity market investors (Barber and Odean, 2008) to bidders in U.S. treasury auctions (Goldreich, 2015). In this paper, planning costs impose bounded rationality on households, and this generates significantly different behavior than fully rational households who have unlimited cognition.

2.2.2 Financial Planning Horizons and Planning Costs

A large literature in household finance and psychology focuses on financial planning horizons, defined in the Survey of Consumer Finance as the time period considered most important by the household when making plans. Intuitively, long planning horizons are important for financial stability and lifetime welfare, especially in retirement and other important life events (Munnell et al., 2001). In standard models with full rationality, households reoptimize over their entire lifetimes in response to any shock, yielding "infinite planning horizons." However, a number of studies document "finite planning horizons," i.e., that planning horizons are limited and correlate with factors such as time preferences, age, education, health status, and financial constraints (Fisher and Montalto, 2010; Hong and Hanna, 2014; Streeter, 2021). Hong and Hanna (2014) take this analysis one step further and document that "the financial planning horizon variable is a situational factor rather than measuring a constant time preference." In this paper, planning horizons reflect both, and the optimal horizon depends on the windfall income shock's size relative to the household's income and wealth.

Many of the papers cited earlier that study the consumption response to windfall income shocks also have suggestive evidence of finite planning horizons. Specifically, as opposed to infinite planning horizons and lifetime reoptimization, the consumption response of households to income shocks decays to zero within a short time period. In the US, Parker, Souleles, Johnson and McClelland (2013) estimate that the total consumption response out of stimulus checks in 2008 was 50-90% within three months of receipt, and Gelman (2022) estimates that income tax returns were spent in their entirety within six months of receipt. Fagereng, Holm and Natvik (2021) estimate that the consumption response out of Norwegian lottery winnings decays to zero after four years, and Auclert, Rognlie and Straub (2024) find agreement for this estimate using Italian survey data. Relatedly, Thakral and Tô (2022) refine the coarseness of standard mental accounts for "future" and "current" income by studying the time horizon over which households anticipate receiving windfall income shocks. In addition to using a unique empirical setting to confirm the strong response to windfall income shocks, they provide novel evidence that the strength of the response is negatively correlated with the anticipation horizon.

Boehm et al. (2025) estimate that "the consumption response to stimulus transfers is concentrated early on," and cannot reconcile this finding with standard models, noting that "the MPC response is much more long-lived in HANK and in canonical buffer-stock saving models." Indeed, in standard PIH models, even for a households a with large initial consumption responses, the decay to zero is gradual. In the limiting case of a fully unconstrained household, the income shock is fully annuitized and consumption increases in every remaining period. While alternative structures for time preference, such as present bias, can help explain the front-loaded average consumption response, these mechanisms work through generating a larger mass of constrained households without significantly changing household behavior at a given level of liquid wealth.

The mechanism developed in this paper, bounded intertemporal rationality, takes a specific stance on the propensity to plan by connecting planning costs to planning horizons. As a result, the choice of a longer planning horizon trades off the benefits of additional consumption-smoothing against the cognitive costs of additional planning. This is motivated by empirical evidence from a similar domain in which there is an explicit choice regarding horizon: Gabaix, Laibson, Moloche and Weinberg (2006) and Spears (2012) study environments in which forecasters must choose over how many periods to make costly forecasts, and find that the finite forecasting horizon is chosen to trade off the benefits of reduced uncertainty against the costs of additional forecasting.

3 Illustrative Model of Finite Planning Horizons

Before turning to the full model in the next section, I develop the intuition in an illustrative model of consumption smoothing. Consider first a simple three-period model illustrated in Figure 1. The vertical bars show the upward-sloping income profile of a household that lives for three periods. I assume that preferences and interest rates are such that the household's consumption target is represented by the horizontal line labeled $c_{target,0}$, which is a function of total lifetime income. Actual consumption is given by the solid markers. In the first two periods, the consumption target is greater than income and the household aims to smooth consumption in the current period by borrowing from the future.

In panel (a), I assume the household is financially constrained and cannot borrow. As such, in the first two periods, the household sets consumption equal to income, well below the consumption target. In the final period, the household also consumes all of its income. At the other extreme, in panel (b), I assume the household can borrow without limit. Consumption in each period is equal to the consumption target. In the first two periods, the household borrows from the future to increase consumption above income. As a result, in the final period, consumption is below income. This is the household's optimal lifetime plan for consumption because of its desire to smooth consumption.

Suppose the household receives an unanticipated $\Delta > 0$ income shock. The household reoptimizes to accommodate for the additional income, increasing the consumption target commensurate to $c_{target,1}$. Consider first the constrained household that was not

Figure 1: Consumption Smoothing in Stylized Model



Notes: Illustrative three-period model of consumption smoothing. Vertical bars depict income, dashed lines represent consumption targets, and markers show actual consumption. Black pattern illustrates initial household behavior and red pattern illustrates new behavior after $\epsilon > 0$ income shock in first period.

reaching its initial consumption target. This household opts to consume the entire income shock, bringing it closer to its consumption target in the first period. Because the household is so far from its consumption target in the first period, the benefit from smoothing consumption for one period is greater than the benefit from smoothing consumption for two (or three) periods. Through the lens of my model, the household optimally selects a one-period planning horizon, even before considering the planning costs.

Now consider instead the unconstrained household. Absent planning costs, the marginal propensity to consume is roughly ¹/₃ because the household opts to smooth the income shock equally across every period of its life. In each period, the household again meets its (increased) consumption target. In the first period, because of the income shock, the household borrows less than it previously had. In the second period, the household borrows slightly more and, in the third period, the household consumes slightly more of its income. For the unconstrained household, the benefit from smoothing consumption for three periods is greater than the benefit from smoothing for two periods, which is in turn greater than the benefit from smoothing remain the same but the household selects a shorter horizon since the planning costs are increasing in the horizon.

The intuition for unconstrained households is similar when the household has a flat income profile. To illustrate this, consider another example, in Figure 2, of a household that lives for 10 periods and faces a constant stream of income. The household consumes



Figure 2: Consumption Smoothing in Stylized Model

Notes: Illustrative three-period model of consumption smoothing. Vertical bars depict income, dashed lines represent consumption targets, and markers show actual consumption. Black pattern illustrates initial household behavior and red pattern illustrates new behavior after $\epsilon > 0$ income shock in first period.

its endowment in every period and net saving is zero. Suppose again that the household receives an unanticipated $\Delta > 0$ income shock. Absent planning costs, the household smooths the income shock across every period of its life and its marginal propensity to consume is roughly 1/10 in each period. With planning costs, the household must choose the optimal planning horizon. Table 1 shows the MPCs over time for each choice of planning horizon in this stylized example. Suppose that the household's optimal choice of planning horizon is four periods, or $k^* = 4$. In the period of the shock and the next three periods, consumption increases by 1/4 of the income shock. Beginning in the fifth period, consumption returns to its original level, as-if the shock had never occurred.

The mechanism in this simple model extends directly to the model with $T \leq \infty$ periods, stochastic income, and an occasionally binding borrowing constraint. Constrained households have a desire to smooth consumption by borrowing from the future but are unable to do so; when subject to a positive income shock, they spend a large fraction of it to immediately increase consumption, generating a large marginal propensity to consume. Unconstrained households have a desire to smooth consumption by saving for the future, but planning costs subtract from the benefits of smoothing deep into the future. The household finds it optimal to front-load their consumption of the shock and this gen-

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Horizon, k	Cost	1	2	3	4	5
1	$\phi(1)$	1	0	0	0	0
2	$\phi(2)$	1/2	1/2	0	0	0
3	$\phi(3)$	1/3	1/3	1/3	0	0
4	$\phi(4)$	1/4	$^{1/4}$	$^{1/4}$	1/4	0

Table 1: MPCs with Finite Planning Horizons in Stylized Example

Notes: Stylized example of MPCs and corresponding planning costs for planning horizon $k \in \{0, 1, 2, 3, 4\}$.

erates a larger marginal propensity to consume. The model developed in the rest of this paper will have additional features that bring it closer to the data in other dimensions, but the core mechanism of bounded intertemporal rationality will work exactly as it does in this stylized model.

4 Structural Model of Finite Planning Horizons

Building on the intuition of the illustrative model, this section specifies the full structural model of finite planning horizons. The model consists of two layers. The outer layer is a baseline model of consumption and savings in which the household abides by the Permanent Income Hypothesis (PIH). The household forms state-contingent plans over a stochastic stream of labor income. The household anticipates the potential of unemployment and forms precautionary savings, and it may also have plans for vacations, childbearing, or other large expenses. The inner layer of the model activates when the household faces a completely unanticipated windfall income shock. In response, the household reoptimizes over a finite planning horizon, the length of which is subject to planning costs.

4.1 Baseline Model of Consumption and Saving

I model a household's working life over $T \leq \infty$ periods. The household enjoys consumption, c, and leisure, $\ell = 1 - h$, according to utility function $u(c, \ell)$. The household inelasically supplies a fraction of time, $h \in (0, 1)$, which combines with stochastic productivity, z, to form income, y = zh. Consumption and savings plans, c and s, respectively, are jointly formed to maximize lifetime utility. The household's time preference, λ , determines the discount factor, $\beta = (1 + \lambda)^{-1}$. Financial markets consist of a single bond, s_t , that costs R^{-1} per unit and pays one unit in the next period. In this environment, the household chooses state-contingent streams of consumption and saving to maximize expected lifetime utility,

$$E_0 \sum_{t=0}^T \beta^t u(c_t, \ell),$$

subject to the budget constraint that consumption and saving sum to income and wealth,

$$c_t + R^{-1}s_t = y_t + w_t,$$

and the exogenous borrowing constraint, $s_t \ge -\underline{b}$.

The household's problem can be written recursively as

$$V_t(w, y) = \max_{c_t(w, y), s_t(w, y)} u(c_t(w, y), \ell) + \beta E_t V_{t+1}(w', y'),$$

with income exogenously specified. Given the budget and borrowing constraints, wealth evolves according to the policy function for saving,

$$w' = s_t(w, y) = R(y_t + w_t - c_t(w, y)) \ge -\underline{\mathbf{b}}.$$

4.2 Windfall Income Shocks

In this section, I model the household's response to a windfall income shock. While abiding by its lifecycle plans, which may account for some stochasticity of income, the household may be subject to a windfall income shock. In response, the household reoptimizes and forms short-term plans to accommodate for the income shock. I model the household's joint choice of the planning horizon, consumption plan, and savings plan, subject to bounded intertemporal rationality on the household in the form of planning costs that are increasing in the planning horizon. As such, the household still aims to smooth the windfall income shock over many periods, but only up to a limit determined by the tradeoff between the benefits of intertemporal smoothing and the planning costs.

Formally, suppose that in some period *t*, the household learns of an income shock path,

$$\boldsymbol{\Delta} = \{\Delta_t, \Delta_{t+1}, \dots, \Delta_{t+N_{\Delta}-1}\}$$

The income shock lasts for N_{Δ} periods (including period *t*) and is perfectly anticipated once the household initially learns of it. In response, the household chooses both the length of the reoptimization horizon, *k*, and new state-contingent consumption and sav-

ings plans in each of those periods to maximize its expected lifetime utility:

$$\max_{\{k,c_{\tau},s_{\tau}\}_{\tau=t}^{t+k-1}} E_t \left\{ u(c_t, \ell - \Phi(k)) + \sum_{\tau=t+1}^{t+k-1} \beta^{\tau-t} u(c_{\tau}, \ell) + \sum_{q=t+k}^{T} \beta^{q-t} u(c_q, \ell) \right\},\$$

subject to periodic budget constraints and the total borrowing constraint. The household chooses new plans over the k periods of the reoptimization horizon, represented by the first two terms of this expression. The difference between the first and second terms are the planning costs, $\Phi(k)$, that are fully paid in the first period of the reoptimization. These planning costs depend exclusively on the length of the endogenous planning horizon, k.

I assume that the entire income shock is expended over the planning horizon and that the household returns to its original plans after completion of the planning horizon. This is in line with the motivating evidence regarding the short window over which income shocks are spent (Gelman, 2022; Fagereng et al., 2021; Gelman, 2021). As such, in the third term, which includes the periods after the planning horizon, $q \ge t+k$, the household uses the consumption and savings plans it had previously formed. In reality, income shocks are likely not expended exactly over a finite planning horizon, but this assumption makes the model technically tractable without limiting the qualitative mechanism.

The household's problem consists of jointly choosing a discrete planning horizon, k, and new consumption and savings plans over the planning horizon. In the next two sections, I separate the household's reoptimization into two subproblems and describe each in more detail: first, the choice of the optimal planning horizon, and second, for a given horizon, the choice of consumption and savings plans. I assume that the household is subject to a one-period positive income shock, $\Delta > 0$. The exposition can easily be extended to multi-period positive or negative shocks.

4.2.1 Optimal Planning Horizon

Let $k_t^*(\Delta; w, y)$ denote the optimal planning horizon for a household at time *t* with wealth *w*, income *y*, and facing windfall income shock Δ . The optimal horizon depends on both the characteristics of the shock (Proposition 1) and those of the household (Proposition 2).

Proposition 1: Optimal Planning Horizon and Shock Size. If $\Delta' > \Delta$, then $k_t^*(\Delta'; w, y) \ge k_t^*(\Delta; w, y)$.

Proposition 1 states that the optimal planning horizon is increasing in the size of the shock. Proofs of both propositions are in Appendix A. Intuitively, the benefit of consumption smoothing increases with the size of the income shock. The proof leverages a lemma

which shows that for a given level of wealth, the marginal value of a windfall income shock is larger for longer planning horizons. Therefore, if the optimal planning horizon for a small shock is k, then for a larger shock, it will always be at least as beneficial to smooth for that many periods and pay the same planning cost. This establishes the weak inequality in Proposition 1. If the larger shock is sufficiently large, then it will be worth extending the planning horizon and paying a larger planning cost, which is the strict inequality in Proposition 1. The proof of this proposition depends on the assumption that planning costs depend only on the length of the planning horizon, and I discuss the implications of this simplifying assumption in Section 2.2.

Proposition 2: Optimal Planning Horizon and Household Characteristics. If w' > w or y' > y, then $k_t^*(\Delta; w', y') \ge k_t^*(\Delta; w, y)$.

Proposition 2 states that the optimal planning horizon is increasing in the household's wealth. This proposition builds on the fact that the benefits of consumption smoothing over additional periods are increasing in the household's wealth. Using a lemma which shows that for a given windfall income shock, the marginal value of wealth is larger for longer planning horizons, the proof builds on the intuition that wealthier households benefit more from additional consumption smoothing. Poorer households have lower consumption and higher marginal utility, and therefore benefit more from additional consumption, poorer households therefore prefer a more frontloaded consumption plan relative to wealthier households who have lower marginal utility in a given period and would prefer to smooth across additional periods. As a result, wealthier households will optimally select a longer planning horizon than a poorer household will for a given income shock.

This derives directly from the household's assumed prudence; that is, it derives from the convexity of the marginal utility function (Kimball, 1990). Intuitively, wealthier households have higher consumption and lower marginal utility. It benefits them more to increase consumption marginally over many future periods than to increase consumption by the same total amount but over fewer periods. As the household's wealth and consumption decrease, its marginal utility increases and its returns to smoothing consumption further into the future decrease. Alternatively, one can frame the household with higher wealth as being relatively more patient and, therefore, deriving additional benefits from consumption in later periods relative to a poorer and less-patient household.

4.2.2 Windfall Consumption and Savings Plans

For a given planning horizon k, the household must reoptimize from periods t to t+k-1. Letting $\tau = t+s-1$ corresponds to period s of the reoptimization horizon, the household's problem in periods $s \in \{1, 2, ..., k-1\}$ can be written recursively as:

$$V^k_{\tau}(w, y, \Delta) = \max_{c^k_{\tau}(\cdot), s^k_{\tau}(\cdot)} u(c^k_{\tau}(w, y, \Delta), \ell^k_{\tau}) + \beta E_{\tau} V^k_{\tau+1}(w', y', \Delta').$$

The reoptimization in the final period of the horizon, s = k, is different and will be discussed in the next section. In only the first period of the reoptimization, the planning cost is taken out of leisure time:

$$\ell_{\tau}^{k} = \begin{cases} \ell - \Phi(k) & \text{ if } s = 1, \\ \ell & \text{ otherwise.} \end{cases}$$

As before, the household maximizes subject to the exogenous borrowing constraint, $s_t^k(w, y, \Delta) \ge -\underline{b}$, and the budget constraint

$$c_t^k(w, y, \Delta) + R^{-1} s_t^k(w, y, \Delta) = y + w + \Delta.$$

The key difference between this set of value functions and the value functions from the outer layer, $V_t(w, y)$, is the additional state variable, Δ , that represents windfalls. As the budget constraint makes clear, wealth and windfalls are transactionally equivalent; instead, the state variables represent two distinct mental accounts for regular wealth, w, and windfalls, Δ .

The mental account for wealth evolves according to the policy functions that the household constructed prior to receiving the income shock, $w' = y' + s_t(w, y)$. The wind-fall mental account evolves as the residual saving induced during the reoptimization:

$$\Delta' = s_t^k(w, y, \Delta) - s_t(w, y).$$

Altogether, the household keeps track of the windfall in a separate mental account, while regular wealth evolves exactly as it would have had there been no windfall income shock.

Final Period of Reoptimization The final period of the planning horizon bridges the short-term reoptimization back to the household's original consumption and savings plans. The policy functions in this period follow directly from assuming that the entire windfall income shock is spent over the finite planning horizon. This implies that

the household consumes the entire balance of the windfall mental account, Δ , and saves nothing into the future windfall mental account, $\Delta' = 0$. Therefore, in period t + k - 1, consumption and saving are given by:

$$c_{t+k-1}^k(w, y, \Delta) = c_t(w, y) + \Delta.$$

$$s_{t+k-1}^k(w, y, \Delta) = s_t(w, y).$$

The household's value in the final period of the reoptimization is given by:

$$V_{t+k-1}^{k}(w, y, \Delta) = u(c_{t+k-1}(w, y) + \Delta) + \beta E_{t+k} V_{t+k}(s_{t+k-1}(w, y), y')$$

Since the household no longer has any windfall and is returning to its original plans, it evaluates the future using the original value function over only regular income, $V_{t+k}(w, y)$.

5 Calibration

In this section, I bring the model to the data in two steps. After introducing two important quantitative features, I first calibrate the model's external parameters using standard values from the literature. I then use estimates of the consumption response to the Economic Stimulus Act of 2008 to calibrate the reoptimization costs in the model which drive bounded intertemporal rationality. For external validity, I show that behavior in the calibrated model is comparable to empirical estimates from Gelman (2022), an unrelated study of a separate form of windfall income shocks.

5.1 Quantitative Model Extensions

I enrich the model with three additional features that are important quantitatively but do not qualitatively affect the main mechanisms driving bounded intertemporal rationality.

Epstein-Zin Preferences I use Epstein-Zin preferences to separate the roles of risk aversion and the elasticity of intertemporal substitution (EIS). Following Rudebusch and Swanson (2012), I use the following form of recursive preferences:

$$V_t(x) = \max_{c_t(\cdot), s_t(\cdot)} u(c_t(x), \ell) + \beta E_t(V_{t+1}(x')^{1-\alpha})^{\frac{1}{1-\alpha}}.$$

This formulation of recursive preferences is chosen since the kernel for utility includes both consumption and leisure. When $\alpha = 0$, risk aversion and the EIS are inversely related, while a choice of $\alpha > 0$ can yield any combination of risk aversion and EIS. Correctly calibrating the degree of risk aversion is important for generating realistic precautionary saving. As noted by Olafsson and Pagel (2018) and Gelman (2021), and discussed extensively by Aguiar et al. (2024), correctly calibrating the elasticity of intertemporal substitution is crucial for discussion of the marginal propensity to consume. Regardless of financial constraints, a preference for less intertemporal substitution generates a high propensity to consume and less liquid wealth. If low liquid wealth is used as a proxy for financial constraints, then a researcher may attribute the high propensity to consume to financial constraints, when consumption decisions are based solely on preferences. By separating risk aversion from the intertemporal elasticity of substitution, the model can generate realistic precautionary savings and marginal propensities to consume.

I assume standard separable preferences between consumption and leisure:

$$u(c, \ell) = \frac{c^{1-\gamma}}{1-\gamma} + \frac{\ell^{1+\chi}}{1+\chi}.$$

In line with this literature and my focus on consumption-savings plans, I assume that when making long-term plans, the household inelastically supplies a fraction of its unitary time endowment to labor, h. Leisure is fixed to $\ell = 1 - h$ and the leisure component of utility is irrelevant for the maximization of long-term utility. As such, I do not need to calibrate either the Frisch elasticity of labor supply, χ^{-1} , or fraction of hours worked, h, to solve the long-term problem. However, in forming short-run plans, the household must allocate its time between leisure, labor, and forming plans, and the choice of leisure is endogenous. I will discuss in Section 5.3.3 my choice to calibrate the leisure component of utility nonparametrically in order to avoid taking a stand on preferences over leisure.

Differential Saving and Borrowing Rates To further aid in generating a realistic distribution of liquid wealth, I assume that households save and borrow at different rates. Between both mental accounts, if the household is a net borrower, the interest rate is r_{borrow} , and if the household is a net saver, the interest rate is r_{save} .

Default Planning Horizon I modify the optimal horizon selection process to allow for a zero-period planning horizon that is the first choice considered by the household in its optimization framework. This choice is not without loss and generates behavior consistent with the empirical fact that households report an inactivity region for smaller positive income shocks, that is, the positive extensive margin effect (Hsieh, 2003; Kueng, 2018; Fagereng et al., 2021; Fuster, Kaplan and Zafar, 2021).

With a zero-period planning horizon, the household ignores the shock and freely disposes of it, yielding a marginal benefit of zero. The planning cost is set to zero, $\Phi(0) = 0$,

yielding a zero net benefit when the shock is ignored. I label the zero-period horizon as the default behavior because this is the first horizon considered and, if chosen, the household's consumption and saving plans do not change. Propositions 1 and 2 imply that this structure will yield an inactivity region below some size threshold that is increasing in the household's wealth. The size threshold will depend on the calibration for the one-period planning cost. If the one-period planning cost is sufficiently small, then it is never optimal to dispose of the shock and there will be no inactivity region.

5.2 External Calibration

Income Households in the model receive monthly income according to a discretized AR(1) process. Gelman (2021) uses monthly transaction-level data for a long panel of households to separate permanent and temporary fluctuations in income. I use his estimates of:

$$y_{it} = (1 - \rho)\mu_y + \rho_y y_{i,t-1} + \sigma_y \epsilon_{it},$$

in which $(\rho_u, \mu_u, \sigma_u) = (0.883, 0.096, \sqrt{0.039})^2$

Preferences Following Kaplan and Violante (2014), I set the annualized discount factor to 0.941, which is similar to the estimated annualized discount factor of 0.935 in Gelman (2021). I also set the coefficient of (constant) relative risk aversion to 4 and the elasticity of intertemporal substitution to 1/2.

Aguiar et al. (2024) demonstrate that households with high marginal propensities to consume also have high average propensities to consume, implying that their behavior may be driven by preferences in addition to liquidity constraints, and the authors suggest a different calibration for the elasticity of intertemporal substitution. In my baseline specification of the model, I use the same calibration as Kaplan and Violante (2014) to facilitate a comparison. In an alternate specification using the calibration in Aguiar et al. (2024), all households indeed have larger marginal propensities to consume, but the planning mechanism in my model remains crucial for generating a realistic relationship between the propensity to consume and wealth.

Financial Markets Using Table H.15 from the Federal Reserve Board, I calculate that the annualized interest rate on a 3-month certificate of deposit in 2007 was 2.73% and use this as the interest rate for savings. According to the Survey of Consumer Finances, the median interest rate on credit cards was 9.10% and the median credit card borrowing

²For more details on the procedure he uses to reach these estimates, see Section 3.3.3 of Gelman (2021).

Parameter	Description	Value	Source				
	Regular Incom	e Process	1				
$ ho_y$	Persistence	0.096	Gelman (2021)				
μ_y	Unconditional Mean	0.883	Gelman (2021)				
σ_y^2	Variance	0.039	Gelman (2021)				
Preferences							
β	Annualized Time Preference	0.941	Kaplan and Violante (2014)				
γ	Risk Aversion	4	Kaplan and Violante (2014)				
	Elasticity of Intertemporal Substitution	1/2	Kaplan and Violante (2014)				
Financial Markets							
r_a	Annualized Saving Rate	2.73%	Federal Reserve Board				
r_d	Annualized Borrowing Rate	9.10%	Survey of Consumer Finances (2007)				
<u>a</u>	Borrowing Limit (\times monthly income)	1.51	Survey of Consumer Finances (2007)				

Table 2: Summary of Long-Term Model Parameters

Notes: Summary of the calibrated parameters governing dynamics of outer long-term layer of model.

limit was 1.51 times monthly income. I use these as values for the annualized interest rate on borrowing and the borrowing limit, respectively.

Table 2 summarizes the parameters governing the model's long-term plan layer. Figure 3 plots the stationary distribution of wealth in the long-term model compared to the distribution of liquid wealth from the 2007 Survey of Consumer Finances. Given its parsimony, the model does a fairly good job of fitting the distribution. By construction, the minimal value of wealth in the model is $-1.51 \times$ monthly income, but approximately 10% of households in the Survey of Consumer Finance reported liquid wealth of less than this amount. Similarly, the model is unable to capture roughly the top 10% of the liquid wealth distribution. The model also does not attempt to replicate the mass of households that report holding zero wealth. Despite all of this, the average level of wealth in the model is approximately 0.59× monthly income, which is approximately the average level of wealth in the lower and upper 10% of the distribution are excluded.

5.3 Internal Calibration: Planning Costs

Planning costs are the key driver of the household's short-term response to windfall income shocks. I calibrate the planning cost function, $\Phi(k)$, using the Generalized Method of Moments and the consumption response of households to Economic Stimulus Payments in 2008.





Notes: In blue, histogram of liquid wealth to monthly income in the data, censored from below at -1.51, the borrowing constraint in the model, and from above. Black line shows the stationary distribution of liquid wealth to monthly income in the model. Vertical lines depict the average level of liquid wealth to monthly income in the data and model.

5.3.1 Planning Cost Function

I model the planning costs as a draw on the household's limited time endowment, drawing away from leisure in order to exert effort in making new consumption and savings plans. Each household is endowed with a unit of time that is initially (exogenously) divided between leisure, ℓ , and labor, h. Planning costs are represented as a function, $\phi(k)$, which depends on the length of the planning horizon, k. Households derive utility from leisure, and planning costs subtract from leisure:

$$\ell = 1 - h - \phi(k).$$

In my analysis, I assume that the leisure cost of forming plans depends only on the length of the planning horizon, *k*. This assumption is akin to focusing exclusively on the extensive margin of forming plans over a specified horizon. However, both the extensive and intensive margins of planning likely depend on the characteristics of the household, such as preferences or budgeting ability (Ameriks et al., 2003), and the characteristics of the shock, such as its size. I abstract from these factors because I will be unable to account for them in the calibration.

This simplifying assumption is relied upon in the proofs to Propositions 1 and 2, which, respectively, study the optimal horizon as the characteristics of the household (i.e., wealth) and the shock (i.e., size) vary. If planning costs varied with either one, then I would require additional assumptions or restrictions for these proofs. The weakest restriction I must make for the main mechanism to remain intact is that high-wealth unconstrained households face planning costs sufficiently high that their optimal planning horizons are shorter than those of households in the standard model. Given that planning costs are zero in the standard model, this requires assuming that high-wealth households face positive planning costs for all shocks. This is a reasonable assumption since although it may or may not be that high-wealth households have an inherent ability for financial planning, the opportunity cost of leisure is increasing in wealth and, thus, planning costs for even high-wealth households are likely net positive.

5.3.2 Empirical Target: The Economic Stimulus Act of 2008

The Economic Stimulus Act of 2008 transferred almost \$100 billion directly into the pockets of households. Economic Stimulus Payments (ESPs) ranged from \$300 to \$600 per adult, depending on income, and additional payments were made to households with dependents. Parker et al. (2013) use the 2008 wave of the Survey of Consumer Expenditure to estimate that households increased non-durable spending by between 12 and 30 percent of the ESP within three months of receipt. They find that low-income households spent the largest fraction of their ESPs but high-income households spent nearly as much. Reflecting holdings of wealth, they find some relationship between age and homeownership.³ Shapiro and Slemrod (2009) use an insert in the University of Michigan's Survey of Consumers to ask households whether they used the majority of their ESPs to increase

³Lewis, Melcangi and Pilossoph (2021) propose a novel econometric method to study the relationship between household characteristics and the MPC. In their model, instead of *ex ante* grouping households by a given characteristic, they optimally weight households into various groups to maximize model fit. This allows the data to *ex post* reveal underlying patterns between household characteristics and the MPC. Their main findings are that households with high income and/or mortgages have larger MPCs and that households' MPCs and average propensities to consume are related.

spending, increase savings, or repay debt. Approximately 20% of households responded that they used the majority of the rebate to increase spending. High-income households most frequently reported that they would spend the majority of their ESPs, but again, the differences between the income groups were small.

Overall, evidence from both revealed and reported preferences suggests violations of the standard PIH model. Borrowing constraints may be part of the explanation, but still cannot account for high propensities to consume of households with high income and/or liquid wealth that are traditionally believed to be financially unconstrained. In Appendix C, I show that the presence of hand-to-mouth households defined in Kaplan and Violante (2014) and Kaplan, Violante and Weidner (2014) increases the number of constrained households theoretically and empirically, but, again, cannot account for high propensities to consume for the remaining and presumably unconstrained households.

Economic Stimulus Payments as Windfall Income Shocks I use the consumption responses of households to ESPs to calibrate the model of short-run plans formed over windfall income shocks. Following the discussion in Section 2.1, the ESPs meet the criteria to be considered windfall income shocks. These direct payments to households were unanticipated, unearned, and explicitly labelled as "stimulus" payments.

Economic Stimulus Payments moved from idea to implementation in roughly three months, leaving little time for households to anticipate and incorporate them into their lifecycle plans. Economic Stimulus Payments were suggested by Federal Reserve Chairman Ben Bernanke in a January 17, 2008, speech before the U.S. House of Representatives. Less than one month later, the Economic Stimulus Act was signed into law, and the first payments were distributed in April 2008, less than two months later.

The IRS distributed payments to all households below certain income thresholds, requiring no opt-in or even knowledge of the program. In his speech, Bernanke suggested that the goals of fiscal policy should be "maximizing the amount of near-term stimulus" and "explicitly temporary . . . to avoid unwanted stimulus beyond the near-term horizon." The resulting fiscal transfers were explicitly labelled Economic Stimulus Payments and were clearly structured as one-time payments.⁴

Sorting Households by Relative Payment Size Payments from the Economic Stimulus Act of 2008 were made to households with joint income of up to \$150,000, almost three

⁴This fiscal program was designed as a stimulus program in the traditional sense: direct payments intended to prop up the economy and avoid a recession. In contrast, for example, Economic Impact Payments distributed in 2020 as part of the CARES Act were distributed after the pandemic-induced lockdown had began. These, and a second round of transfers in early 2021, were more akin to insurance payments than stimulus.

times median annual income in the United States.⁵ In this section, I present motivating evidence consistent with my model's prediction that smaller relative income shocks induce less intertemporal smoothing and therefore higher MPCs. I construct Relative ESP by dividing the ESP into either monthly income or cash-on-hand, defined as the sum of monthly income and liquid assets.

The distribution of relative ESPs is driven by variation in both income and ESPs, which may vary due to non-income factors such as household composition. This is an important feature of the data because in the model, the consumption response is driven by both the size of the shock and the household's income and wealth. In Kueng (2018), which also studies the relation between the consumption response and the household's characteristics, every household receives the same dividend payment.

Evidence from the Survey of Consumer Expenditures. The 2008 wave of the Survey of Consumer Expenditures asked respondents about the ESP. I use the publicly available Parker et al. (2013) dataset which aggregates responses to the household level. The dataset includes all households in the Survey of Consumer Expenditures that received exactly one ESP. The authors note the data reliability issues with respect to both income and, especially, liquid assets, which roughly half of households in the sample do not report. For more details on how the data is constructed, see Appendix C of Parker et al. (2013).

I divide households into terciles by relative ESP and present summary statistics in Table 3 for the relative ESP, the ESP amount, monthly income, and liquid assets. By construction, the median relative ESP is increasing by tercile, from 12% of monthly income for the first tercile to 41% of monthly income for the third tercile. Households in the first tercile have the smallest ESPs and most income and liquid assets, followed by households in the second tercile, then households in the third tercile. Using income and liquidity as standard proxies for borrowing constraints, households in the first tercile are those least likely to be financially constrained.

Specifically, households in the first tercile received an average ESP of \$803, this group's average monthly income was \$7,862, and both average values were close to their medians. The average level of liquid assets for these households was \$14,127, but the distribution was highly skewed, and the median level of liquid assets was \$5,788. Relative to the first tercile, households in the second tercile had, on average, larger ESPs of \$1,023, less monthly income of \$4,778, and less liquid assets of \$11,750. Households in the third tercile of the relative ESP had the largest ESP payments of \$1,048, the smallest monthly incomes of \$2,398, and the smallest level of liquid assets was much less than the average.

⁵Median (nominal) income was \$52,397 in the 2007 Survey of Consumer Finances.

		Mean	Std. Dev.	25^{th} Perc.	Median	75^{th} Perc.
	Rel. ESP	0.109	0.036	0.084	0.115	0.138
Т1	ESP Amount	803	413	600	600	1,200
11	Monthly Inc.	7,862	3,903	4,681	7,507	10,310
	Liquid Assets	14,127	21,409	1,600	5,788	17,000
	Rel. ESP	0.218	0.034	0.189	0.212	0.245
тэ	ESP Amount	1,023	495	600	1,200	1,200
12	Monthly Inc.	4,778	2,360	2,833	4,583	6,393
	Liquid Assets	11,750	23,393	500	2,706	10,000
	Rel. ESP	1.187	10.302	0.334	0.405	0.560
тo	ESP Amount	1,048	575	600	1,030	1,200
13	Monthly Inc.	2,398	1,536	1,250	2,000	3,388
	Liquid Assets	5,652	15,169	5	900	4,200

Table 3: CEX Terciles of ESP to Monthly Inc.

Notes: Summary statistics for households receiving exactly one ESP and reporting annual income, which is divided by 12 to yield monthly income. See Appendix C of Parker et al. (2013) for more details on how the sample was constructed.

To estimate the propensity to consume out of the ESP, Parker et al. (2013) regress changes in consumption on the amount of the ESP:

$$\Delta c_{it} = \alpha + \beta \cdot ESP_{it} + \delta \cdot z_{it} + \gamma_t + u_{it},$$

where Δc_{it} is the measured change in consumption for household *i* between *t* and *t* - 1, ESP_{it} is the Economic Stimulus Payment at *t* for household *i*, z_{it} contains changes in family demographics, such as the number of children and adults, and γ_t is a monthly fixed effect. The coefficient of interest is β , which measures the propensity to spend out of the ESP in the same month of receipt.

The effect of the stimulus is identified by exploiting the randomized timing of ESP receipts among the non-random sample of households selected to receive these payments. Specifically, households received ESPs (either by check or direct deposit) based on the last two digits of their Social Security Numbers. To identify the causal impact of the ESPs on consumption, I compare consumption at t of households that received their ESPs at t against the consumption of households at t that received their ESPs at $t' \neq t$.

To measure the differential effect across relative ESP terciles, I interact the ESP amount

with the relative ESP tercile:

$$\Delta c_{it} = \alpha + \beta_1 \cdot ESP_{it} + \sum_{j=2}^3 \beta_j \cdot ESP_{it} \times 1\{\text{Tercile } j\}_{it} + \delta \cdot z_{it} + \gamma_t + u_{it}$$

I instrument for the ESP amount (and interactions) using an indicator for households that received a payment and estimate the regression equation using 2SLS. Standard errors are clustered by household. The estimated coefficients are presented in Table 4.

	(a) No	n-Durables	(b) l	Durables	(c) Total
	Estimate	Implied MPC	Estimate	Implied MPC	Estimate	Implied MPC
ESP (Base: Tercile 1)	0	0.347** (0.168)	(0.715 0.537)	1	1.062* 0.576)
$ESP \times Tercile 2$	-0.137	0.210*	-0.081	0.634	-0.217	0.845**
	(0.138)	(0.120)	(0.423)	(0.392)	(0.456)	(0.424)
$ESP \times Tercile 3$	-0.232*	0.115	-0.260	0.455	-0.492	0.569
	(0.136)	(0.109)	(0.424)	(0.347)	(0.454)	(0.368)
Observations R^2		8,592 0.018		8,592 0.005		8,592 0.007

Table 4: Spending Response of Consumption to Economic Stimulus Payments

Notes: Standard errors in parentheses. *, **, *** denote significance at the 0.10, 0.05, and 0.01 levels under the assumption of a single test. Estimated using two stages least squares and instrumenting for ESP amount with an indicator for ESP receipt. See Parker et al. (2013) for more details.

Consistent with the model, the estimated marginal propensity to consume is decreasing in the relative ESP tercile for all measures of consumption. For reference, pooling all terciles together and estimating the baseline regression for nondurable consumption from Parker et al. (2013), the estimated MPC is 0.308. Sorted by relative ESP constructed using monthly income, the implied MPC for the first tercile is 0.347. The implied MPC for the second tercile is 0.210, which is statistically significant at less than the 5% level, but not statistically different from the implied MPC for the first tercile. The implied MPC for the largest tercile is 0.115, which is not statistically different from zero, but is statistically different from the estimated MPC for the third tercile. A similar pattern emerges for both durable and total consumption, although the estimates are less precise.

Robustness These results suggest that relative ESP size, which takes into account the characteristics of the shock relative to those of the household, is an important determinant of the spending response. From Table 3, the standard deviations of both ESP amount and monthly income are large, and both drive variation in the relative ESP. To ensure this is the case, I calibrate the model with households sorted into terciles by income and by

¹/Income, which is equivalent to assuming that the ESP is constant across households. The results are reported in Appendix B. In both cases, the patterns estimated above for relative ESP disappear. The estimates are largest for the low- and high-income groups, which is consistent with a similar estimation by income in Parker et al. (2013). The Appendix also shows that the estimates above are robust to other specifications of the household-level controls, z_{it} .

The 2008 Consumer Expenditure Survey has limited data on liquid wealth due to high nonresponse rates. In unreported results, I construct relative ESP using "cash-on-hand" defined as the sum of monthly income and liquid assets, and the patterns are largely the same as in Table : average ESP is increasing in terciles, average income is decreasing, and liquid assets are decreasing. The primary difference is that the average relative ESP in each group is much smaller than when the relative ESP is defined using only income in the denominator. In Parker et al. (2013), the estimated consumption responses sorted by liquid wealth are imprecise, and this remains the case when households are sorted by ESP relative to liquid wealth. Using more high-quality data, however, Fagereng et al. (2021) are able to precisely estimate consumption responses for a double-sort by liquidity and shock size. Consistent with the model, they find that conditional on shock size, the consumption response is decreasing in total liquid wealth, and conditional on total liquid wealth, the consumption response is decreasing in shock size.

5.3.3 Generalized Method of Moments

Using the Generalized Method of Moments, I target the estimated propensities to consume in the regressions above. Since the model is monthly and the CEX estimates of consumption are over three-month periods, I target the cumulative MPC over three months in my model. In total, there are six targets for the MPCs, corresponding to a linear interpolation between the three estimates above.

The median and maximum relative ESPs in the first tercile are 11% and 16% of monthly income, respectively, and are targeted to yield cumulative MPCs of 0.347 and 0.279, respectively. The median and maximum relative ESPs in the second tercile are 21% and 28% of monthly income and are targeted to cumulative MPCs of 0.210 and 0.163. In the final tercile, I use the median and 75th percentile, which are 40% and 54% of monthly income. These are targeted to yield cumulative MPCs of 0.115 and 0.057. The six targets are summarized in Panel A of Table 5.

The household's liquid wealth level in the model is an important determinant of its MPC and therefore is extremely relevant for the calibration procedure. Unfortunately, the 2008 wave of the CEX surveyed households on their liquid assets but did not ask

about their liquid debt (i.e., unsecured credit card debt). Instead, I use data on liquid wealth from the Survey of Consumer Finances, merged to the CEX using monthly income profiles. See Appendix F for more details.

Table 5: Summary of Parameter Values (External Estimates and Calibrations)

#	Descr	Target	Model	
1	3M MPC for $\Delta = 0.11y$	(50 th Percentile of T1)	0.347	0.336
2	3M MPC for $\Delta = 0.16y$	$(100^{th}$ Percentile of T1)	0.279	0.277
3	3M MPC for $\Delta = 0.21y$	(50 th Percentile of T2)	0.210	0.207
4	3M MPC for $\Delta = 0.28y$	$(100^{th}$ Percentile of T2)	0.163	0.156
5	3M MPC for $\Delta = 0.40y$	(50 th Percentile of T3)	0.115	0.115
6	3M MPC for $\Delta = 0.56y$	(75 th Percentile of T3)	0.057	0.103

(a) GMM Targets

Notes: Calibration targets for GMM. Distribution of shock sizes, Δ , and three-month marginal propensities to consume (3M MPCs) are estimated from Economic Stimulus Payments in 2008 (see Section 5.3.2).

(b) External Validation

	$\Delta = 0.33y$		$\Delta =$	0.45y	$\Delta =$	$\Delta = 0.58y$		
	Data	Model	Data	Model	Data	Model		
t = 1	0.083	0.057	0.059	0.042	0.038	0.034		
t = 2	0.144	0.113	0.110	0.084	0.075	0.068		
t = 3	0.173	0.167	0.138	0.125	0.096	0.101		

Notes: Out-of-sample test for external validity of the calibrated planning costs. Data columns contain estimates from Gelman (2021) of the one-, two-, and three-month cumulative marginal propensity to consume out of positive income shocks equal to 33%, 45%, and 58% of monthly income, respectively. Model columns contain marginal propensities to consume in calibrated model.

Implementing the Generalized Method of Moments For each target $n \in \{1, 2, ..., N_{GMM}\}$, I find the planning horizon in the model, k_n^* , that yields the closest cumulative MPC. For each target n, let $V_n(k, \Phi(k))$ denote the value from choosing horizon k and paying planning cost $\Phi(k)$:

$$V_n(k,\Phi(k)) \equiv \max_{\{c_{\tau},s_{\tau}\}_{\tau=t}^{t+k-1}} E_t \left\{ u(c_t,\ell-\Phi(k)) + \sum_{\tau=t+1}^{t+k-1} \beta^{\tau-t} u(c_{\tau},\ell) + \beta^k V_{t+k} \right\}.$$

In the calibration procedure, I truncate the household's problem so that it considers up to \bar{k} options when determining its optimal planning horizon. This large truncation value is

chosen such that it will never be binding and the calibration results are not sensitive to *k*.

The utility function is separable between consumption and leisure. In the GMM procedure, I replace the term containing leisure with a scalar, $1 - \theta(k)$:

$$u(c, \ell - \Phi(k)) = \frac{c^{1-\gamma}}{1-\gamma} + \frac{(1-h-\Phi(k))^{1+\chi}}{1+\chi} = \frac{c^{1-\gamma}}{1-\gamma} + (1-\theta(k)),$$

where I use leisure and hours worked, h, and the planning cost must sum to the unit time endowment. I make this change for two reasons. First, this allows me to avoid calibrating the Frisch elasticity of labor supply, χ^{-1} , or hours worked, h. After $1 - \theta(k)$ is determined from the GMM procedure, it is straightforward to calculate $\Phi(k)$ for a given calibration of the Frisch elasticity and hours worked. Second, from a technical perspective, the procedure is less computationally intensive when I introduce planning costs in this linear fashion instead of the curvature associated with standard utility over leisure.

To align the model with the targets, I impose a set of conditions such that the value from choosing k_n^* , inclusive of planning costs, is greater than the value from choosing any other $k \neq k_n^*$. That is, for $k \in \{1, 2, ..., \bar{k}\} \setminus \{k_n^*\}$, the GMM procedure searchers for $\Phi_{k_n^*}$ and Φ_k such that

$$V_n(k_n^*, \Phi_{k_n^*}) - V_n(k, \Phi_k) > 0,$$

I implement these inequality constraints as equality constraints using the method described in Moon and Schorfheide (2009). Defining $V_n(k^*, k)$ as the difference in value between the targeted planning horizon, k_n^* , and some other planning horizon, k, this condition can be rewritten as

$$V_n(k_n^*, \Phi_{k_n^*}) - V_n(k, \Phi_k) = \varphi_{n,k},$$

with the parameter restriction $\varphi_{n,k} > 0$ representing the inequality constraint and entering the minimization problem directly. Recalling that \bar{k} is the truncation value that denotes the longest planning horizon considered in the calibration, each target generates one inequality constraint for each horizon other than k_n^* , for a total of $\bar{k} - 1$ inequality constraints per target.

Stacking each of the above restrictions in a vector, the minimization problem can be written as

$$\min_{\Theta} \frac{1}{2} \left(\boldsymbol{V}(\boldsymbol{k}^*) - \boldsymbol{\varphi} \right)' W \left(\boldsymbol{V}(\boldsymbol{k}^*) - \boldsymbol{\varphi} \right),$$

where Θ contains the \bar{k} elements of the planning costs and $N_{GMM} \times (\bar{k}-1)$ inequality constraint parameters are subject to the constraint that each element of φ is strictly positive.

Although the complexity of the problem itself does not change, the computational burden in terms of unknown elements and constraints increases in \bar{k} . Regardless, \bar{k} is chosen so that the procedure is completely insensitive to the truncation value, and the household never selects a finite planning horizon close to \bar{k} -periods long. Finally, although these conditions alone generally yield a strictly increasing cost function, I find large computational benefits by imposing that the planning cost is strictly increasing, that is, $\Phi_k > \Phi_{k-1}$.

Figure 4: Calibrated Planning Costs as Fraction of Monthly Income



Notes: Grey line is calibrated planning cost as a function of monthly income for household with median wealth and dashed black line is logarithmic approximation.

5.3.4 Calibrated Planning Costs

The calibrated planning costs are largely successful in bringing the model in line with the targets, as listed in Panel A of Table 5. Instead of taking a stance on the Frisch elasticity of labor, I plot the monthly income equivalent of the calibrated planning cost in Figure 4. In response to an unanticipated income shock, the household pays just over 7% of monthly income as a one-time fee to select even a one-month planning horizon and spends the entire shock. Planning costs increase slowly to around 7.7% of monthly income for one year and 8% of monthly income for two years. In 2008, median household income in the American Community Survey was \$52,029 (in 2008 dollars). Using this as the baseline for annual income, reoptimizing for one month incurs a one-time fee of roughly \$300, while increasing the planning horizon to one year increases planning costs to \$330.

Comparison to Other Estimations of Planning Costs The consumption-equivalent planning costs are in line with comparable studies in the literature. As noted by Cochrane (1989), only small planning costs are required to push households from perfectly rational to "near rational" behavior. Although the mechanisms behind bounded intertemporal rationality and two-asset models are not directly comparable, both introduce costs that induce less interemporal smoothing than in the standard model. Reassuringly, the calibrated planning costs for finite planning horizons are of the same order as transaction costs in two-asset models. Kaplan and Violante (2014), citing papers that estimate transaction cost for the household to adjust its illiquid assets in response to a shock, which corresponds to approximately 2.1% of average consumption per adjustment. In Kaplan, Moll and Violante (2018), the steady state transaction costs in the New Keynesian two-asset economy are equal to less than 4%.

The planning costs in this paper reflect the cognitive effort required by the household, but can also be interpreted as how much the household would pay an external planner to solve the problem on their behalf. Lusardi, Michaud and Mitchell (2017) build a model in which households pay a fee to acquire financial knowledge and survey the cost of financial planners to calibrate their cost function. Individual consultations cost \$250 per hour on average (Turner and Muir, 2013), while subscription services for financial planning can range from between \$25 to \$45 per month. Again, these estimates are not directly comparable to the calibrated planning costs, but are of the same order of magnitude.

External Validity In Panel B of Table 5, I perform an out-of-sample test by comparing the calibrated model against external data kindly provided by Gelman (2022). He measures the consumption response of households to their annual tax refunds at a monthly frequency, and I compare the empirical marginal propensity to consume over each of the first three months to the model counterpart. The model is able to match the external targets fairly well, lending external validity to the procedure using the Economic Stimulus Act of 2008.

6 The Distribution of Consumption Responses

With the calibrated planning costs in hand, I study the distribution of consumption responses, or MPCs, across the distributions of households and shocks. For each, I summarize the vast empirical literature on the empirical distribution of MPCs, then compare the model's consumption response function both to the data and to other models. Overall, the model of bounded intertemporal rationality generates a consumption response function consistent with two sets of facts that standard models cannot replicate.

First, constrained households have larger MPCs than unconstrained, but even highly liquid households have large and economically significant MPCs. Second, two size effects, positive extensive-margin effect and negative-intensive margin effect, which, respectively, dictate that the fraction of non-zero consumption responses is increasing in the shock size, and, given a non-zero response, the consumption response is decreasing in the shock size. Evidence for these facts is found in both studies using "reported preferences," i.e., survey data which asks households about their consumption behavior, and "revealed preferences", i.e., consumption data from which MPCs are extimated directly.

As I detail below, the hallmark feature of all modern theoretical models are consumption functions that are concave in wealth and, by extension, concave in positive income shocks. As such, these models generate behavior *qualitatively* consistent with the two facts above, but *quantitatively* inconsistent by up to an order of magnitude. In contrast, behavior in the BIR model is both qualitatively and quantitatively consistent with the empirical evidence.

6.1 MPC and Liquid Wealth

Empirical Evidence There is ample evidence that the marginal propensity to consume is decreasing in liquidity. For example, panel (a) of Figure 5 plots empirical evidence on self-reported MPCs from Italy studied in Jappelli and Pistaferri (2014), and shows a clear negative trend. However, this figure also illustrates another fact that has recently received more attention: even highly liquid households have a large and economically significant propensity to consume. In the figure, the MPC is 0.75 for the least liquid households and decreases in cash-on-hand, but even the most liquid households have an MPC of 0.30.

Fagereng et al. (2021) estimate the MPC from large windfall lottery winnings using Norwegian administrative panel data on total (durable and non-durable) consumption. They estimate that "the within-year consumption response is 0.62 in the low-liquidity quartile, gradually falling to 0.46 in the high-liquidity quartile." Boehm et al. (2025) implement a randomized experiment which distributed windfall income shocks to French households and estimate the MPC for services, non-durables, semi-durables, and durables. Across the board, they document "a systematic negative relationship between the level of liquid wealth and the MPC," but note that "the MPC remains high even for households who have substantial liquid wealth." Johnson, Parker and Souleles (2006) and Parker et al. (2013) study stimulus payments in 2001 and 2008, respectively, using reported consumption behavior from the Survey of Consumer Expenditure. The authors find evidence of a stronger consumption response amongst the least liquid households in 2001 for both durable and non-durable consumption, but, citing large non-response to balance sheet questions, find no differences across liquidity in 2008. Lewis et al. (2021) estimate the entire distribution of MPCs from the Economic Stimulus Act of 2008 and find that "even the smallest MPCs are substantially larger than zero."

A number of papers use variation in paycheques to study the consumption response to unanticipated changes in income. Using data from a personal finance software in Iceland, Olafsson and Pagel (2018) study the "liquid hand-to-mouth" in an event-study framework around regular paydays and find "payday responses that are decreasing but large even for the most liquid people" for a number of non-durable spending categories. Gelman (2022) uses data from a different personal finance application in the U.S. and a similar event-study framework around payweeks. He separates households into low, medium, and high liquidity terciles, finding statistically and economically significant changes in food expenditure for all three groups. Ganong et al. (2020) use a large panel of householdlevel microdata and find that liquidity is a key predictor of the non-durable consumption response to unexpected labor demand shocks that increase wages.

Baugh, Ben-David, Park and Parker (2021) use high-frequency account-level data to study the asymmetric saving and consumption (durable and non-durable) behavior around tax payments and tax refunds. They find that "households in the bottom tercile of the ex ante distribution of liquidity have large propensities to consume out of refunds," and "household-years in the top tercile of the distribution of liquidity ... still increase spending when refunds arrive, albeit at a lower rate than low-liquidity households." Graham and McDowall (Forthcoming) use spending data on non-durables from a panel of 17.2 million households at one U.S. financial institution and finds that "consumption responses decline moderately in levels of liquidity and are significant even for households with high levels of income and substantial liquid assets." Separating households into deciles of liquidity and maintaining statistical power due to the large sample size, they estimate "one month MPCs ranging from 0.32 at the first decile to 0.09 at the tenth decile" of liquid assets.

Model Comparison Panel (b) of Figure 5 plots the three-month cumulative MPC as a function of liquid wealth for three different models. The black line in the figure is from the calibrated BIR model developed in this paper. The red line represents the MPC calculated from a one-asset model that is calibrated the exactly same as the long-term

model in Section 5.2. The two blue lines are the MPC calculated from the two-asset model developed in Auclert, Bardóczy, Rognlie and Straub (2021). In the two-asset model, the household can freely invest in a liquid asset or pay a transaction fee each time it adjusts its illiquid asset. The dashed blue line is the MPC for a household with low illiquid wealth and the dotted blue line represents a household with high illiquid wealth.⁶





(a) Empirical Evidence (Jappelli and Pistaferri, 2014)

(b) Model Comparison

Notes: (a) Marginal propensity to consume is survey response to hypothetical question. Cash-on-hand is the sum of income and liquid wealth. *Source:* 2010 Italian Survey of Household Income and Wealth. Replicates Figure 2 of Jappelli and Pistaferri (2014). (b) Marginal propensity to consume out of a windfall income shock for different levels of liquid wealth across different models.

In all four cases, the MPCs for households with low liquid wealth is high. As discussed in Section 4.2.1, households near their borrowing constraint have an unmet desire to smooth consumption by borrowing from the future. Faced with a positive income shock, they opt to increase consumption in the current period, generating large MPCs. This is true for all four models. As liquid wealth increases, the MPC decreases, but much more quickly in the one- and two-asset models. In these models, unconstrained households smooth the positive income shock over their entire lifetimes, consistent with the Permanent Income Hypothesis. The household saves most of the income shock in order to fund its increased consumption in every future period, generating a small marginal propensity to consume out of the shock.

⁶Recall that the innovation in the two-asset model is that households with low liquid wealth behave similarly regardless of their illiquid wealth. For this reason, the two lines from the two-asset model are similar.

In the BIR model, the MPC decreases more slowly because wealthier households opt to smooth the income shock over relatively fewer periods. This is due to the combination of diminishing returns to consumption smoothing and increasing costs in the planning horizon. Again consistent with the Permanent Income Hypothesis, the wealthy household wishes to smooth the income shock over future periods, but doing so now incurs the planning costs, and this tradeoff induces shorter planning horizons. As a result, the BIR model generates MPCs for unconstrained households that are still smaller than for constrained households, but much more in line with the empirics.

Discussion Panel (b) of Figure 5 illustrates that while conventional models with concave consumption functions indeed feature larger MPCs for low-liquidity households relative to high-liquidity households, the MPCs for high-liquidity households are counterfactually very close to zero. Fagereng et al. (2021) write that "the MPC is remarkably high even among the most liquid households, and this finding will prove hard to match with conventional buffer stock saving models." This is because in both one- and two-asset models built on the Permanent Income Hypothesis (PIH), only borrowing constrained households have non-zero consumption responses. Households away from the borrowing constraint will always have very small consumption responses, but these models are successful in generating larger average MPCs by correctly calibrating the distribution of wealth to generate more constrained households with high MPCs.

For example, Kaplan et al. (2014) estimate that the fraction of households who are hand-to-mouth, as measured by their balance sheets, is around 30% in eight advanced economies, including the USA, United Kingdom, and Canada. Seminal two-asset models, such as Kaplan and Violante (2014) and Kaplan et al. (2018), focus on behavior of these hand-to-mouth households, and conclude that they can explain an important share of the aggregate consumption response. However, these models cannot speak to the majority of households who are non-hand-to-mouth yet display a meaningful consumption response.

Further, insofar as other mechanisms, such as consumption habits, infrequent large expenditures, or alternative preference structures, push households toward the borrowing constraint, the average MPC will be higher (Attanasio et al., 2024; Maxted et al., 2024; Campbell and Hercowitz, 2019). For a given level of wealth, however, the consumption response is similar to that in a model with standard time preferences. For example, models with hyperbolic discounting generate more constrained households due to higher relative impatience, but the consumption response for unconstrained households is similar to that in the standard exponential model because the "effective discount factor" is approximately equal to exponential discounting for high-wealth households (see Appendix E).

The model presented in this paper maintains the behavior of financially constrained households, while proposing bounded rationality to understand the behavior of highly liquid liquids. Together, this explains the consumption response across the entire distribution of liquid wealth.

6.2 MPC and Shock Size

In this section, I study the model's extensive and intensive margins of consumption responses as shock size varies. Income shocks vary across households in absolute and relative amounts, and there is a small but growing empirical literature that studies how the consumption response varies by shock size.

6.2.1 Shock Size and Extensive Margin

Empirical Evidence The positive extensive-margin size effect documents that the fraction of households that adjust consumption in response to a positive income shock is increasing in the size of the income shock. Panel (a) of Figure 6 plots the evidence from Fuster et al. (2021) of this positive extensive-margin effect: as they "increase the size of the windfall from \$500 to \$2,500 to \$5,000, a larger fraction of respondents say they would increase their spending." Specifically, 18% of respondents report increasing spending in response to a \$500 windfall income shock, compared to 22% for a \$2,500 shock and 36% for a \$5,000 shock. Lewis et al. (2021) also document a positive extensive-margin effect when they estimate the distribution of consumption responses, and Misra and Surico (2014) use quartile estimation to arrive at a similar conclusion: there is a large mass of households with no consumption out of the Economic Stimulus Payments of 2008 and a mass of households with a significant response.

Model Comparison In Panel (b) of Figure 6, I compare the fraction of households with a positive consumption response between the Bounded Intertemporal Rationality model, the one-asset model, and the two-asset model, as the size of the windfall income shock increases continuously.

The BIR model is able to generate a positive extensive-margin effect. For small shocks, the cost of making new plans for even the current period outweighs the benefit, so the consumption response is zero. As the size of the shock increases, the benefits of consumption smoothing increase heterogenously across households depending on the relative size of the shock for each household, and more households choose to reoptimize. Eventually, for a large enough shock, it is optimal for all households to reoptimize, and the fraction



Figure 6: Fraction of Households with Positive MPC and Shock Size



(b) Model Comparison

Notes: (a) Fraction of households with positive MPC in response to hypothetical windfall income shock in survey data. *Source:* Table 3 in Fuster et al. (2021). (b) Fraction of households with positive MPC in response to income shocks across different models.

of households with a positive consumption response is one.

In contrast, for both the one- and two-asset models, all households have a positive consumption response to all income shocks: the benefit of consumption smoothing is always positive, and without bounded rationality, the planning costs are zero. As a result, even the smallest income shocks induce all households to reoptimize to an extent that will vary only slightly with the size of the shock. As I show in the next section, even this intensive margin of the size effect is counterfactual in the one- and two-asset models.

6.2.2 Shock Size and Intensive Margin

Empirical Evidence The negative intensive-margin effect states that the marginal propensity to consume is decreasing in shock size, conditional on adjusting consumption (i.e., conditional on the positive extensive-margin discussed in the previous section). For example, Panel (a) of Figure 7 plots the estimated non-durable consumption response in Kueng (2018), which studies fixed payments from the Alaskan Permanent Fund across households sorted by income. This work builds on Hsieh (2003), who finds that households who have large consumption responses out of small income tax refunds have much smaller consumption responses out of larger dividend payments from the Alaskan Permanent Fund. With the Alaskan Permanent Fund, the windfall dividend payment is the same for all households, but the relative size depends on household income. This figure

displays the negative intensive-margin effect, i.e., the negative relationship between the size of an income shock and the size of the consumption response.

Fuster et al. (2021) provide the most compelling evidence on size effects. They construct and implement survey questions that explicitly vary shock size, timing, and sign. They document a negative intensive-margin effect, in that "the average MPC conditional on responding decreases." The average MPC conditional on responding is 0.53 for a \$500 shock, 0.43 for a \$2,500 shock, and 0.36 for a \$5,000 shock. Fagereng et al. (2021) also document a negative intensive-margin effect out of lottery winnings in Norway. The MPC decreases from 1.31 for the smallest lottery prize size quartile, 0.97 for the second quartile, 0.69 for the third quartile, and 0.51 for the largest lottery prizes in the fourth quartile. A notable exception is Andreolli and Surico (2021), who find a positive intensive-margin effect: on average, the same household reports consuming marginally more of an income shock equal to one year of income than an income shock equal to one month of income. Adding to the evidence for negative intensive-margin effects, in this paper, I estimate the consumption response to Economic Stimulus Payments in 2008 sorted by relative shock size and find a negative relationship: the MPC decreases from 0.35 for the smallest relative shocks to 0.12 for the largest.

Model Comparison In Panel (b) of Figure 7, I vary the size of the income shock to between 1% of 100% of monthly income and compare the MPC across the same three models as above. I study the MPC for an unconstrained household with high liquid wealth to emphasize that these results are not driven by borrowing constraints. The figure for a constrained household is similar except the level of the MPC is higher on average. Overall, the model of bounded intertemporal rationality produces very different MPCs for small income shocks and similar MPCs to the other models for larger income shocks.

For smaller shocks, households in the BIR model have much larger MPCs than households in either the one- or two-asset models. In those standard models, the household costlessly smooths any income shock and the MPC is roughly 0.10. In contrast, the BIR household opts to partially smooth income shocks, generating a distinct pattern of MPCs. For income shocks up to 40% of monthly income, the benefits of consumption smoothing are dominated by the planning costs and the household selects shorter planning horizons.

As the size of the income shock increases, the household is more willing to reoptimize over additional periods but the MPC is still larger than in the one- and two-asset models. Eventually, for a sufficiently large shock, the unconstrained BIR household opts to pay the planning cost and fully smooth the income shock, and the BIR household's behavior resembles that of the other models.



Figure 7: Marginal Propensity to Consume and Shock Size

Notes: (a) Estimated marginal propensity to consume out of dividend payments from the Alaska Permanent Fund with 95% confidence intervals. Relative dividend size is payment divided by income. *Source:* Columns (5) and (6) of Table 4 in Kueng (2018). (b) Marginal propensity to consume out of an income shock ranging from 0% to 100% of monthly income across different models.

6.2.3 Discussion of Shock Size Effects

As Figure 7 shows, standard one- and two-asset models with concave consumption functions technically generate a negative intensive-margin effect. However, the response is largely inelastic in the size of the shock, especially for unconstrained households, and therefore inconsistent with the empirical evidence. Two-asset models with non-convex portfolio adjustment costs, such as the seminal model in Kaplan and Violante (2014), the consumption function is kinked and households exhibit large positive extensive-margin effects around the kink. However, conditional on adjusting, the consumption response function is again inelastic with respect to the size of the shock, and the same holds in two-asset models with smooth transaction costs, such as Kaplan et al. (2018) or Auclert et al. (2021).

On the extensive-margin side, Fuster et al. (2021), who provide the most comprehensive evidence on size effects, survey the theoretical literature and conclude that "one feature of all of the models discussed [above] is that they do not generate a meaningful extensive margin of consumption responses." Similar in spirit to Kaplan and Violante (2014), they show that non-convex consumption adjustment costs generate the correct positive extensive margin effect, and intentionally remain agnostic as to the source of these costs. Importantly, non-convex adjustment costs cannot alone generate the positive intensive margin effects or large consumption response of highly liquid households documented above. The planning costs used in this paper are both consistent with the abstract costs discussed by Fuster et al. (2021) and can generate behavior in line with all of the empirical evidence.

7 Implications of Bounded Intertemporal Rationality

Bounded intertemporal rationality is a costly thing for households. If one takes the stance that it can be fixed, then I show how programs which increase financial literacy will have welfare gains, especially for middle-income households. At the same time, if taken as given, then fiscal stimulus can lean into this to increase the demand of

7.1 Stimulative Fiscal Policy

As demonstrated in the previous section, the model developed in this paper generates a consumption response function that varies over the entire distribution of wealth and income shock size. The relationship between the marginal propensity to consume and the size of an income shock provides a framework for the design of stimulus programs intended to boost consumption: smaller payments, relative to a household's income, induce less intertemporal smoothing and larger immediate increases in consumption.

To demonstrate this, I compare the actual distribution of Economic Stimulus Payments in 2008 to a hypothetical cost-equivalent program. Panel (a) of Figure 8 plots the 2008 distribution of stimulus payment divided by income. In this histogram, I further divide households into three groups by income: the lowest 25%, the middle 50%, and the upper 25%. Mechanically, the highest income group is concentrated amongst the lowest relative shock sizes, since the small variation in stimulus payments is dwarfed by the large differences in income. The low and middle income groups are more dispersed throughout the distribution of relative shock sizes.

Viewed through the lens of the model, a policymaker that wishes to maximize the aggregate MPC can improve on this distribution of stimulus payments. Panel (b) plots a proposed alternate stimulus program that increases each stimulus cheque of the lowest 25% by \$600 and decreases each payment to households in the middle 50% by \$300. In this cost-equivalent program, the mass of middle income households in the relative shock distribution moves to the left and is replaced by low income households. In the model, the aggregate MPC for the alternate plan is 17.1% larger, increasing by almost 5 p.p. from



Figure 8: Comparison of Stimulus Payments Across Programs



(b) Hypothetical Stimulus Program

Notes: In panel (a), the distribution of Economic Stimulus Payments relative to monthly income, from the 2008 wave of the Survey of Consumer Expenditures. In panel (b), the distribution of stimulus payments relative to monthly income for a hypothetical stimulus program.

25.7% to 30.1%.

The large increase in MPCs comes from both giving more stimulus to lower income households but also from giving less stimulus to middle income households. Since households have bounded intertemporal rationality, decreasing the relative payment size to middle income households decreases the optimal planning horizon and increases the immediate consumption response. At the same time, increasing the relative payment size to the low income households does not increase their optimal planning horizon because these borrowing constrained households optimally choose short planning horizons even without bounded intertemporal rationality.

In other words, middle income households have a threshold at which they further smooth income shocks, and decreasing the stimulus payment below this threshold increases the aggregate MPC. Low income households also have a threshold at which they further smooth income shocks, but it is larger because they are borrowing constrained and even without bounded rationality choose to immediately consume income shocks. As such, there is more room to increase their stimulus payments before they will smooth to longer horizons. Together, these factors combine so that diverting stimulus payments away from middle income households to lower income households increases the aggregate MPC.

To emphasize the importance of making payments smaller for the middle income

	Benchmark	Alternate 1	Alternate 2
Lowest 25% Income	_	+\$600	+\$600
Middle 50% Income	_	-\$300	_
Highest 25% Income	_	_	-\$600
Aggregate MPC	0.257	0.301	0.275
% Rel. to Benchmark	_	17.4%	7.20%

Table 6: Summary of Fiscal Stimulus Programs: Payments and Aggregate MPCs

Notes: Benchmark uses the observed distribution of ESPs and calibrated model to calculate the aggregate MPC. Alternates 1 and 2 are cost-neutral stimulus programs which redistribute payments across the distribution of income.

group, I consider another cost-equivalent stimulus program that increases each stimulus cheque of the lowest 25% by \$600 and decreases each payment to households in the top 25% by \$600. With this program, the aggregate MPC increases by only 1.8 p.p. or 7.1%. Since households in the top 25% already had the smallest relative stimulus payments, further decreasing their payments does not significantly increase their consumption responses. This exercise highlights that while increasing payments to constrained households does increase the aggregate MPC, simultaneously decreasing payments to middle income households is another useful lever, especially if the goal is to remain costequivalent.

7.2 Financial Literacy and Planning Costs

Bounded intertemporal rationality is inherently due to welfare-decreasing planning costs that represent the difficulties of financial planning. Building on the model in Lusardi et al. (2017) where investments in financial knowledge can increase financial returns, this section studies the welfare implications of decreasing planning costs through a hypothetical financial literacy program.

In Figure 9, I consider two financial literacy campaigns that reduce planning costs for all households by 25% and 50%. For each household along the distribution of liquid wealth, I consider a 15% windfall income shock under the reduced planning costs, and then compute how much more the windfall income shock would have to be under the baseline planning costs to make households indifferent between the two.

Consider first the 25% reduction in planning costs. For the poorest households who are on the borrowing constraint, a windfall income shock of 15% under the reduced planning costs is utility-equivalent to a 1.5 p.p. larger windfall income shock under the baseline planning costs. As liquid wealth increases, the equivalent windfall income shock

Figure 9: Comparison of Shock Sizes with Increased Financial Literacy



Notes: The additional shock required (in percentage points of monthly income) to make a household indifferent between baseline planning costs and reduced planning costs from increased financial literacy. Dashed vertical line is median household wealth. Black lines are for a 50% reduction in reduction, blue lines for a 25% reduction. Solid lines for a windfall income shock equal to 15% of monthly income, dashed lines for a 30% windfall income shock.

increases, reaching approximately 2.0 pp for the median level of liquid wealth. Under the 50% reduction in planning costs, a windfall income shock of 15% must be 2.9 pp larger under the baseline planning costs for borrowing constrained households, and this increases to 4.0 pp for the median household. For a larger windfall income shock equal to 30% of monthly income, the same patterns remain nearly identical, indicating that these results are driven by the household's level of wealth, not the size of the shock.

This analysis implies that the welfare gains to financial literacy and reduced planning costs are greater for wealthier households. Applying the 25% reduced planning costs to the 2008 Economic Stimulus Act studied in the previous section, Panel A of Figure 10 plots the distribution of welfare gains, measured as compensating variation, for households in the lowest 25% of the income distribution, middle 50%, and highest 25%. In this experiment, I compute the difference in liquid wealth required to make each household indifferent between the same Economic Stimulus Payment under the baseline and reduced planning costs. All households benefit from receiving the same stimulus payment and being subject to reduced planning costs.



Figure 10: Marginal Propensity to Consume and Liquid Wealth

Notes: The distribution of welfare gains from a 25% decrease and 50% decrease in planning costs due to increased financial literacy. The distribution of gains is further divided into three groups: the lowest 25% of the income distribution, the middle 50%, and the highest 25%.

Consistent with the analysis for Figure 9, the largest welfare gains are for those in the middle and highest parts of the income distribution. This is true to an even larger extent when planning costs increase decrease by 50%, as illustrated in Panel B of Figure 10. Unlike in many contexts where increased financial knowledge has the largest returns for the poorest households, in the context of bounded intertemporal rationality from finite planning horizons, increased financial literacy that reduces planning costs generates larger welfare gains for relatively wealthier households.

Welfare gains are increasing in wealth for two reasons. First, planning costs are simply not very relevant for the poorest households. As demonstrated in Section 6.1, even without planning costs, constrained households optimally choose shorter planning horizons, and therefore decreasing planning costs does not impact their optimal horizon. Second, since the benefits of additional consumption smoothing are increasing in wealth, decreasing planning costs and inducing longer horizons has larger benefits for wealthier households. In other words, wealthier households lose the most from having short planning horizons. When planning costs decrease, wealthier households can more easily plan for longer horizons and smooth their consumption to additional periods with larger marginal utility returns.

8 Conclusions

I develop a model of consumption behavior in which households form consumption and savings plans over stochastic fluctuations in income but reoptimize in response to unanticipated windfall income shocks. I label the households in my model as displaying bounded intertemporal rationality because although they are fully rational, their ability to make plans for intertemporal substitution is bounded by the presence of planning costs. Absent these costs, my model collapses to the standard one-asset model with full consumption smoothing for unconstrained households. Financially constrained households immediately spend positive income shocks because of an unmet desire to smooth consumption, while even unconstrained households have high marginal propensities to consume because they opt to only partially smooth income shocks. For both types of households, the larger the shock, the stronger the incentive for consumption smoothing and the smaller the marginal propensity to consume.

The calibrated model produces results that are consistent with three key facts: the large consumption response out of income shocks for unconstrained households, the positive relationship between the fraction of households reporting a positive consumption response and the size of the shock, and conditional on a positive consumption response, the negative relationship between the size of the consumption response and the size of the shock. The model's contribution is a framework that uses bounded rationality to generate realistic consumption responses along the entire distribution of wealth and income shocks.

This more realistic behavior at the household-level allows for a fuller understanding of the aggregate consumption response function, which, in turn, allows for macroeconomic models that can better study distributional effects and aid in designing policies to maximize aggregate welfare. Future work in this area will extend in two directions: first, it will expand the framework to analyze other shocks, such as to interest rates or borrowing limits; and second, it will embed bounded intertemporal rationality into a broader framework to fully examine the effects of fiscal and monetary policy in general equilibrium.

References

- Agarwal, Sumit, Richard J. Rosen, and Vincent W. Yao, "Why Do Borrowers Make Mortgage Refinancing Mistakes?," *Management Science*, 2016, 62 (12), 3494–3509.
- _ , Souphala Chomsisengphet, Chunlin Liu, and Nicholas S. Souleles, "Do Consumers Choose the Right Credit Contracts?," *Review of Corporate Finance Studies*, 2015, 4 (2), 239–257.
- _, Vyacheslav Mikhed, and Barry Scholnick, "Peers' Income and Financial Distress: Evidence from Lottery Winners and Neighboring Bankruptcies," *The Review of Financial Studies*, May 2019, 33 (1), 433–472.
- Aguiar, Mark, Mark Bils, and Corina Boar, "Who Are the Hand-to-Mouth?," Review of Economic Studies, May 2024.
- Ameriks, John, Andrew Caplin, and John Leahy, "Wealth Accumulation and the Propensity to Plan," *The Quarterly Journal of Economics*, Aug. 2003, *118* (3), 1007–1047.
- **Andreolli, Michele and Paolo Surico**, "LESS is More: Consumer Spending and the Size of Economic Stimulus Payments," *CEPR Discussion Paper No. DP15918*, Mar 2021.
- Arkes, Hal R., Cynthia A. Joyner, Mark V. Pezzo, Jane-Gradwohl Nash, Karen Siegel-Jacobs, and Eric Stone, "The Psychology of Windfall Gains," Organizational Behavior and Human Decision Processes, September 1994, 59, 331–347.
- Attanasio, Orazio, Agnes Kovacs, and Patrick Moran, "Temptation and Commitment: a Model of Hand-to-Mouth Behavior," *Journal of the European Economic Association*, February 2024, 22 (4), 2025—2073.
- Auclert, Adrien, Bence Bardóczy, Matthew Rognlie, and Ludwig Straub, "Using the Sequence-Space Jacobian to Solve and Estimate Heterogeneous-Agent Models," *Econometrica*, 2021, *89* (5), 2375–2408.
- _ , Matthew Rognlie, and Ludwig Straub, "The Intertemporal Keynesian Cross," Journal of Political Economy, December 2024, 132 (12), 4068–4121.
- **Barber, Brad M. and Terrance Odean**, "All That Glitters: The Effect of Attention and News on the Buying Behavior of Individual and Institutional Investors," *The Review of Financial Studies*, April 2008, *21* (2), 785–818.

- **Baugh, Brian, Itzhak Ben-David, Hoonsuk Park, and Jonathan A. Parker**, "Asymmetric Consumption Smoothing," *American Economic Review*, Jan. 2021, *111* (1), 192–230.
- **Beatty, Timothy K. M., Laura Blow, Thomas F. Crossley, and Cormac O'Dea**, "Cash by any other name? Evidence on labeling from the UK Winter Fuel Payment.," *Journal of Public Economics*, Oct. 2014, *118*, 86–96.
- **Bernard, René**, "Mental Accounting and the Marginal Propensity to Consume," Technical Report, Working Paper 2023.
- Blundell, Richard, Luigi Pistaferri, and Ian Preston, "Consumption Inequality and Partial Insurance," *American Economic Review*, 2008, *98* (5), 1887–1921.
- **Boehm, Johannes, Etienne Fize, and Xavier Jaravel**, "Five Facts about MPCs: Evidence from a Randomized Experiment," *American Economic Review*, January 2025, *115* (1), 1–42.
- **Bornstein, Gideon and Sasha Indarte**, "The Impact of Social Insurance on Household Debt," Working Paper 2020.
- **Bosch-Rosa, Ciril and Brice Corgnet**, *Cognitive Finance* Handbook of Experimental Finance, Edward Elger,
- **Boutros, Michael and Andrej Mijakovic**, "The Macroeconomic Implications of Coholding," Working Paper July 2024.
- **Briggs, Joseph, David Cesarini, Erik Lindqvist, and Robert Östling**, "Windfall gains and stock market participation," *Journal of Financial Economics*, January 2021, *139* (1), 57–83.
- Browning, Martin and M. Dolores Collado, "The Response of Expenditures to Anticipated Income Changes: Panel Data Estimates," *American Economic Review*, Jun. 2001, 91 (3), 681–692.
- Calvet, Laurent E., John Y. Campbell, and Paolo Sodini, "Down or Out: Assessing the Welfare Costs of Household Investment Mistakes," *Journal of Political Economy*, Oct. 2007, 115 (5), 707–747.
- **Campbell, Jeffrey R. and Zvi Hercowitz**, "Liquidity Constraints of the Middle Class," *American Economic Journal: Economic Policy*, Aug. 2019, *11* (3), 130–155.

- Campbell, John Y., "Household Finance," *Journal of Public Economics*, Aug. 2006, 61 (4), 1553–1604.
- **Cochrane, John H.**, "The Sensitivity of Tests of the Intertemporal Allocation of Consumption to Near-Rational Alternatives," *The American Economic Review*, Jun. 1989, 79 (3), 319–337.
- **Cookson, J. Anthony, Erik P. Gilje, and Rawley Z. Heimer**, "Shale Shocked: Cash Windfalls and Household Debt Repayment," *Journal of Financial Economics*, December 2022, 146 (3), 905–931.
- **DellaVigna, Stefano**, "Structural Behavioral Economics," in "Handbook of Behavioral Economics: Applications and Foundations 1," Vol. 1, North-Holland, 2018, pp. 613–723.
- **Enke, Benjamin, Thomas Graeber, and Ryan Oprea**, "Complexity and Time," Working Paper 2023.
- **Epley, Nicholas, Dennis Mak, and Lorraine Chen Idson**, "Bonus or Rebate? The Impact of Income Framing on Spending and Saving," *Journal of Behavioral Decision Making*, January 2006, *19*, 1–15.
- Ergin, Haluk and Todd Sarver, "A Unique Costly Contemplation Representation," *Econometrica*, July 2010, *78* (4), 1285–1339.
- Fagereng, Andreas, Martin B. Holm, and Gisle J. Natvik, "MPC Heterogeneity and Household Balance Sheets," American Economic Journal: Macroeconomics, 2021, 13 (3), 1–54.
- **Fisher, Patti J. and Catherine P. Montalto**, "Effect of Saving Motives and Horizon on Saving Behaviors," *Journal of Economic Psychology*, 2010, 31 (1), 92–105.
- Fogel, Suzanne, "Income Source Effects," Working Paper 1999.
- Forster, Jens and Laura Dannenberg, "GLOMOsys: A systems account of global versus local processing," *Psychological Inquiry*, 2010, 21 (3), 175–197.
- Fuchs-Schuendeln, Nicola and Tarek Alexander Hassan, Natural Experiments in Macroeconomics, Vol. 2 of Handbook of Macroeconomics, North-Holland,

- Fuster, Andreas, Greg Kaplan, and Basit Zafar, "What Would You Do with \$500? Spending Responses to Gains, Losses, News and Loans," *Review of Economic Studies*, July 2021, 88 (4), 1760–1795.
- Gabaix, Xavier, Behavioral Inattention, Vol. 2 of Handbook of Behavioral Economics, Elsevier,
- __, David Laibson, Guillermo Moloche, and Stephen Weinberg, "Costly Information Acquisition: Experimental Analysis of a Boundedly Rational Model," *American Economic Review*, Sept. 2006, 96 (4), 1043–1068.
- Ganong, Peter, Damon Jones, Pascal Noel, Diana Farrell, Fiona Greig, and Chris Wheat, "Wealth, Race, and Consumption Smoothing of Typical Income Shocks," Technical Report, Working Paper 2020.
- **Gelman, Michael**, "What Drives Heterogeneity in the Marginal Propensity to Consume? Temporary Shocks vs Persistent Characteristics," *Journal of Monetary Economics*, 2021, 117, 521–542.
- _, "The Self-Constrained Hand-to-Mouth," *The Review of Economics and Statistics*, September 2022, *104* (5).
- Gerardi, Kristopher, Kyle F. Herkenhoff, Lee E. Ohanian, and Paul S. Willen, "Can't Pay or Won't Pay? Unemployment, Negative Equity, and Strategic Default," *Review of Financial Studies*, 2018, *31* (3), 1098–1131.
- **Goldreich, David**, "Bounded Rationality of Dealers in U.S. Treasury Auctions," Technical Report, Working Paper 2015.
- Graham, James and Robert A. McDowall, "Mental Accounts and Consumption Sensitivity Across the Distribution of Liquid Assets," *American Economic Journal: Macroeconomics*, Forthcoming.
- Hankins, Scott, Mark Hoekstra, and Paige Marta Skiba, "The Ticket to Easy Street? The Financial Consequences of Winning the Lottery," *Review of Economics and Statistics*, August 2011, 93 (3), 961–969.
- Harris, Christopher and David Laibson, "Dynamic Choices of Hyperbolic Consumers," *Econometrica*, 2001, 69 (4), 935–957.
- Heathcote, Jonathan, Fabrizio Perri, and Giovanni L. Violante, "Unequal We Stand: An Empirical Analysis of Economic Inequality in the United States, 1967-2006," *Review of Economic Dynamics*, Jan. 2010, 13 (1), 15–51.

- Hong, Eunice and Sherman D. Hanna, "Financial Planning Horizon: A Measure of Time Preference or a Situational Factor?," *Journal of Financial Counseling and Planning*, Dec. 2014, 25 (2), 184–196.
- Hsieh, Chang-Tai, "Do Consumers React to Anticipated Income Changes? Evidence from the Alaska Permanent Fund," *American Economic Review*, Mar. 2003, *93* (1), 397–405.
- **Ilut, Cosmin and Rosen Valchev**, "Economic Agents as Imperfect Problem Solvers," *The Quarterly Journal of Economics*, July 2022, *138* (1), 313–362.
- Jappelli, Tullio and Luigi Pistaferri, "Fiscal Policy and MPC Heterogeneity," American Economic Journal: Macroeconomics, October 2014, 6 (4), 107–136.
- Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles, "Household Expenditure and the Income Tax Rebates of 2001," *American Economic Review*, December 2006, 96 (5), 1589–1610.
- **Kaplan, Greg and Giovanni L. Violante**, "A Model of the Consumption Response to Fiscal Stimulus Payments," *Econometrica*, July 2014, 82 (4), 1199–1239.
- __, Ben Moll, and Gianluca Violante, "Monetary Policy According to HANK," American Economic Review, 2018, 3 (108), 697–743.
- _, Giovanni L. Violante, and Justin Weidner, "The Wealthy Hand-to-Mouth," Brookings Papers on Economic Activity, 2014, 1, 77–138.
- **Kimball, Miles S.**, "Precautionary Saving in the Small and in the Large," *Econometrica*, Jan. 1990, *58* (1), 53–73.
- Krueger, Dirk, Kurt Mitman, and Fabrizio Perri, Macroeconomics and Heterogeneity, Including Inequality, Vol. 2 of Handbook of Macroeconomics, Elsevier,
- Kueng, Lorenz, "Excess Sensitivity of High-Income Consumers," *The Quarterly Journal of Economics*, November 2018, *133* (4), 1693–1751.
- Laibson, David, "Golden Eggs and Hyperbolic Discounting," *Quarterly Journal of Economics*, 1997, 112 (2), 443–477.
- **Lewis, Daniel, Davide Melcangi, and Laura Pilossoph**, "Latent Heterogeneity in the Marginal Propensity to Consume," Working Paper 2021.
- Lian, Chen, "Mistakes in Future Consumption, High MPCs Now," American Economic *Review: Insights*, December 2023.

- Lusardi, Annamaria, Pierre-Carl Michaud, and Olivia S. Mitchell, "Optimal Financial Knowledge and Wealth Inequality," *Journal of Political Economy*, April 2017, 125 (2), 431– 477.
- Lynch, John, Richard G Netemeyer, Stephen A Spiller, and Alessandra Zammit, "A Generalizable Scale of Propensity to Plan: The Long and the Short of Planning for Time and for Money," *Journal of Consumer Research*, 2010, 37 (1), 108–128.
- Maxted, Peter, David Laibson, and Benjamin Moll, "Present Bias Amplifies the Household Balance-Sheet Channels of Macroeconomic Policy," *The Quarterly Journal of Economics*, September 2024, 140 (1), 691–743.
- Misra, Kanishka and Paolo Surico, "Consumption, Income Changes, and Heterogeneity: Evidence from Two Fiscal Stimulus Programs," *American Economic Journal: Macroeconomics*, October 2014, 6 (4), 84–106.
- Moon, Hyungsik Roger and Frank Schorfheide, "Estimation with Overidentifying Inequality Moment Conditions," *Journal of Econometrics*, Dec. 2009, *153* (2), *136–154*.
- **Munnell, Alicia H., Annika E. Sunden, and Catherine Taylor**, "What Determines 401(k) Participation and Contributions?," *Social Security Bulletin*, 2001, *64* (3), 64–75.
- Navon, David, "Forest before trees: The precedence of global features in visual perception," *Cognitive Psychology*, July 1977, 9 (3), 353–383.
- **Olafsson, Arna and Michaela Pagel**, "The Liquid Hand-to-Mouth: Evidence from Personal Finance Management Software," *The Review of Financial Studies*, November 2018, *31* (11), 4398–4446.
- Parker, Jonathan A., Nicholas S. Souleles, David S. Johnson, and Robert McClelland, "Consumer Spending and the Economic Stimulus Payments of 2008," *American Economic Review*, October 2013, 103 (6), 2530–2553.
- **Reis, Ricardo**, "Inattentive Consumers," *Journal of Monetary Economics*, 2006, 53 (8), 1761–1800.
- **Rudebusch, Glenn D. and Eric T. Swanson**, "The Bond Premium in a DSGE Model with Long-Run Real and Nominal Risks," *American Economic Journal: Macroeconomics*, Jan. 2012, *4* (1), 105–43.
- Shapiro, Matthew D. and Joel Slemrod, "Did the 2008 Tax Rebates Stimulate Spending?," American Economic Review: Papers & Proceedings, 2009, 99 (2), 374–379.

- Sims, Christopher A., "Implications of Rational Inattention," Journal of Monetary Economics, 2003, 50 (3), 665–690.
- **Spears, Dean**, "Cognitive Limits, Apparent Impatience, and Monthly Consumption Cycles: Theory and Evidence from the South African Pension," Technical Report, Working Paper 2012.
- Streeter, Jialu L., "Do Adverse Health Shocks Induce Myopic Financial Planning?," Financial Planning Review, Dec. 2021, 4 (4).
- **Thakral, Neil and Linh T Tô**, "Anticipation and Consumption," Technical Report, Working Paper 2022.
- **Thaler, Richard H.**, "Anomalies: Saving, Fungibility, and Mental Accounts," *Journal of Economic Perspectives*, Winter 1990, 4 (1), 193–205.
- **Turner, John A. and Dana M. Muir**, *The Market for Financial Advisers* The Market for Retirement Financial Advice, OUP Oxford,
- **Zhang, C. Yiwei and Abigail B. Sussman**, "Perspectives on Mental Accounting: An Exploration of Budgeting and Investing," *Financial Planning Review*, March–June 2018, 1 (1-2), e1011.

Appendices

A Proofs

Let $V_t(\Delta, k; w)$ denote the lifetime value from smoothing shock Δ over k periods for a household at time t with long-term wealth w. Formally:

$$V_t(\Delta, k; w) = \max_{\{\tilde{c}_{\tau}^{\Delta}\}_{\tau=t}^{t+k-1}} \sum_{\tau=t}^T \beta^{\tau-t} u(c_{\tau} + \tilde{c}_{\tau}^{\Delta}),$$

with the entire shock spent over the *k* planning periods, i.e.,

 $t \cdot$

1. over the first *k* periods,

$$\sum_{\tau=t}^{+k-1} \frac{\tilde{c}_{\tau}^{\Delta}}{(1+r)^{t-\tau}} = \Delta,$$

2. for the remaining periods, $\tau > t + k - 1$,

$$\tilde{c}^{\Delta}_{\tau} = 0.$$

In this equation, total consumption is expressed using the definition of "excess consumption" from Section 4. Total consumption is the sum of the initial lifecycle consumption plan, c_{τ} , and the marginal consumption out of the income shock, c_{τ}^{Δ} . As discussed, the initial consumption and savings plan continue to evolve according to the policy functions from the lifecycle optimization and are unaffected by the windfall-induced reoptimization. For clarity and to focus on the reoptimization plans, I suppress the notation indicating that in each period, c_{τ} depends on wealth, w, in period τ .

Let $c_{\tau}^{\Delta}(\Delta, k; w)$ denote the optimal consumption out of the windfall shock at time τ for a household at time t that has wealth w, faces shock Δ , and reoptimizes over k periods. Note that for every period τ , this function is defined over the initial state variable w, as these will be the focus of the proofs.

Then the expression above can be rewritten as:

$$V_t(\Delta, k; w) = \sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u(c_{\tau} + c_{\tau}^{\Delta}(\Delta, k; w)) + \sum_{\tau=t+k}^{T} \beta^{\tau} u(c_{\tau}),$$

Lemma 1. Fix wealth, w. Then:

$$\frac{\partial V_t(\Delta, k+1; w)}{\partial \Delta} > \frac{\partial V_t(\Delta, k; w)}{\partial \Delta}.$$

Proof. With respect to Δ :

$$\frac{\partial V_t(\Delta,k;w)}{\partial \Delta} = \sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u'(c_\tau + c_\tau^{\Delta}(\Delta,k;w)) \cdot \frac{\partial c_\tau^{\Delta}(\Delta,k;w)}{\partial \Delta} > 0.$$

From before, the entire shock is spent inside the planning horizon, and the derivative of this constraint is given by:

$$\sum_{\tau=t}^{t+k-1} \frac{1}{(1+r)^{t-\tau}} \frac{\partial c_{\tau}^{\Delta}(\Delta,k;w)}{\partial \Delta} = 1.$$

Without loss, assume that $\beta = (1+r)^{-1}$. The sum above is weighted in each period by the derivative of the short-run consumption function, with weights summing to unity.

When k increases, there is an additional term in the summation and the weights continue summing to unity. By construction, the short-term construction function is decreasing in the number of planning horizons. The value entering the marginal utility function decreases in every term, and since marginal utility is decreasing, each term is larger. Thus the sum is over more terms, and each term is increasing, so the total summation is larger.

Lemma 2. *Fix* Δ *. Then:*

$$\frac{\partial V_t(\Delta,k+1;w)}{\partial w} > \frac{\partial V_t(\Delta,k;w)}{\partial w}$$

Proof. The derivative with respect to *w*:

$$\frac{\partial V_t(\Delta, k; w)}{\partial w} = \sum_{\tau=t}^T \beta^{\tau-t} u'(c_\tau + c_\tau^\Delta(\Delta, k; w)) \\ \times \left(\frac{\partial c_\tau}{\partial w} + \frac{\partial c_\tau^\Delta(\Delta, k; w)}{\partial w}\right)$$

Note that from t + k to T, all of the c_{τ}^{Δ} terms are zero. When w changes, the marginal value is how utility changes with consumption, $u'(\cdot)$, multiplied by how consumption changes.

Consider the difference between the left- and right-hand side expressions in the inequality. The terms $\tau > t+k$ are equal and net to zero. In $\tau = t+k$, short-run consumption is zero for planning horizon k but positive for planning horizon k + 1, and the terms in $\tau \in \{t, t + 1, ..., t + k + 1\}$ differ since the short-term consumption function is different for the two planning horizons.

As in Lemma 1, the multiplicative term in brackets can be normalized into a weighted

average composing of the marginal utility functions. From the constraint for short-term consumption, we know that:

$$\sum_{\tau=t}^{t+k-1} \frac{1}{(1+r)^{t-\tau}} \frac{\partial c_{\tau}^{\Delta}(\Delta,k;w)}{\partial w} = 0.$$

This states that when long-term wealth changes, the total change in short-run consumption does not change, since the income shock does not change. As such, for either planning horizon, the sum of the weights does not change, but is re-arranged across the different terms.

Consider the terms of the summation above which differ:

$$\sum_{\tau=t}^{t+k} \beta^{\tau-t} u'(c_{\tau} + c_{\tau}^{\Delta}(\Delta, k+1; w)) \times \left(\frac{\partial c_{\tau}}{\partial w} + \frac{\partial c_{\tau}^{\Delta}(\Delta, k; w)}{\partial w}\right)$$

>
$$\sum_{\tau=t}^{t+k-1} \beta^{\tau-t} u'(c_{\tau} + c_{\tau}^{\Delta}(\Delta, k; w)) \times \left(\frac{\partial c_{\tau}}{\partial w} + \frac{\partial c_{\tau}^{\Delta}(\Delta, k; w)}{\partial w}\right) + \beta^{t+k} u'(c_{t+k} + 0) \times \left(\frac{\partial c_{t+k}}{\partial w} + 0\right)$$

The terms $\tau > t+k$ do not appear because they are equal. In $\tau \in \{t, t+1, \ldots, t+k-1\}$, the terms differ since the short-term consumption function is different for the two planning horizons. In the first line with the longer planning horizon, the summation is to t + k, whereas in the second line representing the shorter planning horizon, the summation is to t + k - 1. I include the term for t + k in the second line for the sake of comparison. In $\tau = t + k$, short-term consumption (and its derivative) are zero for the shorter planning horizon.

Recognizing that these two expressions can be expressed this way as an equal number of terms, then it immediately follows from convexity of the marginal utility function that the first expression is strictly greater than the second.⁷

A.1 **Proof of Proposition 1**

Consider three planning horizons of decreasing length, $k_2 > k_1 > k_0$. Let $k_1 \equiv k^*(\Delta)$ denote the optimal planning horizon for the smaller income shock, Δ . I establish the weak inequality in two steps.

⁷Convexity of the marginal utility function follows from the presence of incomplete markets and occasionally binding borrowing constraints in the stochastic case and is directly assumed (i.e., prudence) in the deterministic case.

First, I prove that for Δ' , the planning horizon k_1 dominates any $k_0 < k_1$. Given the optimality of k_1 for Δ , we have that

$$V_t(\Delta, k_1; w) - \phi_{k_1} > V_t(\Delta, k_0; w) - \phi_{k_0},$$

and, re-arranging, that

$$V_t(\Delta, k_1; w) - V_t(\Delta, k_0; w) > \phi_{k_1} - \phi_{k_0}$$

This expression states that the marginal value from increasing the planning horizon is more than offset by the marginal increase in planning costs.

Since $k_2 > k_1$, by Lemma 1,

$$V_t(\Delta', k_1; w) - V_t(\Delta', k_0; w) > V_t(\Delta, k_1; w) - V_t(\Delta, k_0; w)$$

The marginal value from increasing planning horizons is larger for Δ' than it is for Δ . Combining with the above and re-arranging,

$$V_t(\Delta', k_1; w) - V_t(\Delta', k_0; w) > \phi_{k_1} - \phi_{k_0}$$
$$V_t(\Delta', k_1; w) - \phi_{k_1} > V_t(\Delta', k_0; w) - \phi_{k_0},$$

establishing that for Δ' , k_1 is preferred over k_0 . Intuitively, if increasing planning horizons from k_0 to k_1 is preferred for the smaller shock, then this is also preferred for the larger shock given that the slope of the value function with respect to planning horizons is increasing in the income shock.

Second, I prove that for Δ' , the planning horizon $k_2 > k_1$ may be optimal. This is the case when

$$V_t(\Delta', k_2; w) - \phi_{k_2} > V_t(\Delta', k_1; w) - \phi_{k_1}$$

which holds if the marginal value from increasing the planning horizon is larger than the marginal cost,

$$V_t(\Delta', k_2; w) - V_t(\Delta', k_1; w) > \phi_{k_2} - \phi_{k_1}.$$

This expression may obtain given the structure of the value function or planning costs.

A.2 Proof of Proposition 2

This proof proceeds similarly to the proof for Proposition 1. Given income y, consider two levels of wealth at time t such that w' > w and three planning horizons of decreasing

length, $k_2 > k_1 > k_0$. Let $k_1 \equiv k_t^*(w)$ denote the optimal planning horizon for the smaller level of initial wealth, w. I establish the weak inequality in two steps.

First, I prove that for w', the planning horizon k_1 dominates any $k_0 < k_1$. Given the optimality of k_1 for w, we have that

$$V_t(\Delta, k_1; w) - \phi_{k_1} > V_t(\Delta, k_0; w) - \phi_{k_0},$$

and, re-arranging, that

$$V_t(\Delta, k_1; w) - V_t(\Delta, k_0; w) > \phi_{k_1} - \phi_{k_0}.$$

As above, this expression states the the marginal value of increasing the planning horizon is more than offset by the marginal increase in planning costs. Since $k_2 > k_1$, by Lemma 2,

$$V_t(\Delta, k_1; w', y) - V_t(\Delta, k_0; w', y) > V_t(\Delta, k_1; w, y) - V_t(\Delta, k_0; w, y).$$

The marginal value from increasing planning horizons is larger for w' than it is for w'. Combining with the above and re-arranging,

$$V_t(\Delta, k_1; w', y) - V_t(\Delta, k_0; w', y) > \phi_{k_1} - \phi_{k_0}$$
$$V_t(\Delta, k_1; w', y) - \phi_{k_1} > V_t(\Delta, k_0; w', y) - \phi_{k_0}$$

establishing that for w', k_1 is preferred over k_0 . Intuitively, if increasing planning horizons from k_0 to k_1 is preferred for the lower level of wealth, then this is also preferred for the larger level of wealth given that the slope of the value function with respect to planning horizons is increasing in wealth.

Second, I prove that for w', the planning horizon $k_2 > k_1$ may be optimal. This is the case when

$$V_t(\Delta, k_2; w) - \phi_{k_2} > V_t(\Delta, k_1; w) - \phi_{k_1}$$

which holds if the marginal value from increasing the planning horizon is larger than the marginal cost,

$$V_t(\Delta, k_2; w) - V_t(\Delta, k_1; w) > \phi_{k_2} - \phi_{k_1}.$$

This expression may obtain given the structure of the value function or planning costs.

B Robustness of Consumption Spending Responses

This section contains additional regressions that demonstrate robustness of the results in Section 5.3.2. Instead of grouping households by relative shock size, i.e., Economic Stimulus Payment divided by income, Table A1 sorts households by income in Panel (a) and by the reciprocal of income in Panel (b). In both cases, the patterns documented in Section 5.3.2 no longer hold, indicating that including the shock size in determining groups is crucial.

		Panel (a): T	erciles by I	ncome			
	(a) No	n-Durables	(b)	Durables	(0	c) Total	
	Estimate	Implied MPC	Estimate	Implied MPC	Estimate	Implied MPC	
ESP (Base: Tercile 1)		0.251		0.914*	1	.165**	
	(0.161)		(0.486)		(0.520)		
$ESP \times Tercile 2$	-0.104	0.147	-0.518	0.396	-0.622	0.543	
	(0.119)	(0.122)	(0.366)	(0.409)	(0.390)	(0.439)	
$ESP \times Tercile 3$	-0.006*	0.245**	-0.373	0.541	-0.378	0.787*	
	(0.130)	(0.116)	(0.379)	(0.379)	(0.406)	(0.406)	
Observations		8,592		8,592		8,592	
R^2		0.017		0.005		0.008	

Table A1: Spending Response of Consumption to ESP by Income Group

Panel (b): Terciles by $\frac{1}{\text{Income}}$							
	(a) No	n-Durables	(b)	Durables	(d	c) Total	
	Estimate	Implied MPC	Estimate	Implied MPC	Estimate	Implied MPC	
ESP (Base: Tercile 1)	(0.248** (0.116)		0.566 (0.375)		0.813** (0.403)	
$ESP \times Tercile 2$	-0.107	0.141	-0.207	0.359	-0.314	0.500	
	(0.108)	(0.122)	(0.350)	(0.414)	(0.377)	(0.444)	
$\text{ESP} \times \text{Tercile 3}$	0.003	0.251	0.347	0.913*	0.350	1.163**	
	(0.129)	(0.161)	(0.376)	(0.486)	(0.403)	(0.520)	
Observations R^2		8,592 0.017		8,592 0.005		8,592 0.008	

Notes: Standard errors in parentheses. *, **, *** denote significance at the 0.10, 0.05, and 0.01 levels under the assumption of a single test. Estimated using two stages least squares and instrumenting for ESP amount with an indicator for ESP receipt. See Parker et al. (2013) for more details.

Tables A2 and A3 re-estimate the baseline specification with different sets of controls. The baseline specification is exactly as specified in Parker et al. (2013) except for tercile of relative shock size. In Table A2, I remove controls for family composition, and in Table A3, I add controls for income. In both cases, the results are very similar to the baseline, lending credence to the identification strategy.

	(a) No Estimate	n-Durables Implied MPC	(b) Estimate	Durables Implied MPC	(c Estimate) Total Implied MPC
ESP (Base: Tercile 1)	 (0.331**	(0.744 0.535)	1	1.076* 0.575)
$ESP \times Tercile 2$	-0.132 (0.138)	0.199* (0.120)	-0.091 (0.423)	0.653* (0.392)	-0.223 (0.456)	0.852** (0.424)
ESP \times Tercile 3	-0.216 (0.136)	0.115 (0.109)	-0.296 (0.423)	0.448 (0.347)	-0.513 (0.453)	0.563 (0.368)
Observations R^2		8,592 0.015		8,592 0.004		8,592 0.007

Table A2: Robustness of Spending Response: No Family Composition Controls

Notes: Standard errors in parentheses. *, **, *** denote significance at the 0.10, 0.05, and 0.01 levels under the assumption of a single test. Estimated using two stages least squares and instrumenting for ESP amount with an indicator for ESP receipt. See Parker et al. (2013) for more details.

Table A3. Robustiless of Spending Response. Income Controls	Table A3: Robustness	of Sr	pending	Response:	Income	Controls
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	(a) No	n-Durables	(b)	Durables	(c	c) Total
	Estimate	Implied MPC	Estimate	Implied MPC	Estimate	Implied MPC
ESP (Base: Tercile 1)	().332* 0.181)	(0.760 (0.577)	1	1.091* 0.621)
$\text{ESP} \times \text{Tercile 2}$	-0.120	0.212*	-0.129	0.631	-0.249	0.842**
	(0.147)	(0.119)	(0.449)	(0.390)	(0.486)	(0.422)
ESP \times Tercile 3	-0.206	0.126	-0.338	0.421	-0.544	0.548
	(0.157)	(0.105)	(0.486)	(0.334)	(0.523)	(0.353)
Observations R^2		8,592 0.018		8,592 0.005		8,592 0.007

Notes: Standard errors in parentheses. *, **, *** denote significance at the 0.10, 0.05, and 0.01 levels under the assumption of a single test. Estimated using two stages least squares and instrumenting for ESP amount with an indicator for ESP receipt. See Parker et al. (2013) for more details.

C ESPs to Wealthy Hand-to-Mouth Households

Kaplan and Violante (2014) introduce a new class of constrained households that they call the wealthy hand-to-mouth. They define households as hand-to-mouth using liquid wealth, and define them as poor or wealth using illiquid wealth. Traditionally, empirical analysis in this literature focuses only on total net work and thus only the poor hand-to-mouth. Instead, Kaplan and Violante show that a large fraction of households that have low liquid wealth but high net worth behave similarly to households with low liquid wealth and low net worth. These households are defined as the wealthy hand-to-mouth.

A key insight to their analysis is that the ratio of liquid wealth to income is the relevant statistic, as opposed to the level of liquid wealth:

$$LWI = \frac{\text{liquid wealth}}{\text{periodic income}}$$

For example, a household that earns \$1000 per month and carries \$5000 in liquid wealth has LWI = 5, whereas a household that earns 10,000 per month and carries \$5000 in liquid wealth has LWI = 0.5.

Kaplan and Violante deem households hand-to-mouth if their LWI ratios fall within one of two intervals. First, if their liquid wealth to income ratio is between 0 and 1, the household is hand-to-mouth because they keep less than one month of income on hand. Second, allowing for a credit limit up to one month of income, households whose liquid wealth to income is less than -1 are also hand-to-mouth.

	Estimate	Implied MPC			
ESP (Base: Tercile 1)	0.186 (0.163)				
$ESP \times Hand-to-Mouth$	0.045 (0.152)	0.231 (0.143)			
Observations R^2	3,446 0.024				

Table A4: CEX Regressions with H2M Indicator

In the CEX, I calculate LWI and remove extreme outliers (LWI > 10). I then calculate hand-to-mouth status using the two criteria above. To estimate the differential MPC for hand-to-mouth consumers, I estimate the baseline regression and interact the hand-to-mouth indicator with ESP payment. The estimated coefficients are in Table A4. Although

none of the estimated coefficients are statistically significant, the patterns are consistent with existing evidence. The MPC for hand-to-mouth households is 0.231, which is 0.045 percentage points or almost 25% larger than the MPC for non-hand-to-mouth households, 0.186. Again, however, the MPC for non-hand-to-mouth households is much larger than the prediction of near-zero MPCs in standard models.

	Estimate	Implied MPC			
ESP (Base: Tercile 1)	0.334* (0.173)				
$ESP \times Tercile 2$	-0.263 (0.178)	0.071 (0.154)			
$\text{ESP} \times \text{Tercile 3}$	-0.082 (0.191)	0.252 (0.180)			
Observations R^2		3,446 0.024			

Table A5: CEX Regressions with LWI Terciles

As a robustness check, I also separate households into terciles based on liquid wealth to income. In Kaplan et al. (2014), the authors check robustness by changing the criteria used to define LWI (i.e. pay periods, credit limits, etc.), which essentially changes the intervals that define hand-to-mouth status. Dividing households by LWI serves the same purpose. I estimate the baseline regression and interact LWI tercile with ESP payment and the estimated coefficients are in Table A5. Again consistent with existing evidence, I find that households in the lowest tercile are those with the highest MPC. However, the estimated relationship between LWI tercile and MPC is U-shaped, similar to previous findings using this data for the relationship between MPC and wealth. Households in the middle tercile have an MPC of only 0.071, while households in the high tercile have an MPC of 0.252. Overall, it is hard to infer too much from this U-shaped pattern, but it remains the case that the MPC for unconstrained households is too high relative to what standard models would predict.

D Theoretical Construction of the Marginal Propensity to Consume

In standard consumption-savings problems, the marginal propensity to consume out of a temporary income shock is a partial derivative of the consumption function. If the temporary income shock is represented as a distinct state, then the derivative is taken with respect to that state. For example, consider a standard one-asset model in which a house-hold forms state-contingent plans over wealth, *a*, autoregressive permanent income, ν , and perfectly transient temporary income shocks, ϵ . The marginal propensity to consume out of temporary income shocks is given by

$$\mathrm{MPC}(a,\nu,\epsilon) = \frac{\partial c(a,\nu,\epsilon)}{\partial \epsilon}.$$

In practice, the statespace in standard models can be reduced by one dimension since the temporary income shock is equivalent to wealth. To see this, note that when the household's problem is written recursively, the consumption policy function is given by

$$c(a,\nu,\epsilon) = \arg\max_{c} u(c) + \beta E[V(a',\nu',\epsilon')|\nu],$$

with $a' = (1+r)(\nu + \epsilon + a - c(a, \nu, \epsilon))$. Via the budget constraint, a change in ϵ is equivalent to a change in a. Economically, the perfectly transient income shock is equivalent to the household beginning the period with a different level of wealth. Importantly, a change in the temporary income shock, ϵ , is not equivalent to a change in permanent income, ν , because the latter is autoregressive and enters the conditional expectation.

When the statespace is reduced to wealth and permanent income, the marginal propensity to consume out of a temporary income shock, ϵ , can be written as

$$\lim_{\epsilon \to 0} \frac{c(a+\epsilon,\nu) - c(a,\nu)}{\epsilon}$$

which is the partial derivative of the consumption function with respect to wealth.

E Comparison of Time Preference Structures

The finite planning horizon model developed in this paper is isomorphic to the standard recursive consumption-saving model with a specific discount rate structure. In this section, I consider a household that lives for T periods and faces an income shock at time

t = 1, and I compare the discount rate structure of exponential or quasi-hyperbolic discounting with the finite planning horizon model.

Suppose that, for the same reasons as in the finite planning horizon model, the household in the standard model must reoptimize consumption and savings plans to account for the unexpected change in income at time t = 1. The first two rows of Table A6 show how future periods are discounted with exponential and quasi-hyperbolic discounting.

	Periods After $t = 1$									
	1	2		k-1	k	k+1	•••	T-1	T	
Standard Discounting	β	β^2		β^{k-1}	β^k	β^{k+1}		β^{T-1}	β^T	
Quasi-Hyperbolic Discounting	β	$\delta \beta^2$		$\delta\beta^{k-1}$	δeta^k	$\delta\beta^{k+1}$		$\delta\beta^{T-1}$	$\delta\beta^T$	
Finite <i>k</i> -period Plan	β	β^2		β^{k-1}	β^k	0		0	0	

Table A6: Discounting Factors in Consumption-Saving Models

In the standard model, discount rates are a geometric series with base β . With quasihyperbolic discounting, the household discounts between time t + 1 an t + 2 using $\delta\beta$, but then discounts any two further future periods, i.e., t + 3 and t + 4,⁸ using only β . This generates present bias since the household discounts the immediate future more than the distant future.

The third row of Table A6 shows discount rates in the finite horizon model. Faced with an income shock at time t = 1, the household determines an optimal k-period planning horizon over which to reoptimize. Within the planning horizon, the household uses standard exponential discounting. Beyond the planning horizon, the household behaves as-if the income shock had never occurred and uses its existing long-term consumption and savings plans. As a result, from the perspective of its reoptimization, it is as-if the household completely disregards all periods beyond k, i.e., discounts them with rate zero.

E.1 Comparison to Models of Present Bias

To isolate the impact of finite planning horizons on household behavior, I make as few departures as possible from the standard model with geometric time discounting. It is straightforward to incorporate bounded intertemporal rationality into a model with

⁸More generally, t + s and t + s + 1 for any $s \ge 2$. I also deviate from the standard notation in quasi-hyperbolic discounting in order to maintain comparability with the notation in standard discounting. Specifically, I use β for the exponential/geometric discounting and δ for the additional first-period discounting, as opposed to the opposite notation usually employed in this literature (see, for example, Laibson (1997)).

present bias since the two mechanisms are complimentary. Present bias, modeled using quasi-hyperbolic discount factors, has been used to generate larger aggregate consumption responses, but unlike bounded intertemporal rationality, cannot generate large consumption responses for unconstrained households because the degree of the present bias endogenously and negatively covaries with wealth.

To demonstrate this, Harris and Laibson (2001) derive a generalized Euler equation under hyperbolic preferences and show that a household's "effective discount factor" is a weighted average between the standard exponential discount factor and the present bias discount factor. The weight on the present bias discount factor is the expected marginal propensity to consume in the next period, which depends exclusively on expected wealth in the next period. In this class of models, wealth is highly persistent. Unconstrained households anticipate continuing to be unconstrained and their effective discount factor places almost all weight on the standard exponential factor. As a result, these households' consumption responses are small and observationally equivalent to those in the standard model. Constrained households anticipate continuing to be constrained and have effective discount factors that are larger than in those in the standard model, generating even larger consumption responses out of income shocks for constrained households. Altogether, for a given fraction of constrained households, the aggregate consumption responses will be larger than in the standard model, and the aggregate response, again, is driven by constrained households.

Empirically, Gelman (2021) estimates a consumption response function that is in line with predictions from the generalized Euler equation. Gelman presents estimates of the consumption response to a positive income shock for households sorted by quintiles of liquidity. Unconstrained households in the upper quintiles consume evenly across many periods, which is consistent with both present bias and exponential discounting. Constrained households in the lower quintiles unevenly tilt consumption towards earlier periods, which is a telltale sign of present bias. However, the estimated level of the consumption responses for unconstrained households is too large to be explained by either type of discounting on its own, but these responses can be explained by finite planning horizons.

F Constructing Liquid Wealth in the CEX

In the 2008 wave of the Survey of Consumer Expenditures (CEX), approximately half of households did not respond to the optional question on liquid assets, and there is no corresponding question on liquid debt. As such, in this section, I describe the method by

which I merge the CEX and Survey of Consumer Finances (SCF), which contains detailed data on both liquid assets and debt.

The SCF collects responses from two groups: a random sample of US households and an additional selected sample of high-wealth households (who, generally, have higher income). In order to make the distributions of household income in the SCF and CEX comparable, I drop the top 6% of observations (see, for example, Heathcote, Perri and Violante (2010) for a broader discussion on comparing household income and wealth across surveys). In Figure 11, I plot monthly income by percentile in each survey. I evaluated dropping between the top 1 and 10% of households in the SCF and found that 6% minimized the mean squared error between each line in the figure. Notably, household income in each percentile is remarkably similar until around the 95th percentile.



Figure 11: Monthly Income by Percentile in CEX and SCF

Notes: Top 6% of income distribution in SCF truncated in order to approximate income distribution in CEX. See text for details.

Figure 12 verifies that liquid assets in each distribution are similar. The solid lines represent the median value of liquid assets in each survey. Unsurprisingly, liquid assets in the CEX display much more variability. In both surveys, liquid assets are increasing in income; this is made clearer by the dashed lines, which are estimated logarithmic regressions of the income percentile on median liquid assets. The lines are almost perfectly overlaid, demonstrating the similarity between liquid assets in the raw CEX and truncated SCF distributions.

Finally, Figure 13 plots median liquid assets and liquid wealth by income percentile in the SCF. The difference between the two is liquid debt, which has been documented to be





Notes: Top 6% of income distribution in SCF truncated in order to approximate income distribution in CEX. See text for details.

increasing in household income (see, for example, Bornstein and Indarte (2020) or Boutros and Mijakovic (2024)). For all households, there is a notable difference between liquid assets and wealth. Altogether, these values of liquid wealth from the SCF are matched to households in the CEX by percentile of monthly income.

Figure 13: Liquid Assets and Liquid Wealth by Percentile in SCF



Notes: Top 6% of income distribution in SCF truncated in order to approximate income distribution in CEX. See text for details.