Marginal Propensities to Consume
with Mental Accounting[*]

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Abstract

The empirical literature studying marginal propensities to consume (MPCs) has identified a set of puzzles that are difficult to reconcile with traditional theories of consumption behaviour. This paper proposes a model of dissaving-averse households, a behavioural feature consistent with mental accounting, that addresses several of these puzzles jointly. The model generates high MPCs out of income gains, low MPCs out of income news and wealth and asymmetric MPCs, i.e. stronger consumption responses to income losses than to income gains, for high-liquidity households. I show through the lens of a quantitative life-cycle model with mental accounting preferences that asymmetric MPCs dampen the effectiveness of redistributive fiscal policy.

Keywords: Consumption, Mental accounting, Fiscal stimulus
JEL Codes: D12, D91, E21, H31

1 Introduction

The marginal propensity to consume (MPC) plays a central role in the transmission of fiscal and monetary policy by quantifying the consumption response to changes in income. At the same time, understanding the magnitude of the MPC helps discriminate between different models of consumption behaviour. In this context, the empirical literature has identified several puzzles that are difficult to reconcile with traditional theories of household consumption behaviour. Empirically observed consumption responses tend to be excessively sensitive to contemporaneous income changes, insensitive to changes in wealth and news about future income, and only loosely related to liquidity constraints.

This paper first aggravates the divide between theory and data by putting forward an additional puzzle: consumption responds more strongly to income losses than to income gains irrespective of liquidity constraints. It then resolves this divide by proposing a unifying theoretical framework of consumption behaviour that jointly addresses the aforementioned puzzles.

Five widely documented empirical observations motivate the disconnect between empirical and theoretical MPCs. First, MPCs are larger than predicted by the permanent income hypothesis (Parker et al., 2013; Fagereng et al., 2021; Crawley and Kuchler, 2023). Second, the MPC out of income losses is larger than the MPC out of income gains, i.e. MPCs are asymmetric (Baker, 2018; Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2021). Third, MPCs out of news about future income changes are lower than MPCs out of current income changes. (Ganong and Noel, 2019; Graham and McDowall, 2024; Fuster et al., 2021). Fourth, MPCs out of changes in wealth are similarly low (Di Maggio et al., 2020; Chodorow-Reich et al., 2021; Christelis et al., 2021). In principle, a combination of liquidity constraints and transaction costs can explain observations one to four. However, a fifth observation is that the magnitude of the MPC is only weakly related to household liquidity (Parker et al., 2013; Christelis et al., 2019; Lewis et al., 2019; Fuster et al., 2021).

Several theories have been suggested that can explain high MPCs out of income or low MPCs out of income news or wealth without relying on liquidity constraints (Reis, 2006; Kueng, 2018; Laibson et al., 2021; Lian, 2021a; Boutros, 2022; Ilut and Valchev, 2023), but they fail at generating larger consumption responses to income losses than to income gains. For this reason, I focus on the second fact, the MPC asymmetry, as the central statistic to discriminate between consumption models. In support of this choice, I provide additional evidence on the extent of MPC asymmetries in the data. Using hypothetical household spending responses to positive and negative income shocks from the Fed Survey of Consumer Expectations (SCE), I find a relatively small average MPC out of positive income shocks of 0.20 and a substantially larger average MPC

out of negative income shocks of 0.73. Compared to Fuster et al. (2021), who also use the SCE to study asymmetries but consider a substantially smaller income shock, the asymmetry found in this paper is twice as large. This suggests that size effects might play an important role in the determination of the MPC asymmetry.

Asymmetric consumption responses are a pervasive feature of household behaviour. Around 85 percent of households indicate that they would adjust consumption more strongly in response to negative than to positive income changes. These responses do not seem to be driven by differences in liquidity as heterogeneity across the distribution of liquid wealth is moderate. The difference between the MPC out of income losses and income gains decreases from 0.62 for the bottom quintile to 0.42 for the top quintile of the liquid wealth distribution, but this decrease is small relative to the absolute level of the asymmetry. More liquidity primarily reduces the MPC out of losses, but insufficiently so to close the gap with the MPC out of gains. The asymmetry is present across various measures of liquidity and therefore unlikely to be explained by the presence of wealthy hand-to-mouth households, who hold substantial amounts of wealth but behave like liquidity-constrained households due to a large share of illiquid assets (Kaplan et al., 2014).

The empirically observed MPC asymmetry is at odds with the predictions of conventional consumption models. Models that incorporate borrowing constraints and idiosyncratic income risk can explain larger consumption responses to income losses than to income gains for households with low liquidity through the concavity of the consumption function (Kaplan and Violante, 2010), but predict symmetric MPCs for households that are not liquidity-constrained. This conclusion holds irrespective of the existence of an illiquid asset in the choice set of the household, which extends the share of households in the economy that are liquidity-constrained (Kaplan and Violante, 2014), but does not materially affect the behaviour of unconstrained households. I also illustrate how the introduction of asymmetric portfolio adjustment costs does not generate meaningful asymmetries in MPCs.

In order to rationalize these empirical patterns, I propose an extension of the standard consumption model that incorporates mental accounting preferences (Shefrin and Thaler, 1988; Graham and McDowall, 2024). Mental accounting theory suggests that individuals split their financial resources into separate mental categories or accounts, where each account is assigned specific rules or purposes. Using funds for something other than its intended purpose can create a mental burden, breaking the assumption of fungibility. Such violations of fungibility are frequently discussed as an explanation for household consumption behaviour, but are rarely explicitly formalized (Baugh et al., 2021; Fuster et al., 2021; Boehm et al., 2023).

I consider a framework with two mental accounts, one for income and one for assets as in Graham and McDowall (2024). Funds pertaining to the income account are labelled for spending, while funds in the asset account are labelled for savings. The central feature of the model is a utility cost of consuming out of the mental account for assets. This cost is governed by the level of *dissaving-aversion* that households exhibit, i.e. how much they dislike spending out of the asset account.

The partition between mental accounts is given by a saving rule against which households benchmark their saving decisions. Saving more than suggested by the saving rule implies that consumption is fully covered by funds from the income account while saving less implies consumption out of the asset account, which is costly. The assumption of households following saving rules is supported by the data. Most households in the SCE sample in fact state that they plan their savings.

The design of the saving rule is central to the predictions of the model and constitutes the most relevant deviation from the mental accounting framework in Graham and McDowall (2024). Motivated by behavioural theories of costs to information acquisition and processing (Gabaix, 2014; Ilut and Valchev, 2023), I consider a saving rule that is derived from an optimization problem which only partially takes into account the household's state vector. Households in Graham and McDowall (2024), instead, follow a simpler rule-of-thumb in which the saving rule is given by households' current wealth. I illustrate how added sophistication in the formation of the saving rule generates very distinct consumption responses.

The response of the saving rule to changes in resources is informative about the mental classification of funds – under a fully flexible saving rule, funds are classified as assets while under a rigid rule, they are classified as income. I assume that the saving rule adjusts flexibly to changes in wealth, but only imperfectly to changes in income. The combination of dissavings-aversion and rigidity in saving rules generates rich non-linearities in the consumption response to different types of shocks.

I show analytically that a stylized version of the mental accounting model generates predictions that are consistent with three empirical observations. First, it generates MPCs out of income losses that are larger than MPCs out of income gains. Second, it predicts responses to news about income changes that are smaller than responses to contemporary income changes in excess of what a model without mental accounting would predict. Third, it predicts MPCs out of wealth that are lower than MPCs out of income.

To study the implications of dissaving-aversion in a quantitative setup, I incorporate mental accounting preferences into a life-cycle model with income risk and borrowing constraints. I discipline the dissaving-aversion motive by matching two moments of the data: the average MPC out of losses and the share of households with a saving plan

in the SCE. A moderate degree of dissaving-aversion is sufficient to match the targeted moments. The welfare loss incurred by mental accounting amounts to less than one percent of life-time consumption.

The quantitative model generates large MPC asymmetries that closely match the ones observed in the data. It predicts large MPCs out of losses across all levels of wealth while keeping MPCs out of gains moderate. The precise magnitude of the asymmetry depends on the size of the income shock, providing a potential explanation for the differences in empirical estimates of MPC asymmetries across studies. At the same time, it also addresses empirical facts one and five which were not captured in the analytical framework. First, the mental accounting model predicts a relatively large average MPC out of gains for unconstrained households compared to a model without mental accounting. Intuitively, mental accounting imposes an additional constraint around which households reduce their consumption. Income windfalls relax this constraint and lead to large consumption responses, similarly to the mechanics of a borrowing constraint. Second, the mental accounting model partly flattens the gradient of the MPC in wealth by attaching less importance to the role of liquidity constraints in the determination of MPCs through the addition of the dissaving-aversion motive. It also generates lower MPCs out of income news and wealth in line with empirical observations three and four and the predictions of the analytical model.

The policy implications of pervasive MPC asymmetries are considerable. They suggest a cautious approach to certain types of redistributive fiscal policies as the traditional logic of redistributing from high-income (low MPC) to low-income (high MPC) households does not necessarily hold in this framework. If high-income households have large MPCs out of losses, their reduction in consumption might be enough to offset the increase in consumption by low-income households. A simulation of the mental accounting model suggests that the effectiveness of a simple redistributive policy in which the bottom half of the income distribution receives transfers crucially depends on how the transfers are financed. A one-off income tax on the richest quarter of households slightly *reduces* aggregate consumption while taxing wealth or future income instead of current income substantially increases aggregate consumption due to low MPCs out of wealth and income news, but high MPCs out of income.

Apart from purely redistributive policies, asymmetric MPCs can also have more general implications. If MPCs at the micro-level are indicative of MPCs at the macro-level, fiscal contractions could translate into stronger consumption responses than fiscal expansions. This is particularly relevant in the light of recent empirical evidence showing asymmetric responses to fiscal policy at the aggregate level (Barnichon et al., 2022). Similar results have been established for monetary policy albeit the mapping to the macro-level is arguably more intricate. Grigoli and Sandri (2022) shows that consumption responds

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more to contractionary than to expansionary shocks while Tenreyro and Thwaites (2016) and Angrist et al. (2018) show that output responds more to interest rate hikes than cuts.

The remainder of this section relates this paper to the literature. Section II presents the empirical facts motivating this study. Section III describes the data and empirical results. Section IV introduces the analytical framework. Section V presents the quantitative model while Section VI draws out implications for fiscal policy. Section VII concludes.

Literature. The theoretical framework outlined in this article connects to a wide literature that finds consumption patterns that are inconsistent with predictions of traditional consumption models. It provides a rationale for large MPCs out of income gains (Parker et al., 2013; Lewis et al., 2019; Fagereng et al., 2021; Crawley and Kuchler, 2023), asymmetric MPCs (Bracha and Cooper, 2014; Sahm et al., 2015; Baker, 2018; Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2021), lower MPCs out of wealth than out of income (Di Maggio et al., 2020), and consumption that is insensitive to the receipt of news about future income, but excessively sensitive once the predictable income change materializes (Kueng, 2018; Olafsson and Pagel, 2018; Ganong and Noel, 2019; Graham and McDowall, 2024; Fuster et al., 2021) without relying on theories of borrowing constraints or transaction costs.

Several studies propose behavioural extensions that rationalize selected aspects of the empirically observed consumption responses. Most of these extensions are focused on generating high MPCs out of income gains. Prominent examples include present bias (Laibson et al., 2021), temptation preferences (Attanasio et al., 2020), near-rationality (Kueng, 2018), bounded rationality (Boutros, 2022), anticipation-dependence (Thakral and To, 2021) or imperfect reasoning (Ilut and Valchev, 2023). Lian (2021a) proposes a mechanism through which anticipation of future mistakes amplifies both MPCs out of gains and losses. Ganong and Noel (2019) introduces households with present bias to generate high MPCs out of predictable income losses. Most closely related to the model presented in this paper, Graham and McDowall (2024) introduces mental accounting to explain high MPCs out of predictable income gains. In contrast to these studies, my model explicitly addresses MPC asymmetries and illustrates their relevance for redistributive fiscal transfers. At the same time, it also *jointly* explains the previously mentioned consumption patterns through the addition of just one friction. While the model in Graham and McDowall (2024) also generates MPC asymmetries, it predicts the opposite asymmetry, i.e. MPCs out of gains that are larger than MPCs out of losses.

This paper also adds to the broader literature on mental accounting by providing a theoretical underpinning to empirical studies of mental accounting. Evidence for mental accounting has been found in the allocation of resources across different types of con-

sumption goods (Milkman and Beshears, 2009; Hastings and Shapiro, 2013; Abeler and Marklein, 2017; Hastings and Shapiro, 2018; Liu et al., 2021) but also in driving total consumption expenditure (Bernard, 2022; Gelman and Roussanov, 2023). This paper relates to the latter and uses mental accounting to explain the allocation of resources across consumption and savings by extending the framework in Graham and McDowall (2024).

Finally, this article is closely related to the empirical literature on MPC asymmetries. Christelis et al. (2019), Fuster et al. (2021) and Kotsogiannis and Sakellaris (2023) document that consumption responds more strongly to negative than to positive income shocks using survey responses to hypothetical income changes. Bracha and Cooper (2014), Sahm et al. (2015) and Bunn et al. (2018) find similar evidence for reported consumption responses to actual income changes while Baker (2018) documents asymmetries using household financial accounts data. Baugh et al. (2021) finds larger responses to income gains than to income losses, but studies expected instead of unexpected income changes which are not the focus of this study. Ballantyne (2021) and Boudt et al. (2022) also find a positive asymmetry using semi-structural methods. This paper contributes to the literature by studying the effects of a relatively large hypothetical income shock and showing that asymmetric consumption responses are sizeable across all levels of wealth and liquidity. Differently to other studies, this paper also provides a theoretical framework that generates large asymmetries for households which are not liquidity-constrained.

2 Stylized facts on MPCs

This section presents five widely documented empirical facts on MPCs that have been established over a variety of methodologies and data sets.[1]

Fact 1: MPCs out of income are large. According to the permanent income hypothesis, the consumption response to transitory fluctuations in income should be close to zero. However, meta-surveys suggest that MPCs are substantially larger than zero (Jappelli and Pistaferri, 2010; Havranek and Sokolova, 2020). While theories of liquidity constraints can explain large MPCs for households close to the borrowing constraint, there is ample evidence of high MPCs for households that are not liquidity-constrained. This has been established across a wide array of studies that differ in methodology, data and the precise definition of MPC and liquidity. For example, Parker et al. (2013) estimates an average quarterly MPC of 0.12-0.30 out of tax rebates with little variation for high-liquidity households. Fagereng et al. (2021) and Golosov et al. (2021) find MPCs of around 0.50 out of lottery winnings for high-liquidity households. Crawley and Kuchler

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[1]Due to the extensive number of empirical studies, the review is certainly non-exhaustive and there may be contrasting evidence on selected findings.

(2023) apply semi-structural methods in the spirit of Blundell et al. (2008) and estimate an MPC of 0.32 for highly liquid households.

Fact 2: MPCs are asymmetric. The permanent income hypothesis predicts symmetric consumption responses to income gains and income losses due to the linearity of the consumption function. However, several studies report consumption responses to income losses that are larger than responses to income gains using hypothetical survey questions (Christelis et al., 2019; Fuster et al., 2021; Kotsogiannis and Sakellaris, 2023), reported consumption behaviour (Bracha and Cooper, 2014; Sahm et al., 2015; Bunn et al., 2018) and transaction-level data from household financial accounts (Baker, 2018). Liquidity constraints can in principle generate such asymmetries through a concave consumption function, but the evidence suggests that also households that are not liquidity-constrained respond asymmetrically to fluctuations in income.

Fact 3: MPCs out of income news are low. Only the present value, not the timing of income changes should determine the consumption response of a permanent income consumer. However, several studies find that consumption barely responds to news about future income. Kueng (2018) and Graham and McDowall (2024) study the response to pre-announced payments using transaction-level data and find negligible anticipation effects. In a survey setting, Fuster et al. (2021) documents that the consumption response to news about future income changes is smaller compared to a similar, but immediate change in income. While borrowing constraints can explain the unresponsiveness to future income gains, they counterfactually predict immediate consumption responses to future income losses (Ganong and Noel, 2019).

Fact 4: MPCs out of wealth are low. The consumption response of a permanent income consumer to a change in wealth should be identical to a change in income as long as both changes have the same effect on permanent income. However, MPCs out of wealth tend to be substantially lower than MPCs out of income. Mian et al. (2013) and Christelis et al. (2021) find MPCs out of housing wealth of less than 0.10, while Chodorow-Reich et al. (2021) estimates an MPC out of stock market wealth of 0.03. Baker et al. (2007) and Di Maggio et al. (2020) compare consumption responses to capital gains and dividend payouts and find MPCs out of capital gains that are substantially smaller than MPCs out of dividend payments. Bernard (2022) shows in a randomized control trial that consumption responds less to windfalls deposited in an instant-access savings account than paid out in cash. A combination of transaction costs and borrowing constraints can in principle generate differential responses to income and wealth, but the evidence suggests that these are insufficient to explain the empirically observed consumption responses.

Fact 5: The link between MPCs and liquidity is often weak. In theory, several of the aforementioned empirical findings can be explained by the presence of liquidity

constraints (Deaton, 1991). Empirically, however, there is often either no clear link between the MPC and access to liquidity or that link is not strong enough to explain the MPC anomaly (e.g. Lewis et al. (2019)). Unless one believes that liquidity constraints are systematically mismeasured and the majority of households are in fact liquidity-constrained, the empirical literature suggests that there are other factors at play.

Several theories have been suggested that can explain high MPCs out of income or low MPCs out of income news and wealth without relying on liquidity constraints (Reis, 2006; Kueng, 2018; Laibson et al., 2021; Lian, 2021a; Boutros, 2022; Ilut and Valchev, 2023), but they are unsuccessful at generating larger consumption responses to income losses than to income gains. The next section present additional evidence on the degree of MPC asymmetry in the data and the extent to which it is related to liquidity.

3 Evidence on asymmetric MPCs

This section provides additional evidence on the extent of MPC asymmetries in the data. I first describe the survey setting. I then show cross-sectional evidence on MPC asymmetries and illustrate that MPC asymmetries are only weakly related to observable characteristics and present irrespective of the household's position in the wealth distribution. Finally, I present several robustness checks corroborating the validity of the survey data.

3.1 Setting

I measure MPCs using hypothetical survey questions from the New York FED Survey of Consumer Expectations (SCE). The SCE is a monthly online survey of a rotating panel of around 1,300 households. It collects information on household expectations and decisions on a broad variety of topics and provides detailed accounts of household income, balance sheets and demographics. As such, it covers a wide range of variables that are typically considered to affect MPCs.

Survey questions about hypothetical scenarios are widely used to elicit MPCs (Jappelli and Pistaferri, 2014; Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2021) and offer several advantages compared to other methods. First, they provide a simple way to measure MPCs out of negative income shocks. Other approaches, such as quasi-natural experiments (Parker et al., 2013; Fagereng et al., 2021) or semi-structural methods (Blundell et al., 2008; Kaplan et al., 2014; Commault, 2022; Crawley and Kuchler, 2023), are often limited to the measurement of MPCs out of positive income shocks or a mix of positive and negative shocks. Second, they measure both MPCs out of positive *and* neg-

ative income shocks for the same household at the same point in time. This is important if households differ structurally in the types of shocks they face or if MPCs vary over time, for example over the business cycle. Third, the survey format allows me to study the same income shock for all households with respect to its magnitude. Other methods frequently average over various shock sizes, even though the magnitude of the shock both theoretically and empirically affects the level of the MPC.

One might suspect that households' actual consumption choices differ from their intended consumption choices, as stated for example in response to hypothetical scenarios. The literature suggests that MPCs are quite robust to the choice of measurement. Within the context of the 2008 and 2020 stimulus payments, Parker and Souleles (2019) and Parker et al. (2022) compare self-reported consumption responses with actual consumption responses and find that the reported use of stimulus payments is highly informative about the household's actual spending response. Bunn et al. (2018) compares reported MPCs to MPCs from hypothetical survey questions and finds similar values. Shapiro and Slemrod (2003) and Sahm et al. (2010) find that ex-ante intended and ex-post reported consumption responses are comparable, while Graziani et al. (2016) finds ex-post consumption responses that are larger than originally intended. Sahm et al. (2015) finds that such responses are particularly aligned for tax increases, i.e. negative income shocks.

MPC measure. The SCE directly measures MPCs through the following two questions:

Suppose next year you were to find your household with 10% more income than you currently expect. What would you do with the extra income?

Now imagine that next year you were to find yourself with 10% less household income. What would you do?

Participants are asked to give both a qualitative and a quantitative response in which they specify what percentage of additional income they would spend, save or use to pay down debt or, in the case of income loss, what percentage would be absorbed by reducing spending, depleting savings or borrowing. Appendix A.1 provides more detailed information on the response options.

Compared to the existing literature on MPCs, the income change considered in this question is relatively large. Tax rebates, which are often used to study MPCs out of income gains, typically amount to several hundred US dollars. As a consequence, much of the literature studying MPCs out of income losses considers income changes of a similar magnitude (e.g. Fuster et al. (2021)). With a median annual income of 65,000 US dollars, the income change in this setting is considerably larger and comparable to the scenario in Christelis et al. (2019) which considers losses of one month and three months of annual income.

Some caveats apply to the phrasing of the questions and response options, which are ambiguous along some dimensions. The term *spending* could refer to both non-durable and durable consumption. In what follows, I will interpret the responses as referring to spending on non-durable consumption. Section 3.2 discusses in more detail the mapping from non-durable to total consumption and the role of durables for MPC asymmetries. The question is also vague about the horizon over which households would increase or decrease their spending. Lastly, households might have different interpretations regarding the persistence of the income shock. In order to map the empirical MPC to the theoretical framework, I will assume that households interpret the income change as transitory. This is supported by the fact that the level of the MPC out of income gains is comparable to the level found in other articles studying transitory income changes. In general, as long as the same household interprets the two (identically phrased) questions regarding income gains and losses in the same way, the difference or asymmetry between consumption responses to positive and negative shocks should be captured adequately, even if the level of the individual MPC measures is biased.[2]

Sample description. I combine the monthly SCE core survey with two additional modules at lower frequency, the Spending Survey and the Household Finance Survey. Incorporating information on household balance sheets from the Household Finance Survey comes at the expense of losing the panel dimension.[3] I only keep households which respond to both MPC questions. Lastly, I winsorize financial variables at the 1 percent level. This yields a cross-section of 4,009 households over the period 2015-2018.

Table 1 reports summary statistics for demographic and financial variables. It also reports summary statistics for MPCs, which are discussed in the next section. The SCE is designed to be nationally representative, but it somewhat oversamples higher income, wealthier and more educated households. It provides survey weights to account for these differences. A detailed comparison of SCE data with the American Community Survey and Survey of Consumer Finances can be found in Fuster et al. (2021).

3.2   Results

Figure 1 shows the distribution of MPCs across households for both income gains (MPC^+) and income losses (MPC^-). The average MPC^+ is 0.2, which is firmly within the range of empirical estimates. Almost half of the households indicate little to no consumption

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[2]Despite the identical phrasing of the questions, one might be concerned that households interpret the persistence of the gain and loss scenarios differently due to differently experienced histories of shocks. Empirical evidence, however, suggests that the persistence of positive and negative income shocks is similar for the median household (Arellano et al., 2017; Guvenen et al., 2021).

[3]MPCs are similar across the larger sample without balance sheet variables and the final sample. The panel dimension of the larger sample also allows me to establish that MPCs are fairly stable within households.

Table 1: Summary statistics

|	Mean	Median	Std. dev.	Min	Max	N
Demographics						
Age	50.72	51.00	15.24	18	96	4,009
Female	0.48	0.00	0.50	0	1	4,009
College degree	0.56	1.00	0.50	0	1	4,009
Homeowner	0.74	1.00	0.44	0	1	3,684
Financial variables						
Income	82,137	65,000	69,549	0	400,000	3,630
Bank holdings	21,735	3,000	61,906	0	1,600,000	3,421
Liquid assets	90,409	10,000	234445	0	1,600,000	3,450
Liqid debt	27,695	10,000	48,463	0	300,000	3,660
Total assets	450,130	239,000	602,383	0	4,585,000	3,284
Total debt	96,766	36,500	133,111	0	880,000	3,642
Spending responses						
MPC+	0.20	0.10	0.24	0	1	4,009
MPC-	0.73	0.85	0.31	0	1	4,009

Notes: Liquid assets include money in checking and savings accounts, stocks and bonds. Total assets additionally include retirement funds and housing wealth. Liquid debt includes credit card debt, auto loans, student loans, and medical or legal bills. Total debt additionally includes mortgages.

adjustment in response to a positive income shock, while only a negligible share indicates to spend all additional income.

This pattern flips completely for MPCs out of income losses. Almost one half of households fully absorb the income loss by cutting consumption, with only few households not adjusting consumption in response to the loss. The average MPC out of income losses is substantial at 0.73. This value is comparable to the values found in Bunn et al. (2018) and Bracha and Cooper (2014), but larger than in Christelis et al. (2019), Surico and Trezzi (2019) or Fuster et al. (2021).

To emphasize this divergence, the right panel in Figure 1 plots the distribution of MPC asymmetries, defined as the difference between MPC^- and MPC^+ for each household. Almost all households adjust consumption more strongly to negative than to positive income shocks. Moreover, the asymmetry is quantitatively large. The average asymmetry amounts to 0.53, and a quarter of households fully cuts consumption in response to negative income shocks, but does not increase consumption at all in response to positive income shocks. Fuster et al. (2021), instead, who also use the SCE to study asymmetries find an average asymmetry of 0.25. Their estimate, however, is based on an income change of 500 US dollars which is substantially smaller than the 10 percent of annual

Figure 1: Distribution of MPCs out of income gains, losses and asymmetries
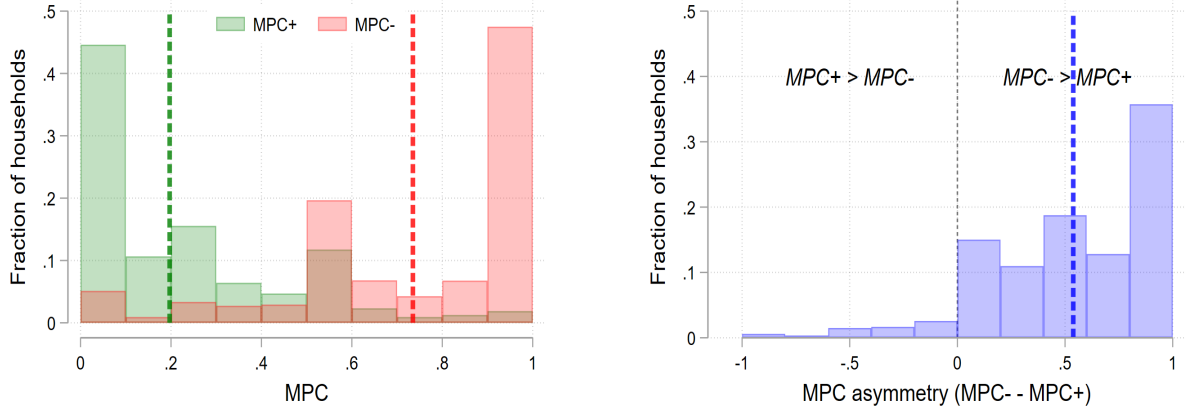
Notes: The dashed lines denote the average MPC^+, MPC^- and MPC asymmetry in the sample.

income studied here.[4] This suggests that size effects might play an important role in the determination of the MPC asymmetry.

The existence of sign asymmetries is by itself not surprising. A standard consumption model with borrowing constraints, for example, predicts asymmetric MPCs for borrowing-constrained households. The size and ubiquity of the asymmetry, however, suggest that liquidity constraints cannot be the main driver of this asymmetry.
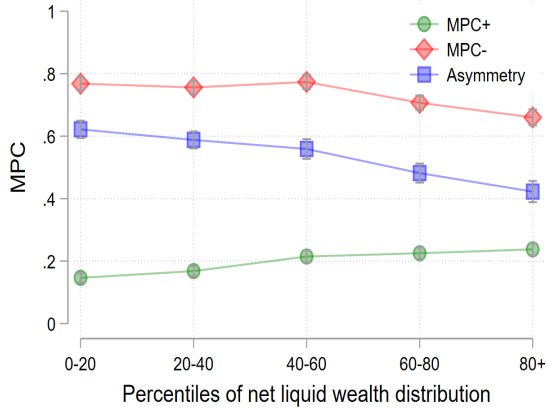
To understand the role of liquidity, Figure 2 plots the average MPC asymmetry across quintiles of the net liquid wealth distribution, defined as the sum of bank deposits, stocks and bonds minus liquid debt. The asymmetry is present irrespective of the position in the wealth distribution. It decreases in wealth, but only marginally compared to the absolute level of the asymmetry, and much less than theory would predict. While a standard consumption model with borrowing constraints and idiosyncratic income risk would predict symmetric MPCs, the data suggest that even the wealthiest 20 percent have an asymmetry of 0.42. Figures A1 and A2 in the Appendix show that this asymmetry is also present for the top ten and five percent of the wealth distribution.

Figure 2 also decomposes the asymmetry into MPCs out of gains and losses. While MPCs out of gains are fairly constant across wealth levels, MPCs out of losses are decreasing in wealth. As such, the MPC out of losses is the primary driver behind the narrowing of the asymmetry for higher levels of wealth. Still, even the wealthiest households display large consumption responses to negative income shocks.

The finding that the relation between MPC^+ and wealth is weak at best has been documented before in other settings (Bunn et al., 2018; Christelis et al., 2019; Fuster
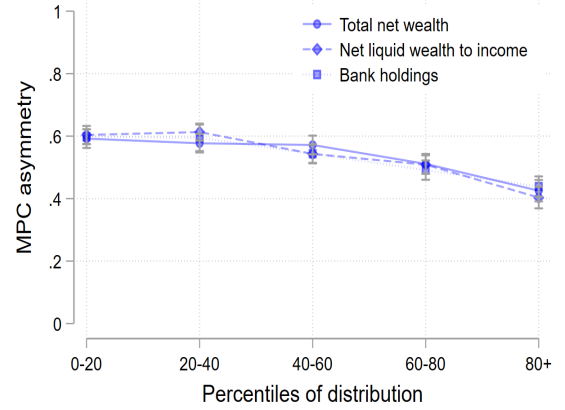
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[4]The authors field a special module to study consumption responses across several scenarios. Apart from the shock size, their question also differs slightly in other aspects.

Figure 2: MPCs across the net liquid wealth distribution	Figure 3: MPC asymmetries across measures of liquidity constraints

Notes: MPC asymmetry is defined as the difference between the MPC out of losses and the MPC out of gains. Grey bars indicate 95% confidence bands.

Notes: Each line corresponds to the MPC asymmetry across the respective distribution. Grey bars indicate 95% confidence bands. Total net wealth is defined as total assets (liquid assets + retirement funds and housing wealth) - total debt (liquid debt + mortgages). Bank holdings refer to money in checking and savings accounts.

et al., 2021; Colarieti et al., 2024). In the SCE, low MPCs out of gains for households with little wealth are primarily driven by households that hold debt. These households predominantly use the income windfall to repay debt, as for example studied in Kosar et al. (2023) and Boutros and Mijakovic (2024). To illustrate this point, Figure A3 of the Appendix singles out the role of net debtors and shows that once net debtors are excluded, the relation between MPCs out of gains and wealth is essentially flat. Boutros and Mijakovic (2024) further shows that net wealth positions are not sufficient to accurately characterize the MPC. Because a large part of the population simultaneously holds liquid assets *and* credit card debt, gross wealth positions are more informative about marginal propensities than net positions. The positive relation between MPC^+ and wealth could also be explained by the large size of the transfer. Andreolli and Surico (2021), for example, finds a similar slope for large, but not small transfers and explains this finding through a model with non-homothetic preferences. Colarieti et al. (2024) instead argues that other factors than economic and financial characteristics need to be taken into account to explain the large consumption responses of high-liquidity households such as psychological traits or past experiences.

Irrespective of which wealth measure one looks at, consumption always responds more strongly to income losses than to gains (Figure 3). MPCs are similar across the distributions of liquid and total wealth, i.e. the sum of liquid and illiquid wealth. This speaks against the presence of wealthy hand-to-mouth households explaining the results (Kaplan

and Violante, 2014). In particular, even when I restrict the wealth definition to only include funds in checking and savings accounts, arguably the most liquid assets apart from cash, MPCs are still highly asymmetric. Finally, Figure 3 shows that also households with substantial liquid wealth relative to income do not smooth consumption in response to income losses. The top quintile holds liquid wealth in excess of annual income and should in theory be able to buffer a loss that amounts to only a small fraction of that. Appendix A.2 shows that the asymmetry is also present across other observable characteristics and supports the findings with a formal regression analysis.

As discussed earlier, it is not obvious from the framing of the survey question if the measured MPC refers to strictly non-durable consumption or also includes durable consumption. This distinction can be important as the durable-inclusive MPC has in some cases been found to be substantially larger (Parker et al., 2013). To understand its relevance in the present context, one can use the theory-based mapping from MPC to MPX proposed in Laibson et al. (2022), where MPC denotes the marginal propensity for notional consumption flow and MPX the marginal propensity for expenditure. The former includes the consumption flow from non-durables and durables, whereas the latter includes expenditure on non-durables and durables. For non-durables, consumption flow and expenditure are identical by definition, whereas they can differ substantially for durables. Using the formula suggested by the authors, $MPX = (1 - s + \frac{s}{r+\delta})MPC$, where s is the durable share of notional consumption, r the real interest rate and δ the depreciation rate of durables, yields a conversion factor of 1.5.[5] If one interpreted the survey question as capturing the MPX, i.e. both non-durable and durable spending, the formula would therefore yield a notional MPC of $MPC^+ = 0.20/1.5 = 0.133$ and $MPC^- = 0.73/1.5 = 0.486$ and still exhibit a large asymmetry. The idea that the inclusion of durables does not significantly affect the size of the MPC asymmetry has also found empirical support. Christelis et al. (2019) carefully distinguish between the non-durable and durable consumption response to income gains and losses and find similar asymmetries across the two consumption concepts.

3.3 Validity

The magnitude and ubiquity of MPC asymmetries might appear surprising to some readers, even though, as previously discussed, hypothetical survey questions have been shown to capture fairly well actual consumption responses. In this section, I conduct three additional exercises to assess the validity of the survey data and corroborate the empirical findings.

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[5]The conversion factor is computed for a horizon of one year using the parameters $s = 0.1215$, $r = 0$ and $\delta = 0.2$ suggested by the authors.

MPCs out of hypothetical income gains vs tax refunds. The SCE asks participants how much of their annual tax refund they spent or they planned to spend. This allows me to directly contrast the MPC out of the hypothetical income gain with the MPC out of an actual income gain. Figure A5 of the Appendix shows that the distribution of MPCs out of tax refunds and hypothetical income gains are similar. The average MPC out of tax refunds is slightly higher because more respondents indicate that they would spend the entire refund. Given that tax refunds are usually significantly lower than 10% of annual income and MPCs out of gains tend to be negatively correlated with the size of the transfer, this is not surprising.

Financial literacy. One might wonder if households are sufficiently financially literate to accurately predict their consumption response to an income change. For this reason, I construct a measure of financial literacy based on seven questions in the SCE that ask respondents to perform simple quantitative exercises. Restricting the sample to only the most financially literate households, Figure A6 of the Appendix shows that the MPC asymmetry is still sizeable.

Intentions vs Actions. Finally, I can directly study to what degree households' intended spending coincides with their actual spending. Exploiting the panel dimension of the SCE, I compare ex-ante expenditure plans across seven categories of goods with ex-post purchases four months later. In particular, households are asked to provide an estimate of how likely it is that they will purchase a given good over the next four months. Table A2 of the Appendix shows estimates of a linear probability model and a logit model. There is substantial variation across goods categories, but planned expenditure is a strong predictor of actual expenditure.

4 A simple model with mental accounting

The data show that most households respond asymmetrically to changes in income, irrespective of their liquidity levels. This asymmetry suggests a systematic behavioural pattern that induces households to save large fractions of income windfalls, but deters them from using savings to buffer income losses. The latter fact is inconsistent with conventional models of consumption behaviour that incorporate liquidity constraints or income risk, but also several extensions of that framework including common behavioural theories as discussed in Appendix D. I propose instead an extension of the standard consumption model that incorporates mental accounting (Shefrin and Thaler, 1988; Thaler, 1990; Graham and McDowall, 2024).

This section first introduces the concept of mental accounting and related empirical evidence. It then lays out the basic theoretical framework and derives three analyti-

cal results within a stylized model that are consistent with empirical facts two to four: asymmetric MPCs, low MPCs out of income news and low MPCs out of wealth.

4.1 Background

Mental accounting theory suggests that individuals split their financial resources into separate mental categories or accounts. Each account is assigned specific rules or purposes, breaking the assumption of fungibility, i.e. the notion that money has no labels. The need to keep mental accounts can stem, for example, from self-control problems (Thaler and Shefrin, 1981) or decision-making based on imperfect information (Lian, 2021b). One simple formulation is to consider two broad accounts, one for income and one for assets. Funds pertaining to the income account are labelled for spending, while funds in the asset account are labelled for savings. Using funds for something other than its intended purpose, for example spending out of the asset account, can create a mental burden.

Evidence for mental accounting has been found in a variety of applications, such as the allocation of resources across different types of consumption goods (Milkman and Beshears, 2009; Hastings and Shapiro, 2013; Abeler and Marklein, 2017; Hastings and Shapiro, 2018; Liu et al., 2021) and across consumption and savings (Bernard, 2022; Gelman and Roussanov, 2023). Mental accounting is also frequently discussed as an explanation for other puzzling aspects of household consumption behaviour that are difficult to explain otherwise: differences in spending propensities out of capital gains and dividends (Baker et al., 2007; Di Maggio et al., 2020), anticipation-dependence (Thakral and To, 2021), co-holding of liquid assets and debt (Olafsson and Gathergood, 2020), asymmetric consumption smoothing of expected income changes (Baugh et al., 2021) or the implementation design of transfers (Boehm et al., 2023).

4.2 Basic framework

Households hold two mental accounts, one for income and one for assets. Funds pertaining to the mental account for assets are not perfect substitutes for funds in the mental account for income. The partition between the two accounts is given by a savings rule, which can be thought of as a mental rule-of-thumb that households use to facilitate decision-making. Based on this savings rule, we can formally define the different mental accounts:

Definition (Mental accounts): Let m be current cash-on-hand, a^{plan} the desired level of savings according to the savings rule and $\tilde{m}$ the threshold at which $m = a^{plan}$. Then a share of financial resources $[\underline{m}, ..., \tilde{m}]$ is allocated to the mental account for assets whereas $(\tilde{m}, ..., \bar{m}]$ is allocated to the mental account for income, where $\underline{m}$ and $\bar{m}$ denote some lower and upper bound for cash-on-hand, respectively.

Table 2: Share of households with budget or savings/debt repayment plan

Percentile of net liquid wealth distribution	0-20	20-40	40-60	60-80	80+
Keeps budget (in %)	68.0	66.1	72.0	65.9	59.6
Has savings/debt repayment plan (in %)	68.7	66.2	59.1	64.7	53.3

Notes: Households are coded as keeping a budget if they answer the following question with yes: "Do you have a (family) budget, or otherwise plan your monthly spending and saving?" Households are coded as having a savings/debt repayment plan if they answer either of the following questions with yes: "People budget in different ways. Do you (and your family) generally try to focus more on trying to save regular amounts of money?" or "People budget in different ways. Do you (and your family) generally try to pay off regular amounts of debt?"

This formulation of mental accounts is close to the original framework proposed in Shefrin and Thaler (1988) which also considers the allocation of resources into an income and an asset account. Whereas Shefrin and Thaler (1988) additionally introduces a third mental account for *future* income, which is distinct from the account for *current* income, I choose a more parsimonious two-account setting and discuss later how it accommodates changes to future income.

The assumption of saving rules is supported by survey responses of households in the SCE. Table 2 shows that a large majority of households reports to keep a budget or plan their savings. At the same time, there is notable heterogeneity in budgeting behaviour along the distribution of net liquid wealth, with wealthier households budgeting less.

While the survey questions provide some evidence for the existence of saving rules, they are not directly informative about the design of these rules. To derive a specification of the savings rule, I therefore borrow from established behavioural theories in the macroeconomic literature. In particular, I build on the idea that forming optimal plans incurs a cognitive cost without explicitly assuming the source of this cost. One can, for example, think of a cost to acquiring information as in the bounded rationality framework of Gabaix (2014) or a cost to processing information as in the two-system thinking framework of Ilut and Valchev (2023). The formulation of the savings rule provides households with the flexibility to update their mental accounts in response to economically important events, but preserves heuristic thinking in less impactful situations. While the precise definition of the savings rule is deferred to later sections, one can think of a^{plan} as the optimal savings allocation of a household that does not take the entire state-space into consideration. If, for example, the state of the household consisted of household income only, and income was given by a persistent and a transitory income component z and e, respectively, the savings rule could be given by some optimal savings allocation $a^*(z)$, which is only a function of the persistent income component z but ignores the realization of the transitory component e.[6]

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[6]One way to think about this example is that households update their mental accounts in response

Within the mental accounting framework, negative deviations from the savings rule are assumed to be costly as they are equivalent to spending out of the mental account for assets. The asymmetric cost originates from the idea that mental accounting introduces an explicit ordering of mental accounts in which consuming out of the income account is preferred to consuming out of the asset account. For simplicity, I will refer to this feature as *dissaving-aversion*.

Formally, I introduce the mental accounting friction through a modified utility function, as in Graham and McDowall (2024):

$$u^{MA}(c) = u(c) - \lambda(a)d(a', a^{plan}) \tag{1}$$

$$d\left(a', a^{plan}\right) = \begin{cases} 0 & \text{if } a' \geq a^{plan} \\ u(c) - u\left(c^{plan}\right) & \text{if } a' < a^{plan} \end{cases} \tag{2}$$

$$where \quad c^{plan} \equiv c(a^{plan}) \tag{3}$$

where $u(c)$ denotes a standard utility function over consumption and $\lambda(a)d(a', a^{plan})$ denotes the disutility from deviating from the savings rule. The disutility term consists of two elements: first, a penalty function $d(a', a^{plan})$, which depends on the deviation of the actual savings decision a' from the savings rule a^{plan}. Given a budget constraint, the deviation in savings can equivalently be re-mapped into the deviation of actual consumption c from the consumption level that the household obtains following strictly the savings plan, c^{plan}.[7] $d(a', a^{plan})$ is specified in such a way that only negative deviations from the savings plan, i.e. consumption out of the mental account for assets, are penalized. Saving more than planned does not affect the household's utility directly. The second element of the disutility term, $\lambda(a)$, denotes the strength of the dissaving-aversion motive. This formulation of the disutility term is convenient as bounding $\lambda \in [0, 1]$ leads to two extreme types of consumption behaviour at each bound, permanent income consumers for $\lambda = 0$ and hand-to-mouth consumers for $\lambda = 1$. The parameter λ is allowed to depend on the asset position to leave open the possibility that mental accounting frictions may vary with wealth.

The basic framework is a variant of the mental accounting model laid out in Graham and McDowall (2024) that studies the timing of consumption responses to tax refunds. My formulation differs in two important aspects. First, I introduce a different specification of the savings rule, i.e. partition of mental accounts. Whereas Graham and McDowall (2024) postulates a rule of the form $a^{plan} = (1 + r)a$, I will show that a more sophisticated rule is needed to match the consumption responses outlined in Section 2.

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to a promotion at work which persistently raises their income, but not to a one-off change such as a bonus payment.

[7]The object c^{plan} will be introduced once the budget constraint is specified. For a simple formulation of the form $c_t = y_t + Ra_t - a_{t+1}$, c^{plan} would be given by $c^{plan} = y_t + Ra_t - a^{plan}$.

Second, I allow for a more flexible penalty term $\lambda(a)$ as opposed to a constant λ which is required to match the heterogeneity in consumption responses across the distribution of liquid wealth. In particular the savings rule will be critical in reconciling the theoretical predictions with the empirical evidence.

Mental accounting preferences bear some resemblance to expectations-based loss aversion around a reference point (Koszegi and Rabin, 2009). Within the latter, household's period utility not only consists of utility from consumption, but also the deviation of consumption relative to a reference point which is referred to as 'gain-loss utility'. This reference point is given by the household's previous expectations about both present and future consumption. While both mental accounting and loss aversion share the similarity that deviations from a reference point directly enter the utility function, they differ in the definition and formation of the reference point. In the mental accounting framework, the reference point a^{plan} consists of a level of assets whereas with loss aversion it consists of a level of consumption. The reference point is also not necessarily expectations-based, as discussed in the next sections once the design of the savings rule is formalized. These differences in reference points critically affect consumption behaviour, as discussed in Appendix D.

4.3   A simple two-period model of mental accounting

Households in this economy live for two periods $t \in \{0, 1\}$ and are born with zero initial wealth.[8] In the first period, households receive income y_0 and decide how much to consume and how much to save. In the second period, households consume their savings from the first period. Households follow a savings plan which is formed endogenously. Utility is logarithmic, augmented by the penalty term for deviating from the savings plan.[9] For simplicity, I assume that households face no penalty in the second period and that the dissaving-aversion parameter λ is constant.[10] Finally, households discount the future with a subjective discount factor β and save at an exogenous gross interest rate R. This yields the following problem:

$$\max_{c_0, c_1} \quad u(c_0) - \lambda d(a_0, a_0^{plan}) + \beta u(c_1) \tag{4}$$

$$\text{s.t.} \quad c_0 + a_0 = y_0; \quad c_1 = Ra_0; \tag{5}$$

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[8]This assumption is purely made for expositional clarity. Appendix B.1 solves for the case with initial wealth.

[9]Appendix B.2 solves for the case with CRRA utility.

[10]The assumption of no dissaving-aversion in the second period is made purely for clarity. Given that it is always optimal to consume all savings in $t = 1$ and that households do not expect any deviations from their savings plan, the results are identical. See also Appendix B.3.

Maximizing with respect to a_0 yields the following Euler equation:

$$\beta R u'(c_1) = \begin{cases} u'(c_0) & \text{if} \quad a_0 \geq a_0^{plan} \\ (1-\lambda)u'(c_0) & \text{if} \quad a_0 < a_0^{plan} \end{cases} \qquad (6)$$

The savings decision governs which Euler equation the household faces. Saving less than planned reduces marginal utility today by a factor $1 - \lambda$. Saving weakly more than planned preserves the standard Euler equation. Combining the Euler equation and the budget constraint, we can derive an expression for c_0:

$$c_0 = \begin{cases} \frac{y_0}{1+\beta} & \text{if } a_0 \geq a_0^{plan} \\ \frac{y_0}{1+\frac{\beta}{1-\lambda}} & \text{if } a_0 < a_0^{plan} \end{cases} \qquad (7)$$

The final element that is missing is the savings plan. I assume that the household's savings plan is given by the optimal savings decision in an equivalent problem without mental accounting. That is, the savings plan is formed endogenously based on household's current income.[11] Formally, it is derived as the solution to the following problem:

$$\max_{c_0,c_1} \quad u(c_0) + \beta u(c_1) \qquad (8)$$

$$\text{s.t.} \quad c_0 + a_0 = y_0; \quad c_1 = R a_0; \qquad (9)$$

which yields an optimal savings allocation in period 0, a_0^*:

$$a_0^* = \frac{\beta}{1+\beta} y_0 \equiv a_0^{plan} \qquad (10)$$

With the definition of the savings plan at hand, we can define planned consumption as the level of consumption if one strictly followed the savings plan:

$$c_0^{plan} = y_0 - a_0^{plan} \qquad (11)$$

This definition will be useful for providing intuition behind the results. To derive an expression for the MPC, assume that income in $t = 0$ unexpectedly changes by a fraction ϵ. Additionally, assume that households classify the income shock as a change in their mental account for income but not in their mental account for assets. Formally, this implies that the savings rule does not change in response to the income shock, i.e. $a_0^{plan}(y_0 + \epsilon y_0) = a_0^{plan}(y_0)$. This lack of response is precisely what captures the idea of households facing some cost to acquiring or processing information. While the anticipated part of income y_0 is reflected in the saving rule, the unanticipated part ϵy_0 is not. This yields the following

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[11]Other savings plans could also generate asymmetric MPCs. This formulation, however, yields the cleanest analytical results.

Figure 4: Illustration of MPC asymmetries with mental accounting
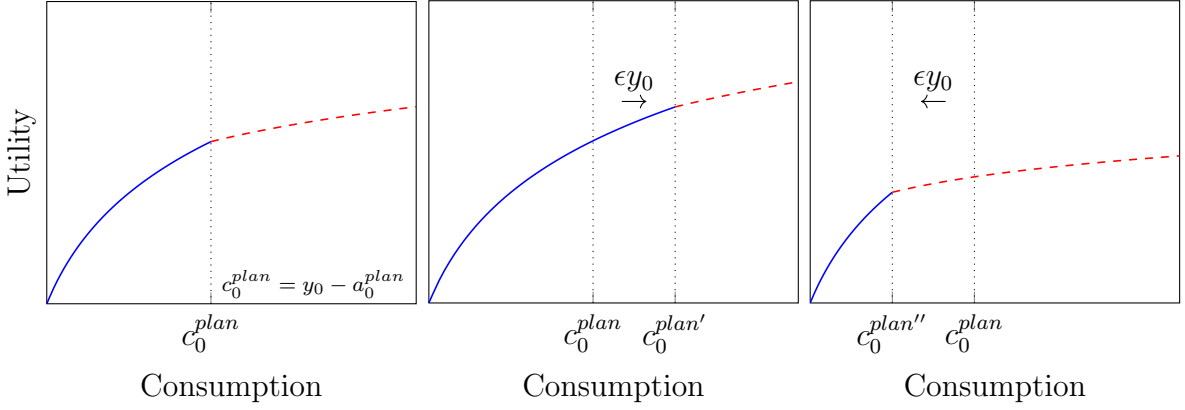
proposition.

Proposition 1 (MPC asymmetry): Define MPC^+ as the MPC out of positive income changes ($\epsilon > 0$) and MPC^- as the MPC out of negative income changes ($\epsilon < 0$). Then $MPC^- > MPC^+$ for any level of dissaving-aversion $\lambda \in (0, 1]$ and size of the income change $|\epsilon| \in (0, 1)$.

$$
MPC = \frac{\Delta c_0}{\Delta y_0} = \frac{\tilde{c}_0(y_0 + \epsilon y_0) - c_0(y_0)}{\epsilon y_0} = \begin{cases} \frac{1}{1+\beta} & \text{if } \epsilon \geq 0 \\ \min\left\{\frac{1}{1+\beta}\left(\frac{1+\epsilon}{\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon}\right), 1\right\} & \text{if } \epsilon < 0 \end{cases}
$$

(12)

Proof. See Appendix B.4. $\qquad\qquad\square$

Proposition 1 suggests that the MPC depends on the direction of the income change, i.e. the sign of ϵ. To gain intuition for this result, suppose y_0 increases by a fraction ϵ. This increase does not move planned savings, but it moves planned consumption by ϵy_0. The increase in planned consumption relaxes the dissaving constraint and additional consumption is not penalized up to an increase of ϵy_0. Hence, as long as the household does not want to increase consumption beyond the increase in income, we recover the standard MPC without mental accounting. Now suppose y_0 decreases by a fraction ϵ. Again, this decrease does not move planned savings, but it reduces planned consumption by ϵy_0. Any consumption beyond planned consumption is now penalized by $1 - \lambda$ in terms of marginal utility. This results in an MPC out of losses that is higher than the MPC out of gains. Figure 4 illustrates the mechanics graphically through shifts of the kink in the utility function that are generated by mental accounting preferences.

Compared to the mental accounting model in Graham and McDowall (2024) which predicts MPCs out of income gains that are larger than MPCs out of income losses, Proposition 1 suggests that the asymmetry goes in the opposite direction. Although the

Table 3: MPCs and savings plans

	MPC^{Asy}	MPC^{Asy}
Keeps budget	0.106***	0.092***
	(0.017)	(0.019)
Has savings/debt repayment plan only	0.070***	0.047*
	(0.018)	(0.020)
R^2	0.02	0.06
Controls	NO	YES
Observations	4009	3341

Notes: Households are coded as keeping a budget if they answer the following question with yes: "Do you have a (family) budget, or otherwise plan your monthly spending and saving?" Households are coded as having a savings/debt repayment plan only if they answer either of the following questions with yes: "People budget in different ways. Do you (and your family) generally try to focus more on trying to save regular amounts of money?" or "People budget in different ways. Do you (and your family) generally try to pay off regular amounts of debt?" but not: "People budget in different ways. Do you (and your family) generally try to pay off regular amounts of debt?". Controls include net liquid wealth, income, housing status, age and income expectations. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observations are weighted using survey weights.

two models are not directly comparable, this discrepancy illustrates the relevance of the savings plan for the prediction of the consumption response. In the quantitative model of Section 5, I perform a detailed comparison of the two saving rules and show that a rule of the form $a^{plan} = (1 + r)a$ has difficulty in matching the consumption responses in the SCE.[12]

The data allow me to partly test the prediction in Proposition 1 by distinguishing between households that have a savings plan and those that do not. Table 3 reports regression results showing that households that explicitly state to keep a budget or follow a savings plan have more asymmetric MPCs. This holds both unconditionally and conditionally on a set of covariates. This suggests that, under the assumption of savings plans being a valid proxy, households subject to mental accounting distinguish more strongly between positive and negative income changes in their consumption response.

The magnitude of the asymmetry in the model depends on the degree of dissaving-aversion λ and the size of the shock ϵ. In the extreme case where $\lambda = 0$, we recover the standard model without any asymmetries. With $\lambda = 1$, the MPC out of losses is 1 and the household behaves as hand-to-mouth in response to negative income shocks. The

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[12]In the two-period model, defining a_0^{plan} as $(1 + r)a$ would generate a symmetric MPC because given that initial wealth is zero by assumption, $a_0^{plan} = 0$, and the mental accounting constraint is never binding.

next result elaborates on the role of ϵ.

Corollary (MPC and shock size): MPC^- is decreasing in the size of the income shock, $\frac{\partial MPC^-}{\partial \epsilon} > 0$, for any level of dissaving-aversion $\lambda \in (0,1]$ and income shock $\epsilon \in (-1,0)$. MPC^+ is independent of the size of the shock.

Proof. Follows directly from taking derivatives with respect to ϵ in expression 12. See Appendix B.4. □

The corollary states that the MPC out of losses is lower for larger shocks. Given that the MPC out of gains is independent of the shock size, the MPC asymmetry is decreasing in the size of the shock. Intuitively, the larger the income loss, the larger is the reduction in planned consumption and as such, the higher is the marginal utility of consuming beyond planned consumption. This reduces the decrease in consumption following the income loss and therefore decreases the MPC. An alternative interpretation not captured in this simple framework is that larger shocks induce agents to update their savings plans, i.e. classify part of the income change in their mental accounts for assets (due to increased salience, for example), which brings the MPC closer to the one in a conventional model. The negative relation between MPC^- and shock size established here goes slightly against conventional predictions of a positive relation. However, these predictions are usually based on theories of liquidity constraints from which I abstract here.

The next two propositions illustrate that the mental accounting model also makes predictions about the MPC out of wealth and income news that are consistent with the empirical evidence. To accurately compare the MPC out of wealth with the previously derived MPC out of income, I add an initial level of wealth w_0 to the household problem to be able to study proportional changes to wealth. Additionally, I assume that the saving plan moves one-to-one with the wealth shock, i.e. $a_0^{plan}(w_0 + \epsilon w_0) = a_0^{plan}(w_0) + \epsilon w_0$. This is consistent with the change in wealth being classified as a change in the mental account for assets.

Proposition 2 (MPC out of wealth): The MPC out of wealth, $\frac{\Delta c_0}{\Delta w_0}$, is smaller than the MPC out of income if the change in wealth enters the mental account for assets:

$$MPC^{+,wealth} = \frac{\Delta c_0}{\Delta w_0} = \max \left\{ \frac{1}{1+\beta} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 0 \right\} < MPC^+$$

$$MPC^{-,wealth} = \frac{\Delta c_0}{\Delta w_0} = \frac{1}{1+\beta} < MPC^-$$

for any level of dissaving-aversion $\lambda \in (0,1]$ and $|\epsilon| \in (0,1)$

Proof. See Appendix B.4. □

Proposition 2 states that the mental accounting model generates MPCs out of wealth that are smaller than MPCs out of income, for both gains and losses, under the assumption that the wealth shock is classified as a change in the mental account for assets. While most theoretical explanations of low MPCs out of wealth are based on differences in liquidity between income and wealth, the mental accounting model introduces non-fungibility by assigning income and wealth shocks to different mental accounts, i.e. through differential responses of the savings plan. Because unexpected changes in wealth shift the savings plan one-to-one with wealth and therefore leave planned consumption unchanged, consuming out of additional wealth is penalized and yields lower MPCs out of wealth compared to income. Similarly, because planned consumption is unchanged, wealth losses require lower reductions in consumption compared to income losses and yield again lower MPCs.

Turning to MPCs out of income news, I assume that similarly to contemporaneous income changes, the savings rule does not respond to shocks to future income, i.e. $a_0^{plan}(y_1 + \epsilon y_1) = a_0^{plan}(y_1)$. While this resulted in a mental classification as income for current income changes and expanded the consumption set for which the dissaving penalty was not incurred, this is not the case for future income changes. Previously, the admissible consumption set defined by c_0^{plan} changed in response to an income shock because given a constant a_0^{plan}, y_0 changed and so did c_0^{plan} as the residual of the contemporaneous budget constraint. In the current scenario, however, there is no corresponding movement in c_0^{plan} because the income change only materializes in the future.[13] This yields the following result.

Proposition 3 (MPC out of income news): The MPC out of income news, $\frac{\Delta c_0}{\Delta y_1}$, is lower than the MPC out of contemporary income changes if income news enter neither the mental account for income nor assets: $MPC^{+,news} < MPC^+$ and $MPC^{-,news} < MPC^-$

$$MPC^{+,news} = \frac{\Delta c_0}{\Delta y_1} = \max\left\{ \frac{1}{1+\beta}\left(\frac{1+\epsilon}{R\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{R\epsilon} \right), 0 \right\} < MPC^+$$

$$MPC^{-,news} = \frac{\Delta c_0}{\Delta y_1} = \frac{1}{R(1+\beta)} < MPC^-$$

for any level of dissaving-aversion $\lambda \in (0,1]$, income change $|\epsilon| \in (0,1)$ and gross interest rate $R \geq 1$.

Proof. See Appendix B.4. □

Proposition 3 suggests that also MPCs out of income news are smaller than MPCs out of contemporaneous income changes under the assumption that news about future

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[13]Intuitively, one can think of income news entering a third mental account, one for future income, which is abstracted from in this stylized framework but forms part of the early work on mental accounting (Shefrin and Thaler, 1988).

income are classified neither under the mental account for income nor assets. Models with borrowing constraints can explain lower MPCs out of positive income news for liquidity-constrained households, but not for unconstrained households and neither for constrained nor unconstrained households in the case of negative income news.[14] The mental accounting model in contrast generates low MPCs out of news for all households without relying on liquidity constraints. The non-fungibility between current and future income is again introduced through assignment to different mental accounts, i.e. the response of the savings plan: it does not change in response to news about future income, similarly to the response to changes in current income. Because the income change only materializes in the next period, planned consumption does not change either. Therefore, any increase in consumption is penalized yielding lower MPCs out of positive news than out of current income gains. Similarly, maintaining the current consumption level is not penalized in response to negative income news compared to current income losses, yielding lower MPCs out of negative news.

Due to the simplicity of the setting, the analytical model does not speak directly to empirical facts one and five, i.e. large MPCs out income gains and the relevance of liquidity constraints. The next section introduces a richer, more realistic model of mental accounting that jointly addresses facts one to five and allows for explicit comparisons with conventional models that feature borrowing constraints and income risk.

5   A quantitative model with mental accounting

This section incorporates mental accounting into a life-cycle model with idiosyncratic income risk and borrowing constraints. Enriching the model along these dimensions generates new predictions about MPCs that were not captured in the stylized framework and allows me to test how well the model matches quantitatively the empirically observed consumption responses.

5.1   Model environment

Time is discrete. The economy is populated by a continuum of households, indexed by i. Households live for J periods and work for JR periods after which they retire. While working, households receive a stochastic income $y_{i,t}$. Households can save in a risk-free asset a that pays an interest rate r. Borrowing is not allowed in this economy, i.e. $\underline{a} = 0$.

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[14]Except for minor differences in MPCs out of current income and news due to discounting of future income receipts.

Households have mental accounting preferences given by:

$$u^{MA}(c_{i,t}) = u(c_{i,t}) - \lambda_0 e^{a_{i,t}\lambda_1} d(a_{i,t+1}, a_{i,t+1}^{plan}) \tag{13}$$

In contrast to the two-period model, I allow the strength of the dissaving-aversion parameter to vary with the level of wealth that the household holds.[15] In particular, dissaving-aversion is modelled as an exponential function with level parameter λ_0 and decay parameter λ_1. This allows the model to flexibly capture two potential features: the covariance between wealth and dissaving-aversion at the intensive margin, i.e. the same household exhibiting different degrees of dissaving-aversion for different levels of wealth and, at the extensive margin, different shares of behavioural households compared to fully rational households at different levels of wealth. Stango and Zinman (2023), for example, shows that households living in worse financial conditions have stronger behavioural biases.

Log income is given by a deterministic life-cycle component $\bar{y}$ and a stochastic component that is modelled as a persistent-transitory process, where the persistent component follows an AR-1 process. The innovations to the persistent and transitory component are orthogonal to each other and independent over time and across households.

$$\log Y_{i,t} = \bar{y}_t + z_{i,t} + e_{i,t} \tag{14}$$

$$z_{i,t} = \rho_z z_{i,t-1} + u_{i,t}, \quad u_{i,t} \sim N(0, \sigma_z^2) \quad e_{i,t} \sim N(0, \sigma_e^2) \tag{15}$$

This yields the following recursive formulation:

$$V(j, z, e, a) = \max_c u^{MA}(c) + \beta \mathbb{E} V(j+1, z', e', a') \tag{16}$$

$$\text{s.t.} \quad c + a' = (1+r)a + y, \quad a' \geq \underline{a} \tag{17}$$

where j denotes age.

The final element that needs to be defined is the partition between the mental accounts for income and assets, i.e. the savings plan. To do so, I generalize the rule from the stylized framework in Section 4 and specify the savings plan as the optimal savings policy from an equivalent household problem as in Equation 16 in which the transitory shock is set to zero: the savings plan responds to persistent, but not to transitory income changes.

$$a_{i,t}^{plan} = \tilde{a}^*(j, z, e = 0, a) \quad \text{from} \quad \tilde{V}(j, z, e, a) = \max_c u(c) + \beta \mathbb{E} \tilde{V}(j+1, z', e', a') \quad \text{s.t.} \quad (16)$$

Compared to the previous savings rule, this rule is more sophisticated as households

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[15]Note that furthermore, a_{t+1} now denotes the choice of savings in period t that is carried over into $t+1$ instead of a_t.

additionally consider their current age and asset position, state variables that did not feature in the stylized model, when forming their savings plan. The role of income, in turn, is preserved. Transitory changes to income are mentally fully classified as income, i.e. the saving rule does not respond to changes in e, whereas persistent changes z are partly assigned to the mental account for income and partly to the mental account for assets.[16] The precise split is derived from the household's optimization problem and depends on the position in the life-cycle and wealth. Intuitively, this specification of the savings rule again provides households with the flexibility to update their mental accounts in response to important events, but preserves heuristic thinking in less impactful situations.

5.2   Calibration

Table 4 provides an overview of the calibrated parameters. I first calibrate several parameters outside of the model. A model period is one year. Households work for 40 years and then spend 20 years in retirement. The interest rate is set to 2 percent. The degree of risk aversion γ is set to 2. The deterministic income component is estimated from PSID data by regressing the logarithm of income on a cubic polynomial in age and time dummies to control for trends in income over time. The persistence and variance of the stochastic processes are taken from Kaplan and Violante (2022). Retirement income depends on the employment history of households. It is determined by the persistent component of income earned in the final period before retirement and fluctuates with the transitory income state. The replacement rate is set to 0.6. Population shares are calibrated to match the age distribution in the SCE sample. Households' initial asset holdings are chosen to approximate the net asset holdings of households in the SCE between ages 25-30.

The parameters β, λ_0 and λ_1 are calibrated using simulated method of moments. I set the discount factor β to match the average net wealth-to-income ratio in the SCE sample.[17] Disciplining the dissaving-aversion parameters is more intricate. I calibrate the level and decay parameter to match two moments of the data: the average MPC out of income losses and the ratio of the shares of households that follow a savings plan between the bottom and top quintile of the wealth distribution from Table 2. The average MPC out of income losses primarily identifies the level of dissavings-aversion while the shares of households with a savings plan across wealth quintiles identify the decay. The latter moment aims to capture differences in behavioural frictions across the wealth distribution, interpreting the presence of savings plans as a proxy for mental accounting behaviour. While choosing this moment introduces a slight inconsistency between data and model

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[16]The analogy to the previous rule is clearer if one considers the persistent component z as the analogue to the deterministic and anticipated income component y_0 in Equation 10.

[17]Calibrating the model to net liquid wealth instead of net total wealth yields qualitatively similar results.

Table 4: Calibration

Parameter	Description	Value	Source/Target
External			
γ	Risk aversion	2	Standard
J	Length of life-cycle	60	Standard
JR	Length of working-life	40	Standard
$\bar{y}$	Life-cycle income profile	Cubic polynomial	PSID
ω	Replacement rate	0.6	Standard
r	Interest rate	0.02	Standard
ρ_z	Persistence of z_t	0.953	PSID (Kaplan and Violante, 2022)
σ_z^2	Variance of innovation in z_t	0.0422	PSID (Kaplan and Violante, 2022)
σ_e^2	Variance of e_t	0.0494	PSID (Kaplan and Violante, 2022)
$\underline{a}$	Borrowing limit	0	Standard
Internal			
β	Discount factor	0.93	Avg. net wealth-to-income
λ_0	Dissaving aversion - level	0.69	Avg. MPC^-
λ_1	Dissaving aversion - decay	-0.015	Top-bottom ratio of households with savings plan

by acknowledging that in the data, some households follow a savings plan while others do not whereas in the model everybody follows one, this dilution of internal and external margin allows me to externally discipline the gradient of the dissaving-aversion motive without explicitly targeting the MPC. An alternative, yet less innocuous strategy, would be to target the slope of the MPC out of losses directly. The moment selection is overall conservative in the sense that I target neither the MPC out of gains, the asymmetry of MPCs nor the behaviour of MPCs across the wealth distribution.

The level parameter of the dissaving-aversion motive λ_0 is calibrated to 0.69, with a moderate decay in wealth of $\lambda_1 = -0.015$. The average level of dissaving-aversion across the simulated households of $\bar{\lambda} = 0.63$ is below the one estimated in Graham and McDowall (2024) who finds a value of 0.80. This is not surprising given that the models are not only structurally different across several dimensions – the share of households subject to mental accounting frictions, the specification of the savings rule, the dissaving-aversion motive and other life-cycle components – but are also calibrated based on different moments. Table C1 of the Appendix shows that the model matches the targeted data moments exactly.

Before turning to the predictions of the model regarding MPCs, it is useful to inspect the relation between planned and actual savings which forms a fundamental building block for consumption-savings decisions in the mental accounting model. Figure 5 illustrates how the actual savings decision $a^*(j, z, e, a)$ deviates from the savings plan $a^{plan}(j, z, e, a)$ for different income realizations and asset levels by the example of a household of age $j = 20$. Households experiencing a positive transitory income shock save more than prescribed by their savings plan, whereas households experiencing a negative income shock save less. While the direction of the savings plan deviation is not necessarily surprising, the differences in magnitude between positive and negative shocks are more informative. Across both low and high persistent income states, the excess savings in

Figure 5: Deviations from the savings plan

A) Low z B) High z
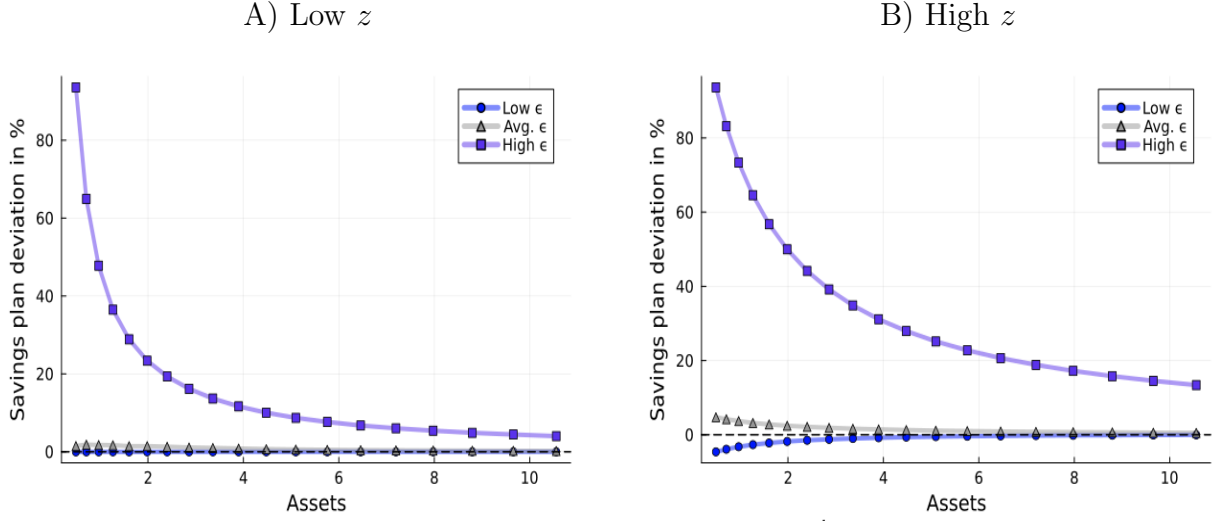
Notes: This figure reports savings plan deviations computed as $\frac{a'-a^{plan}}{a^{plan}}$ for a household of age $j = 20$ across different levels of transitory income and wealth. The left panel reports the deviation for a household with a low, the right panel for a household with a high persistent income realization.

the case of a positive income shock are substantially higher than the negative savings deviation in the case of a negative income shock. This tendency is further exemplified by the positive savings deviation in the case of the average transitory income shock in which $e = 0$. The asymmetry in savings plan deviations is a direct result of the asymmetry in the deviation cost, which effectively concavifies the utility function and therefore generates overall higher savings than in a model without mental accounting.

5.3 MPCs in the mental accounting model

How well does the calibrated model match the empirical evidence on MPCs? In line with the survey questions in the SCE, I compute MPCs out of income gains and losses by simulating households' consumption paths in response to an exogenous transitory increase and decrease in income by 10 percent.

MPC asymmetry. As a first test, Figure 6 reports the distribution of MPCs generated by the model. The left panel shows large MPCs out of losses that are concentrated at values above 0.7 and substantially smaller MPCs out of gains with most mass below 0.3. This closely resembles the patterns in the data (Figure 1). The right panel suggests that the model also replicates the asymmetry at the household level by plotting the distribution of MPC asymmetries, i.e. the difference between MPCs out of losses and gains. A large share of households has very asymmetric MPCs of close to one. At the same time, some households have almost fully symmetric MPCs, resembling permanent income consumers.

Figure 6: Distribution of model MPCs
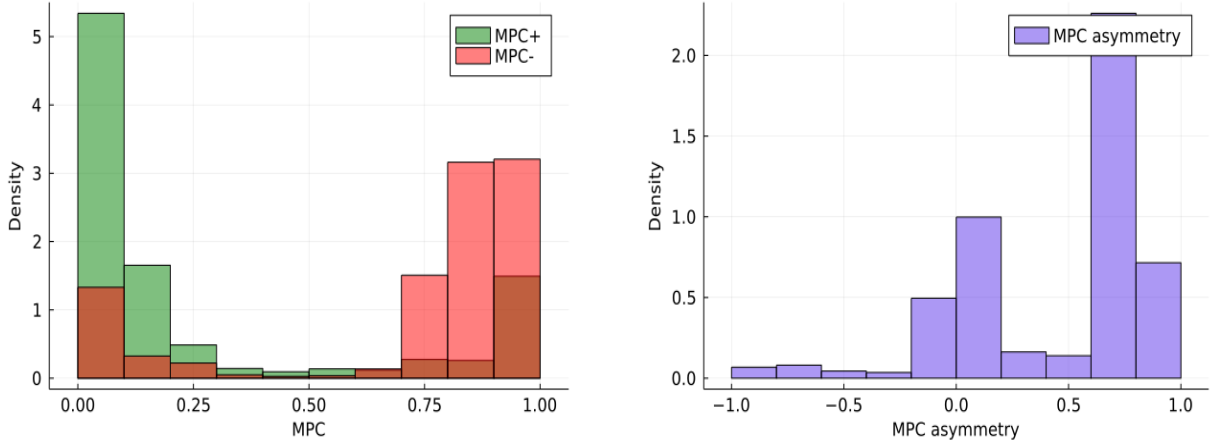
Notes: MPCs are computed by simulating a transitory 10% income shock. MPC asymmetry denotes the difference between the MPC out of losses and gains. Due to numerical error in the simulation of MPCs, some households have MPCs that are marginally below 0 or above 1. These are recoded to 0 and 1, respectively.

Figure 7 plots MPCs across the distribution of wealth. As in the data, the asymmetry is large for all levels of wealth. The average asymmetry in the model is 0.44 compared to 0.53 in the data.[18] Inspecting MPCs out of income gains and losses separately reveals that both are moderately decreasing in wealth. They are somewhat larger for liquidity-constrained households, but remain at high levels for unconstrained households.

To contrast the predictions of the mental accounting model with a more standard model that does not incorporate mental accounting, I solve a version of the model in which $\lambda = 0$. This is equivalent to a one-asset model with borrowing constraints and income risk. Because mental accounting preferences slightly change the distribution of assets in the economy, I recalibrate the discount factor in the model without mental accounting preferences to match the same average net wealth-to-income ratio. A comparison of the two models illustrates the relevance of mental accounting. The model without mental accounting generates much smaller MPCs out of income losses than the data suggest. As a consequence, it fails to generate sizeable differences between MPCs out of gains and losses except for households that are close to the borrowing constraint.

MPC out of gains. The mental accounting model not only generates larger MPCs out of losses compared to a model without mental accounting, but also larger MPCs out of gains. It does so across the entire distribution of wealth and hence irrespective of the proximity to the borrowing limit. Intuitively, mental accounting imposes an additional constraint on consumption around which households consume less than in a world without a constraint. Income windfalls relax this constraint and lead to large consumption responses, similarly to the mechanics of a borrowing constraint. In that sense, mental accounting provides

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[18]Using the mapping from MPX to MPC discussed in Section 3.2, the data-based asymmetry is 0.38.

Figure 7: Model MPCs across the wealth distribution
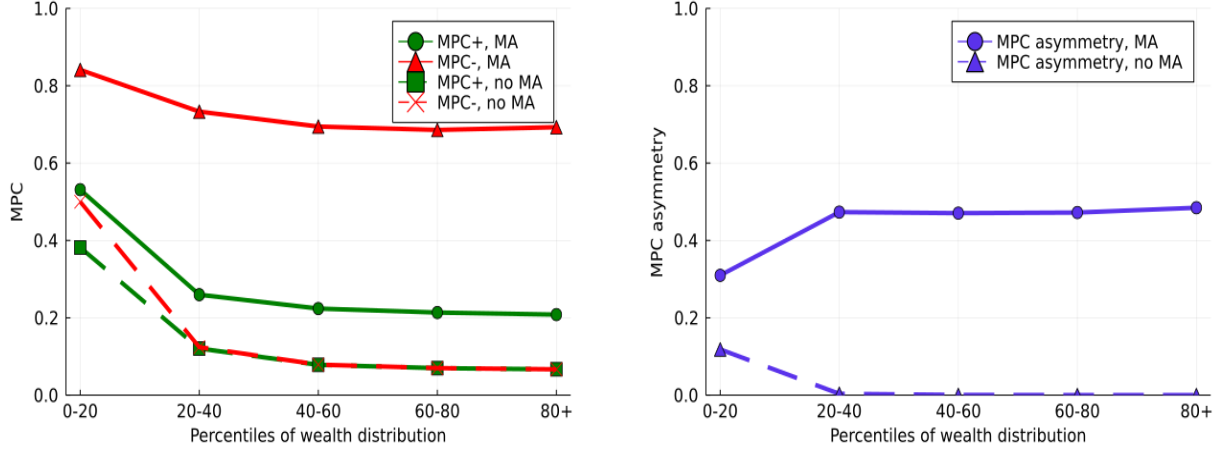
Notes: MPCs are computed by simulating a transitory 10% income shock. Solid lines denote MPCs from the mental accounting model (MA), dashed lines denote MPCs from the model without mental accounting (no MA).

a potential rationale for the empirically observed large consumption response to income windfalls of households with high levels of liquid wealth.

MPC and liquidity constraints. While the mental accounting model preserves the role of liquidity constraints in generating large MPCs, it introduces another channel through which consumption becomes more sensitive. In contrast to liquidity constraints, mental accounting operates irrespectively of households' liquidity and can generate large MPCs across the entire distribution of wealth. Depending on the relative strength of these two motives, mental accounting can therefore partly break the link between MPCs and liquidity and rationalize mixed empirical findings on the subject.

One factor determining the wealth gradient of the MPC is the size of the income shock. Figure 8 compares consumption responses to a 3% and 30% income change, i.e. a relative small and relatively large shock compared to the baseline scenario and shows that size affects both the level and the wealth gradient of the MPC. Larger shocks generate larger asymmetries in the mental accounting framework, driven by a larger consumption response to income losses. If differently sized shocks generate different degrees of asymmetries, this could help reconcile why empirical estimates of MPC asymmetries differ across studies. Fuster et al. (2021) for example finds an average asymmetry of 0.25, which is around half the size of the asymmetry found in this paper. At the same time, they study an income shock that is substantially smaller – 500$ compared to 10% of annual income. The 3% shock studied in Figure 8 is closer to the scenario analysed in Fuster et al. (2021) and produces an average MPC asymmetry of 0.23.
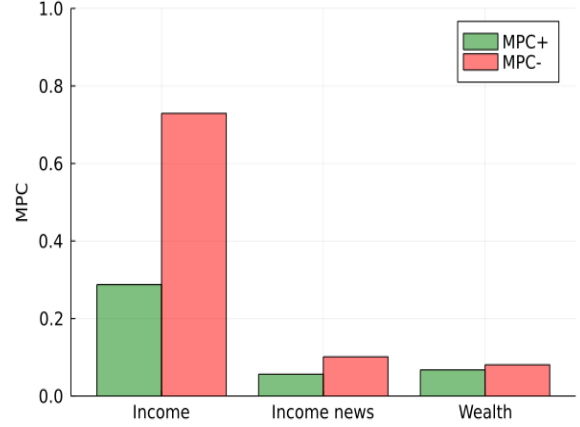
How do we reconcile these findings with the analytical result that MPCs out of losses are decreasing in the size of the shock? In the stylized framework, the household is

Figure 8: Model MPC by size of income shock
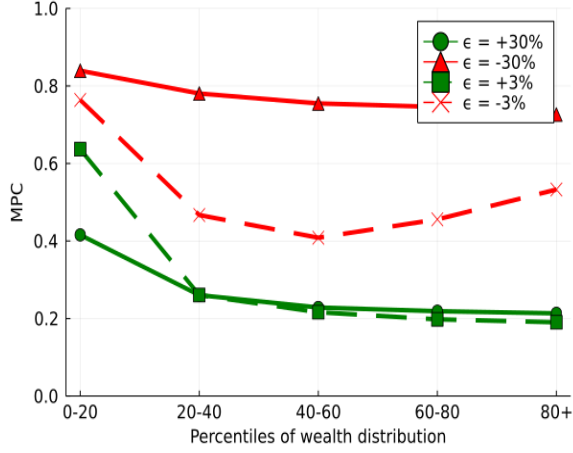
Notes: MPCs are computed by simulating transitory proportional income shocks of different sizes.

Figure 9: Model MPC out of wealth and income news

Notes: MPCs are computed by simulating (i) a transitory 10% shock to current income, (ii) news about a 10% shock to income next period and (iii) a 10% shock to current wealth.

exactly at the mental accounting constraint, i.e. actual savings equal planned savings before the shock hits. In the quantitative model, however, some households are above and some are below the constraint. A larger shock pushes a larger fraction of initially unconstrained households into the constrained region and increases their MPC. The stronger compositional effect induced by larger shocks more than offsets the decrease in MPCs for households that are already constrained and thus generates MPCs out of losses that are larger on average.

Larger shocks also flatten the gradient of the MPC out of gains in wealth. This is particularly relevant in light of recent evidence by Andreolli and Surico (2021) that finds a negative relation between MPCs out of gains and wealth for small shocks, but a flat relation for large shocks. They interpret this finding through a model with non-homothetic preferences, but the mental accounting model seems to, at least qualitatively, produce similar patterns. Compared to the data, however, the model still predicts MPCs that are too high at the lower end of the wealth distribution because it abstracts from the role of debt. As discussed in the empirical analysis, debt holdings depress the MPC and can therefore offset the effect of liquidity constraints. Extending the model by adding a wedge in the interest rate between saving and borrowing or introducing a motive for co-holding assets and debt would further flatten the slope of the MPC in wealth (Kosar et al., 2023; Boutros and Mijakovic, 2024).

MPC out of income news. Figure 9 quantifies the consumption response to news about an income shock one period ahead and contrasts it with the response to a contemporaneous income shock. As in the stylized theoretical framework, the news shock is

assumed to affect neither the mental account for income nor assets. Consistent with the analytical predictions, the mental accounting model generates MPCs out of income news that are much smaller than MPCs out of current income. The sign asymmetry found for responses to current income is also preserved for responses to future income. This resonates with the empirical evidence in Fuster et al. (2021) that finds larger consumption adjustments in response to negative than to positive income news. The model without mental accounting only generates meaningful differences between MPCs out of current income and income news for liquidity-constrained households facing income gains, but not otherwise.[19]

MPC out of wealth. Similarly to MPCs out of income news, also MPCs out of wealth are small. Figure 9 shows that the average MPC out of both wealth gains and losses is several times smaller than the respective MPC out of income. As in the stylized theoretical framework, the wealth shock is classified as a change in the mental account for assets. The model without mental accounting, instead, does not generate differences between MPCs out of income and wealth. Because wealth and income are perfectly fungible, the MPC out of wealth and income are identical. Introducing transaction costs can generate lower MPCs out of wealth for illiquid wealth, but not liquid wealth. The mental accounting model, however, predicts lower MPCs irrespective of the degree of liquidity.

5.4   Discussion

The role of λ. How can we think of the size of λ? Direct welfare comparisons of households with and without mental accounting can be problematic due to differences in preferences. An alternative approach consists of quantifying the distortions caused by the presence of mental accounting. For this purpose, I simulate a set of households in the model without mental accounting frictions, but I equip them with the policy functions of households that are subject to mental accounting. I then compute how much compensation in terms of consumption equivalents these households would require to be as well off as the households that follow the optimal decision rules without mental accounting. This results in a moderate increase in life-time consumption of 0.64 percent.

A different way to analyse the broader role of mental accounting is through examining differences in the dispersion of wealth and consumption or life-cycle dynamics of consumption-savings choices. Appendix Figure C1 shows that the mental accounting model does not materially change household behaviour along these dimensions. Both

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[19]Druedahl et al. (2022) finds that households that are not liquidity-constrained respond immediately to the receipt of news about future income in the context of mortgage payments. Differently to the transitory shock studied here, these changes are persistent and are therefore not necessarily inconsistent with the mental accounting framework.

the dispersion and the life-cycle profile of wealth and consumption are similar across the economies with and without mental accounting. This is illustrative of the fact that mental accounting primarily affects consumption-savings dynamics in response to transitory, but not persistent changes. Incorporating this additional degree of freedom therefore helps match several facts regarding the consumption response to transitory shocks without worsening the model fit with respect to other predictions.

How important is heterogeneity in the dissaving-aversion parameter λ? The baseline model assumed that the strength of the mental accounting motive decays with wealth to reflect heterogeneity in behavioural biases in the data. Figure C2 in the Appendix reports MPCs across the distribution of wealth from a model with constant dissaving-aversion, where λ is set to equal the average λ in the economy with heterogeneous mental accounting frictions. Quantitatively, behavioural heterogeneity does not appear to be critical in generating the empirically observed consumption responses at first glance. Both MPCs out of gains and losses are similar across the two models. Qualitatively, however, the homogeneity in λ induces an MPC out of losses that is increasing for higher levels of wealth which is at odds with the data.

Alternative saving rules. While the choice of the savings rule, i.e. the partition of mental accounts, is grounded in established behavioural theories, one can imagine alternative rules that households might follow that are equally justifiable. One such rule could be the simple rule-of-thumb $a^{plan} = (1 + r)a$ proposed in Graham and McDowall (2024). To understand the relevance of this rule, I solve a version of the model in which I replace the saving rule $a^{plan} = \tilde{a}^*(j, z, e = 0, a)$ with this simpler rule. When $a^{plan} = (1 + r)a$, all wealth is labelled for saving and all income for spending.

Figure C3 in the Appendix shows that this formulation delivers very distinct predictions regarding households' consumption responses. In particular, it generates negligible MPC asymmetries which are at odds with the consumption responses documented in the SCE. This finding is not an artefact of the particularities of the life-cycle model presented in this paper, but is instead a fundamental prediction of the mental accounting model with a simple rule-of-thumb developed in Graham and McDowall (2024). The differences in the consumption response across models are not necessarily surprising given how different the savings rules are between the two specifications and how important the distance from the savings rule is in the determination of the consumption response. Figure C5 illustrates this in more detail across various ages, income and asset levels.

Portfolio adjustment costs. A simple savings rule where all wealth is labelled for saving and all income for spending appears similar to an asymmetric portfolio adjustment cost. In both cases, accessing wealth is costly while building up wealth is costless. To understand if asymmetric portfolio adjustment cost can generate meaningful asymmetries

in MPCs, I solve a version of the model without mental accounting in which I impose that any reduction in the stock of assets generates a monetary cost. This assumption is not necessarily consistent with the empirical exercise in which wealth is liquid and at least in theory costless to access, but serves as a useful thought experiment.

Figure C4 in the Appendix reports MPCs from a model with a small adjustment cost of one tenth and a large adjustment cost of one half of monthly income, roughly comparable to the range of fixed costs studied in Kaplan and Violante (2014). MPCs can be larger than in a model without adjustment costs, but the model does not match the empirically observed asymmetry, irrespective of the size of the adjustment cost. In particular, the model has difficulty in generating large MPCs out of losses. This is not necessarily surprising. Households that are net savers, for example those in the middle of the life-cycle or those subject to a high income realization, do not need to access their wealth and pay the adjustment cost to buffer an unexpected income loss. Instead, they can use their current income to smooth consumption by reducing their flow savings in the period of the shock.[20] Households that are net borrowers, on the other hand, for example retired households or households with a low income realization, already pay the adjustment cost because they are decumulating assets. Faced with an unexpected income loss, these households face no additional cost to further deplete their assets and therefore smooth consumption as well. Overall, the precise magnitude of the consumption response depends on a number of objects such as the size of the income shock, the size of the adjustment cost and the distribution of household assets, in particular the distance to the asset threshold at which they would have to pay the adjustment cost, and is therefore highly non-linear.

6   Implications for fiscal policy

Large asymmetries in MPCs can have important implications for the design of fiscal policies, in particular for redistributive measures. The commonly held view that redistribution from high to low-income households boosts aggregate demand through the reallocation of resources from low to high-MPC households does not necessarily apply. If high-income households have large MPCs out of income losses, their reduction in consumption could more than compensate for the increase in consumption by low-income households. To assess the quantitative significance of this argument, this section compares the effectiveness of fiscal transfers across different financing schemes.

I evaluate a policy in which the government sends targeted lump-sum transfers to the bottom half of the income distribution. The size of the transfer is calibrated to roughly

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[20]The extent to which smoothing out of current income is possible depends of course also on the size of the shock.

match the stimulus checks that were disbursed as part of the COVID-19 Stimulus Package in the US.[21] The transfers are financed in three different ways: (i) a contemporaneous one-off proportional income tax on the top quarter of the income distribution, (ii) a future income tax of the same design which is announced contemporaneously and enacted one period later and (iii) a one-off proportional wealth tax on the top quarter of the wealth distribution.

Table 5 reports the contemporaneous percentage change in aggregate consumption following the introduction of the policy for each type of financing scheme and compares it to the change in aggregate consumption in a model without mental accounting preferences. It also reports the tax rate that is required to finance the transfers.

The first policy design illustrates that redistributive measures can be less effective when MPCs are asymmetric. A policy in which transfers are financed through an income tax on the top quarter of the income distribution *lowers* aggregate consumption by 0.01 percent in the model with mental accounting preferences. It is substantially less effective than in the model without mental accounting preferences due to large MPCs out of losses for high-income households. The reduction in consumption by high-income households in response to the tax is large enough to fully offset the increase in consumption by the recipients of the transfers.

The second policy design suggests that the timing of the tax matters. Financing the transfers through a future instead of current income tax yields a larger contemporaneous increase in aggregate consumption because consumption is less sensitive to changes in future compared to current income. The effect of this policy is stronger in the mental accounting model than in the model without primarily because MPCs out of income gains are larger. Note, however, that this exercise does not study the dynamic response of aggregate consumption, which will depend on the consumption response to expected income changes and the intertemporal MPC.

The third policy design suggests that also the type of tax matters. Financing the transfers through a wealth tax instead of an income tax leads again to a larger increase in aggregate consumption because consumption is less sensitive to changes in wealth than to changes in income. This effect is again stronger than in the model without mental accounting because MPCs out of income gains are larger.

Naturally, the fiscal policy exercise is not designed to make precise quantitative statements about the effects of different types of policies. It is meant to primarily serve illus-

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[21]Eligible individuals received a payment of $1,400 ($2,800 for married couples), plus an additional $1,400 per eligible child. With an average household size in the US of around 2.5, this results in a payment of roughly $3,500 per household. This amounts to around five percent of median income in the SCE sample, and as such roughly half the size of the hypothetical 10 percent shock for the median household.

Table 5: Effects of redistributive fiscal transfers

| | % change in aggregate consumption | | Required tax rate | |
Variable	MA	No MA	MA	No MA
Income tax	-0.01	0.25	3.7	3.6
Future income tax	0.53	0.27	3.7	3.7
Wealth tax	0.57	0.24	0.7	0.7

Notes: This table reports the change in aggregate consumption following lump-sum transfers to the bottom 50 percent of the income distribution financed by a (i) one-off proportional income tax on the top 25 percent of the income distribution, (ii) the announcement of a one-off proportional income tax on the top 25 percent of the income distribution one period ahead and (iii) a one-off proportional wealth tax on the top 25 percent of the wealth distribution. MA refers to the model with mental accounting, no MA to the one without.

trative purposes and highlight the role of the type and the timing of financing schemes when households hold mental accounts. At the same time, it is suggestive of broader aggregate effects. If asymmetric consumption responses at the individual level translate into asymmetric responses at the aggregate level, mental accounting could be one potential explanation for asymmetric fiscal multipliers. Barnichon et al. (2022), for example, documents that fiscal contractions cause larger consumption responses than fiscal expansions.[22]

7   Conclusion

This paper proposed a simple extension of the standard consumption framework that incorporates mental accounting. The framework resolves several empirical puzzles in the consumption literature without relying on theories of liquidity constraints, such as the excess sensitivity of consumption to contemporaneous income changes or the insensitivity to changes in wealth and news about future income. At the same time, mental accounting also generates larger consumption responses to income losses than to income gains, a feature of the data that many models struggle with.

A quantitative evaluation of the mental accounting model illustrated that the implications for certain types of fiscal policy are potentially far-reaching. Redistributive policies can be less effective in stimulating aggregate demand than in a conventional framework if the consumption of households that are taxed to finance the policies is sensitive to income changes. Adequate targeting of population segments is therefore critical both on the spending and the financing side for effective fiscal policy. Asymmetric consumption responses at the household level could furthermore be indicative of asymmetric fiscal

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[22]Ben Zeev et al. (2023) also finds larger responses to negative than to positive fiscal shocks, but these differences do not translate into asymmetric multipliers.

multipliers, i.e. fiscal contractions that translate into stronger aggregate consumption responses than fiscal expansions.

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APPENDIX

A   Empirical appendix

A.1   Survey questions

This appendix shows the phrasing of the survey questions and the response options. If households select response option 4-7, they are additionally asked to quantify what percentage they would spend, save or use to pay down debt in case of an income gain, and by how much they would cut spending, savings or increase debt in case of an income loss.

MPC out of income gains: *Suppose next year you were to find your household with 10 percent more income than you currently expect. What would you do with the extra income?*

1. Save or invest all of it
2. Spend or donate all of it
3. Use all of it to pay down debts
4. Spend some and save some
5. Spend some and use part of it to pay down debts
6. Save some and use part of it to pay down debts
7. Spend some, save some, and use some to pay down debts

MPC out of income losses: *Now imagine that next year you were to find yourself with 10% less household income. What would you do?*

1. Cut spending by whole amount
2. Not cut spending at all, but cut my savings by the whole amount
3. Not cut spending, but increase my debt by borrowing the whole amount
4. Cut spending by some and cut savings by some
5. Cut spending by some and increase debt by some
6. Cut savings by some and increase debt by some
7. Cut spending by some, cut savings by some and increase debt by some

A.2   MPC heterogeneity

This section studies MPC heterogeneity across several observable characteristics. Figure A4 shows graphically that MPC asymmetries are present across different income, age and

housing status groups. To study the relation between MPCs and individual characteristics more formally, I estimate the following specification:

$$MPC_i^j = \beta_0 + \beta_1 wealth_i + \gamma X_i + u_i$$

where MPC_i^j denotes the MPC measure $j \in \{+, -, asymmetry\}$ for household i, $wealth$ is a measure of net liquid wealth and X is a vector of control variables that are typically considered to affect MPCs.
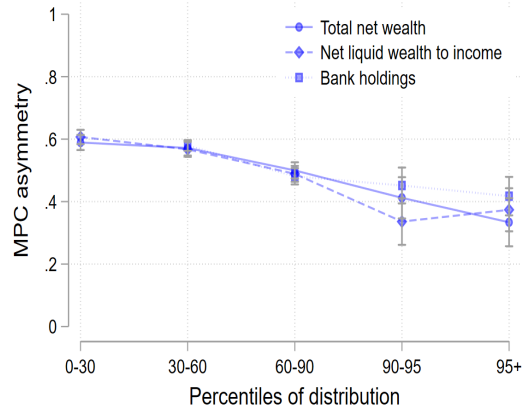
Table A1 shows that observable characteristics only explain a small share of variation in MPCs. As noted earlier, MPC asymmetries are negatively correlated with net liquid wealth (Column 1). This difference primarily stems from the negative correlation of MPCs out of losses with wealth (Column 5), but also partly the positive correlation between MPCs out of gains and wealth (Column 3). Columns 2, 4 and 6 add controls to the respective specifications. Older households have somewhat lower MPC asymmetries, as well as households with higher income. Households with mortgages have higher MPC asymmetries due to a lower MPC out of income gains. Income expectations do not seem to significantly affect MPCs.

Figure A1: MPCs across the net liquid wealth distribution
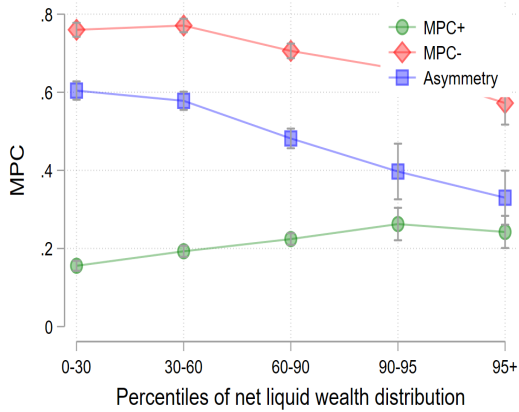
Figure A2: MPC asymmetries across measures of liquidity constraints

Notes: MPC asymmetry is defined as the difference between the MPC out of losses and the MPC out of gains. Grey bars indicate 95% confidence bands.

Notes: Each line corresponds to the MPC asymmetry across the respective distribution. Grey bars indicate 95% confidence bands. Total net wealth is defined as total assets (liquid assets + retirement funds and housing wealth) - total debt (liquid debt + mortgages). Bank holdings refer to money in checking and savings accounts.

Table A1: MPCs and household characteristics

|	MPC^{Asy}	MPC^{Asy}	MPC+	MPC+	MPC-	MPC-
Net liq. asset quintile 2	-0.042	-0.039	0.023	0.011	-0.019	-0.027
	(0.024)	(0.025)	(0.014)	(0.014)	(0.019)	(0.020)
Net liq. asset quintile 3	-0.045	-0.046	0.054***	0.035*	0.010	-0.011
	(0.026)	(0.027)	(0.016)	(0.017)	(0.020)	(0.020)
Net liq. asset quintile 4	-0.161***	-0.147***	0.079***	0.075***	-0.082***	-0.072***
	(0.026)	(0.027)	(0.015)	(0.015)	(0.020)	(0.021)
Net liq. asset quintile 5	-0.194***	-0.165***	0.081***	0.070***	-0.114***	-0.095***
	(0.027)	(0.029)	(0.015)	(0.016)	(0.022)	(0.023)
Age between 35-55		0.030		0.005		0.035
		(0.023)		(0.014)		(0.018)
Age > 55		-0.042		0.047**		0.005
		(0.025)		(0.015)		(0.020)
Income		-0.015		-0.010		-0.025**
		(0.011)		(0.006)		(0.008)
Mortgager		0.054*		-0.053***		0.000
		(0.023)		(0.013)		(0.018)
Homeowner		0.002		-0.013		-0.011
		(0.024)		(0.015)		(0.019)
Income expectations		0.013		0.008		0.021
		(0.017)		(0.010)		(0.014)
Constant	0.636***	0.769***	0.145***	0.260***	0.782***	1.029***
	(0.017)	(0.117)	(0.009)	(0.070)	(0.014)	(0.089)
R^2	0.03	0.04	0.02	0.04	0.02	0.03
Observations	3444	3341	3444	3341	3444	3341

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observations are weighted using survey weights. The dependent variables are the MPC asymmetry in columns 1 and 2, the MPC out of gains in columns 3 and 4 and the MPC out of losses in columns 5 and 6.

Figure A3: Marginal propensities to consume and repay debt across debtors and creditors
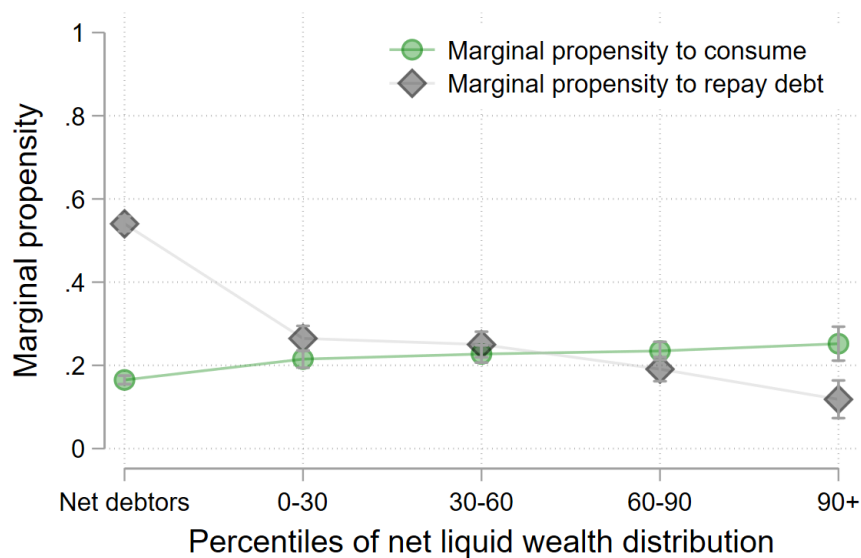
Notes: Net debtors are defined as households that hold net liquid debt. Percentiles of the wealth distribution are computed conditional on holding positive net liquid wealth. Grey bars indicate 95% confidence bands.

Figure A4: MPC asymmetries for different income, age and housing groups

A: Income

B: Age

C: Housing status
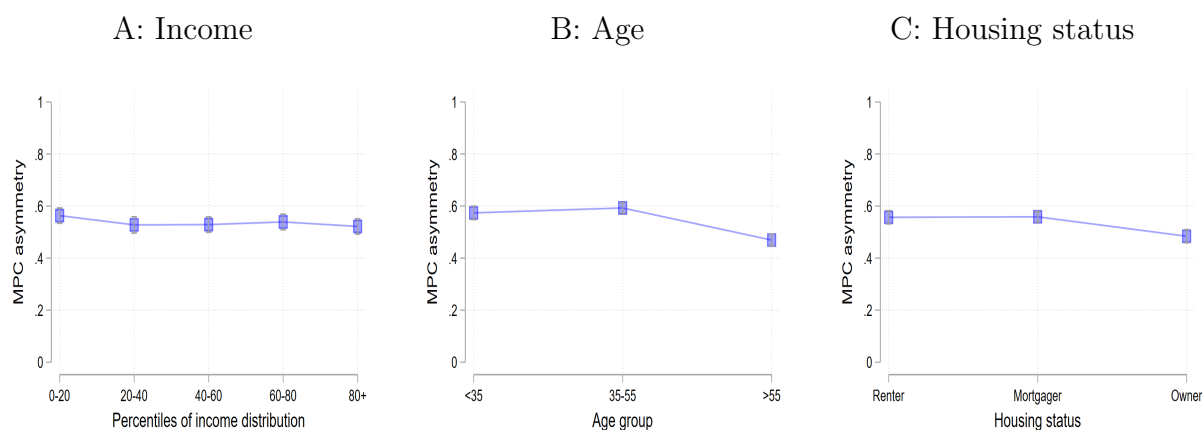
Notes: Grey bars indicate 95% confidence bands.

## A.3 Additional robustness checks

This section collects empirical evidence on the validity of household responses in the SCE. It shows that household spending in hypothetical scenarios is similar to actual spending behaviour, that spending plans predict actual spending decisions and that spending behaviour between financial literate and illiterate households is not too different.

Table A2: Planned vs actual expenditure.

|	(1) Appliances	(2) Electronics	(3) Furniture	(4) Home repairs	(5) Car	(6) Trips	(7) House
LPM	0.30***	0.37***	0.39***	0.48***	0.41***	0.56***	0.28***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Logit	0.20***	0.31***	0.23***	0.37***	0.25***	0.44***	0.08***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
R-squared LPM	0.04	0.05	0.08	0.13	0.07	0.21	0.10
R-squared Logit	0.04	0.04	0.09	0.11	0.07	0.17	0.17
Observations	5704	5693	5683	5691	5673	5690	4741

Notes: The table reports estimates of a linear probability model and a logit model in which an indicator variable that denotes the purchase of a good at time t is regressed on the stated probability in t-1 of purchasing that good. Marginal effects are reported for the logit estimates. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure A5: MPCs out of tax refunds versus hypothetical scenarios
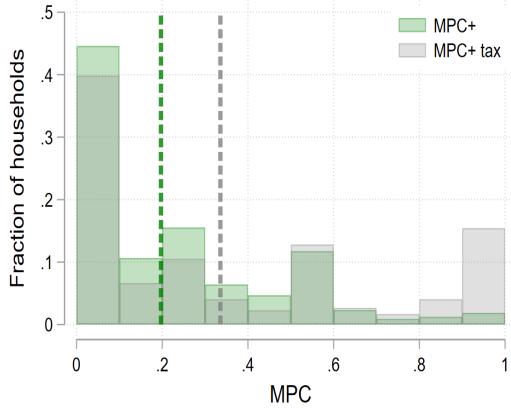
Notes: Dashed lines denote the average MPC out of gains and tax refunds, respectively.

Figure A6: MPC asymmetries for most financially literate households
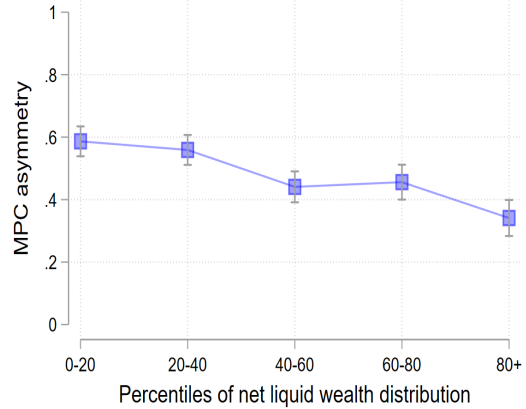
Notes: Grey bars indicate 95% confidence bands. Households are coded as financially literate if they answered all questions about financial literacy correctly. This is the case for around one third of the sample (N=1,382)

B Theory

B.1 Mental accounting model with initial wealth

This section studies the relationship between MPCs and wealth in the mental accounting framework. Introducing initial wealth w yields the following problem:

$$\max_{c_0,c_1} \quad u(c_0) - \lambda d(a_0, a_0^{plan}) + \beta u(c_1)$$

$$\text{s.t.} \quad c_0 + a_0 = y_0 + w; \quad c_1 = Ra_0$$

Solving this problem yields the following consumption allocation:

$$c_0 = \begin{cases} \frac{w+y_0}{1+\beta} & \text{if } c_0 \leq c_0^{plan} \\ \frac{w+y_0}{1+\frac{\beta}{1-\lambda}} & \text{if } c_0 > c_0^{plan} \end{cases}$$

The savings plan is derived as in the benchmark problem and given by $a_0^{plan} = \frac{\beta}{1+\beta}(w+y_0)$. Following the earlier logic, this yields the following MPCs:

$$MPC^+ = \left(\frac{w + y_0 + \epsilon y_0}{1 + \beta} - \frac{w + y_0}{1 + \beta} \right) \frac{1}{\epsilon y_0} = \frac{1}{1 + \beta}$$

$$MPC^- = \min\left\{ \left(\frac{w + y_0 + \epsilon y_0}{1 + \frac{\beta}{1-\lambda}} - \frac{w + y_0}{1 + \beta} \right) \frac{1}{\epsilon y_0}, 1 \right\}$$

Hence, the MPC^+ does not depend on initial wealth. For MPC^-, take the derivative of the first argument with respect to wealth (with some abuse of notation):

$$\frac{\partial MPC^-}{\partial w} = \left(\frac{w}{1 + \frac{\beta}{1-\lambda}} - \frac{w}{1 + \beta} \right) \frac{1}{\epsilon y_0} > 0$$

for $\epsilon \in (-1, 0)$. Hence, MPC^- is increasing in initial wealth w.

B.2 Mental accounting model with CRRA utility

This appendix generalizes the 2-period model to any CRRA utility function $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$. The consumption allocation is given by:

$$
c_0 = \begin{cases}
\frac{y_0}{1+\beta^{\frac{1}{\gamma}} R^{\frac{1-\gamma}{\gamma}}} & \text{if } c_0 \leq c_0^{plan} \\[3mm]
\frac{y_0}{1+(\frac{\beta}{1-\lambda})^{\frac{1}{\gamma}} R^{\frac{1-\gamma}{\gamma}}} & \text{if } c_0 > c_0^{plan}
\end{cases}
$$

The MPC is given by:

$$
\begin{aligned}
MPC = \frac{\Delta c_0}{\Delta y_0} &= \frac{\tilde{c}_0(y_0 + \epsilon y_0) - c_0(y_0)}{\epsilon y_0} \\[3mm]
&= \begin{cases}
\frac{1}{1+\beta^{\frac{1}{\gamma}} R^{\frac{1-\gamma}{\gamma}}} & \text{if } \epsilon > 0 \\[3mm]
\min\left\{ \frac{1}{1+\beta^{\frac{1}{\gamma}} R^{\frac{1-\gamma}{\gamma}}} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta^{\frac{1}{\gamma}} R^{\frac{1-\gamma}{\gamma}}}{1+(\frac{\beta}{1-\lambda})^{\frac{1}{\gamma}} R^{\frac{1-\gamma}{\gamma}}} - \frac{1}{\epsilon} \right), 1 \right\} & \text{if } \epsilon < 0
\end{cases}
\end{aligned}
$$

B.3 Mental accounting model with dissaving-aversion in t=0,1

Introducing dissaving-aversion in t_1 yields the following optimization problem:

$$
\max_{c_0,c_1} \quad u(c_0) - \lambda d(a_0, a_0^{plan}) + \beta \left(u(c_1) - \lambda d(a_1, a_1^{plan}) \right)
$$
$$
\text{s.t.} \quad c_0 + a_0 = y_0; \quad c_1 = Ra_0;
$$

The savings plan is formed at the beginning of each period. We already know a_0^{plan} from the problem without dissaving-aversion in t_1. The formation of a_1^{plan} is trivial as it is always optimal to consume everything in the final period, i.e. $a_1^{plan} = 0$. Dissaving-aversion in t_1 introduces two new Euler conditions, as marginal utility tomorrow now also depends on the difference between planned savings and actual savings tomorrow.

$$
\begin{aligned}
u'(c_0) &= \beta R u'(c_1) &&\text{if} \quad a_0 \geq a_0^{plan} \text{ and } a_1 \geq a_1^{plan} \\
(1-\lambda)u'(c_0) &= \beta R u'(c_1) &&\text{if} \quad a_0 < a_0^{plan} \text{ and } a_1 \geq a_1^{plan} \\
u'(c_0) &= \beta R(1-\lambda)u'(c_1) &&\text{if} \quad a_0 \geq a_0^{plan} \text{ and } a_1 < a_1^{plan} \\
(1-\lambda)u'(c_0) &= \beta R(1-\lambda)u'(c_1) &&\text{if} \quad a_0 < a_0^{plan} \text{ and } a_1 < a_1^{plan}
\end{aligned}
$$

Because it is always optimal to consume all savings in t_1, and the optimal savings plan in t_1 is always $a_1^{plan} = 0$, conditions three and four are irrelevant. Note that $a_1 < a_1^{plan} = 0$ would imply negative assets at death. As such, it is equivalent to the problem without dissaving-aversion in t_1.

B.4 Proofs

Derivation of MPCs in the mental accounting model:

The consumption allocation is given by:

$$c_0 = \begin{cases} \frac{y_0}{1+\beta} & \text{if } c_0 \leq c_0^{plan} \\ \frac{y_0}{1+\frac{\beta}{1-\lambda}} & \text{if } c_0 > c_0^{plan} \end{cases}$$

The MPC is given by:

$$MPC = \frac{\Delta c_0}{\Delta y_0} = \frac{\tilde{c}_0(y_0 + \epsilon y_0) - c_0(y_0)}{\epsilon y_0}$$

Note that the MPC formula consists of two distinct consumption functions, $c_0(\cdot)$ and $\tilde{c}_0(\cdot)$, which differ in the savings plan under which the consumption decision is made. For example, $\tilde{c}(y_0 + \epsilon y_0)$ denotes the consumption allocation under the savings plan $a_0^{plan}(y_0)$, while $c(y_0 + \epsilon y_0)$ denotes the consumption allocation under the savings plan $a_0^{plan}(y_0 + \epsilon y_0)$.

A positive shock $\epsilon > 0$ increases planned consumption c_0^{plan} by ϵy_0. Unless the household increases consumption by more than ϵy_0 (which implies a $MPC > 1$) consumption is always weakly below planned consumption. Because it is never optimal to increase consumption by more than ϵy_0 due to consumption smoothing, consumption is indeed always weakly below planned consumption. Hence:

$$MPC^+ = \left(\frac{y_0 + \epsilon y_0}{1+\beta} - \frac{y_0}{1+\beta} \right) \frac{1}{\epsilon y_0} = \frac{1}{1+\beta}$$

A negative shock $\epsilon < 0$ decreases planned consumption c_0^{plan} by ϵy_0. Unless the household decreases consumption by more than ϵy_0 (which implies a $MPC > 1$) consumption is always weakly above planned consumption. Because it is never optimal to decrease consumption by more than ϵy_0 due to consumption smoothing, consumption is indeed always weakly below planned consumption. Hence:

$$MPC^- = \min \left\{ \left(\frac{y_0 + \epsilon y_0}{1+\frac{\beta}{1-\lambda}} - \frac{y_0}{1+\beta} \right) \frac{1}{\epsilon y_0}, 1 \right\} = \min \left\{ \left(\frac{1+\epsilon}{1+\frac{\beta}{1-\lambda}} - \frac{1}{1+\beta} \right) \frac{1}{\epsilon}, 1 \right\}$$

$$= \min \left\{ \frac{1}{1+\beta} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 1 \right\}$$

Proposition 1 (MPC asymmetry):

Proof. We want to show that $\min\left\{\frac{1}{1+\beta}\left(\frac{1+\epsilon}{\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}}-\frac{1}{\epsilon}\right),1\right\} > \frac{1}{1+\beta}$ for $\epsilon \in (-1,0)$. With regards to the first expression, dividing both sides by $\frac{1}{1+\beta}$ yields $\frac{1+\epsilon}{\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}}-\frac{1}{\epsilon} > 1$. From there, $\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} \leq 1$, which is true for any $\lambda \in (0,1]$. With regards to the second expression, $1 > \frac{1}{1+\beta}$ for $\beta > 0$. $\square$

Corollary (Shock size):

Proof. First, we want to show that the derivative of the first term in MPC^- with respect to ϵ is positive for $\epsilon \in (-1,0)$.

$$\frac{\partial MPC^-}{\partial \epsilon} = \frac{\partial \frac{1}{1+\beta}\left(\frac{1+\epsilon}{\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}}-\frac{1}{\epsilon}\right)}{\partial \epsilon} = \frac{1+\beta}{1+\frac{\beta}{1-\lambda}}\frac{\epsilon-(1+\epsilon)}{\epsilon^2}+\frac{1}{\epsilon^2} = \frac{1}{\epsilon^2}-\frac{1}{\epsilon^2}\underbrace{\frac{1+\beta}{1+\frac{\beta}{1-\lambda}}}_{\leq 1} > 0$$

for $\lambda \in (0,1]$ and $\beta > 0$. Second, $MPC^+ = \frac{1}{1+\beta}$ and as such does not depend on the income shock ϵ.

$\square$

Proposition 2 (MPC out of wealth):

Proof. Introduce initial wealth w to the problem and assume, for simplicity, $y_0 = 0$. Furthermore, assume that a_0^{plan} changes one-to-one as initial wealth changes. The consumption allocation is then given by:

$$c_0 = \begin{cases} \frac{w}{1+\beta} & \text{if } c_0 \leq c_0^{plan} \\ \frac{w}{1+\frac{\beta}{1-\lambda}} & \text{if } c_0 > c_0^{plan} \end{cases}$$

A positive shock $\epsilon > 0$ increases planned savings a_0^{plan} by ϵw and leaves planned consumption c_0^{plan} unchanged. For any increase in consumption, consumption is therefore always above planned consumption. Furthermore, consumption will never drop in response to a positive income shock due to consumption smoothing. This yields the

following MPC^+ out of wealth:

$$MPC^{+,wealth} = \frac{\Delta c_0}{\Delta w} = \max \left\{ \left(\frac{w(1+\epsilon)}{1 + \frac{\beta}{1-\lambda}} - \frac{w}{1+\beta} \right) \frac{1}{\epsilon w}, 0 \right\}$$

$$= \max \left\{ \left(\frac{1+\epsilon}{1 + \frac{\beta}{1-\lambda}} - \frac{1}{1+\beta} \right) \frac{1}{\epsilon}, 0 \right\}$$

$$= \max \left\{ \frac{1}{1+\beta} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1 + \frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 0 \right\}$$

We want to show that $MPC^{+,wealth} < MPC^+$. With regards to the first expression, we can show that:

$$\frac{1}{1+\beta} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1 + \frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right) < \frac{1}{1+\beta} \rightarrow \frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1 + \frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} < 1 \rightarrow \frac{1+\beta}{1 + \frac{\beta}{1-\lambda}} < 1$$

for any $\lambda \in (0, 1]$, $\epsilon \in (0, 1)$ and $\beta > 0$. With regards to the second expression, trivially $0 < \frac{1}{1+\beta}$.

A negative shock $\epsilon < 0$ decreases planned savings a_0^{plan} by ϵw and leaves planned consumption c_0^{plan} unchanged. For any decrease in consumption, consumption is therefore always below planned consumption. This yields the following MPC^- out of wealth:

$$MPC^{-,wealth} = \frac{\Delta c_0}{\Delta w} = \left(\frac{w(1+\epsilon)}{1+\beta} - \frac{w}{1+\beta} \right) \frac{1}{\epsilon w} = \frac{1}{1+\beta}$$

We want to show that $MPC^{-,wealth} < MPC^-$.

$$\frac{1}{1+\beta} < \frac{1}{1+\beta} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1 + \frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right)$$

The proof of Proposition 1 shows that this holds for any $\epsilon \in (-1, 0)$ and $\lambda \in (0, 1]$. $\square$

Proposition 3 (MPC out of income news):

Proof. Introduce income y_1 to the initial problem and assume, for simplicity, $y_0 = 0$. Furthermore, assume that a_0^{plan} does not respond to changes in y_1. The consumption allocation is then given by:

$$c_0 = \begin{cases} \frac{y_1}{R(1+\beta)} & \text{if } c_0 \leq c_0^{plan} \\ \frac{y_1}{R(1 + \frac{\beta}{1-\lambda})} & \text{if } c_0 > c_0^{plan} \end{cases}$$

A positive shock $\epsilon > 0$ to future income y_1 leaves both planned consumption c_0^{plan}

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and planned savings a_0^{plan} unchanged. For any increase in consumption, consumption is therefore always above planned consumption. Furthermore, consumption will never drop in response to a positive news shock due to consumption smoothing. This yields the following MPC^+ out of income news:

$$MPC^{+,news} = \frac{\Delta c_0}{\Delta y_1} = \max\left\{\left(\frac{(1+\epsilon)y_1}{R(1+\frac{\beta}{1-\lambda})} - \frac{y_1}{R(1+\beta)}\right)\frac{1}{\epsilon y_1}, 0\right\}$$

$$= \max\left\{\left(\frac{1+\epsilon}{1+\frac{\beta}{1-\lambda}} - \frac{1}{1+\beta}\right)\frac{1}{R\epsilon}, 0\right\}$$

$$= \max\left\{\frac{1}{1+\beta}\left(\frac{1+\epsilon}{R\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{R\epsilon}\right), 0\right\}$$

We want to show that $MPC^{+,news} < MPC^+$. With regards to the first expression, we can show that:

$$\frac{1}{1+\beta}\left(\frac{1+\epsilon}{R\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{R\epsilon}\right) < \frac{1}{1+\beta} \rightarrow \frac{1+\epsilon}{R\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{R\epsilon} < 1 \rightarrow \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} < \frac{1+R\epsilon}{1+\epsilon}$$

for any $\lambda \in (0,1]$, $\epsilon \in (0,1)$, $\beta > 0$ and $R \geq 1$. With regards to the second expression, trivially $0 < \frac{1}{1+\beta}$. Following a similar logic, one can also show that $MPC^{+,news} < \frac{1}{R(1+\beta)}$ which is the MPC out of news in a model without dissaving aversion.

A negative shock $\epsilon < 0$ to future income y_1 leaves both planned consumption c_0^{plan} and planned savings a_0^{plan} unchanged. For any decrease in consumption, consumption is therefore always below planned consumption. This yields the following MPC^- out of income news:
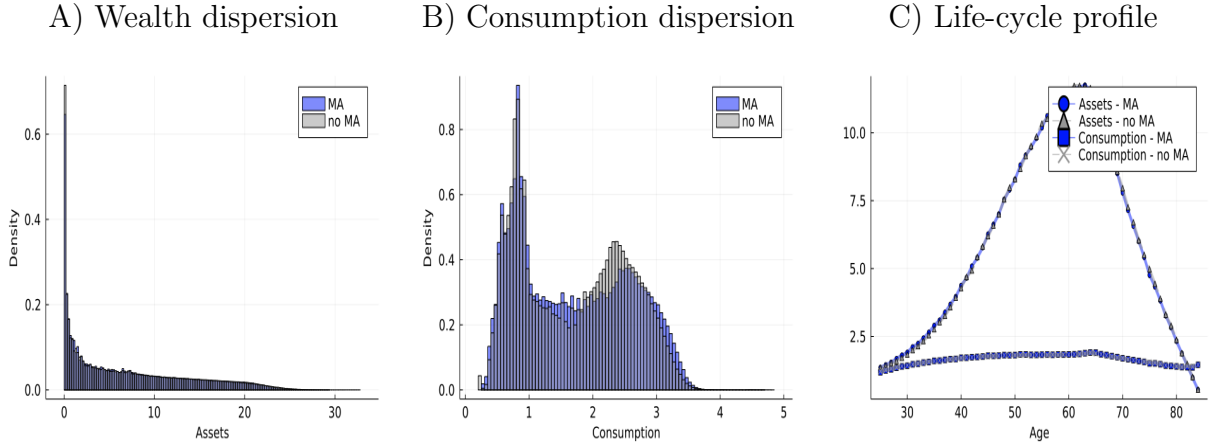
$$MPC^{-,news} = \frac{\Delta c_0}{\Delta y_1} = \left(\frac{y_1(1+\epsilon)}{R(1+\beta)} - \frac{y_1}{R(1+\beta)}\right)\frac{1}{\epsilon y_1} = \frac{1}{R(1+\beta)}$$

We want to show that $MPC^{-,news} < MPC^-$:

$$\frac{1}{R(1+\beta)} < \frac{1}{1+\beta}\left(\frac{1+\epsilon}{\epsilon}\frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon}\right)$$

The proof of Proposition 1 shows that this holds for any $\epsilon \in (-1,0)$, $\lambda \in (0,1]$ and $R \geq 1$. $\square$

Figure C1: Consumption and savings in the mental accounting model

A) Wealth dispersion   B) Consumption dispersion   C) Life-cycle profile

Notes: MA refers to the model with mental accounting preferences while no MA refers to the one without.

C   Additional model results

This section presents additional results from the quantitative model. Table C1 compares model and data moments. Figure C1 compares the dispersion and life-cycle profile of consumption and wealth across the mental accounting and the standard model. Figure C2 shows MPC asymmetries across the distribution of wealth from a model in which the strength of the dissaving-aversion motive λ is constant across households and set to the average λ in the baseline model. Figure C3 shows MPC asymmetries from a model in which the savings plan is defined as $a^{plan} = (1 + r)a$. This formulation of the savings plan is simpler and states that accessing wealth is always costly. All other elements are unchanged compared to the baseline model. Figure C4 shows MPC asymmetries from a model without mental accounting into which I introduce an asymmetric portfolio adjustment cost, i.e. households pay a fixed cost κ if $a' < (1 + r)a$. The figure shows MPCs from two models, one with a relatively low (one-tenth of average monthly income) and one with a relatively high (one-half of average monthly income) adjustment cost. Figure C5 plots the difference between the benchmark saving rule and the simpler rule of thumb $a^{plan} = (1 + r)a$ for various ages, levels of wealth and income.

Table C1: Model moments versus data moments

|	Data	Model
Average wealth-to-income ratio	4.28	4.28
Average MPC out of losses	0.73	0.73
Ratio of households with savings plan/dissaving-aversion ratio between bottom and top quintile of wealth distribution	1.29	1.29

Figure C2: MPCs with constant λ
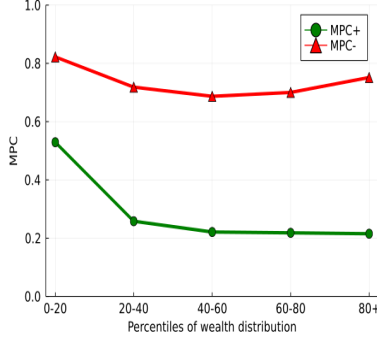
Notes: MPCs from a transitory 10% income shock in a model with no heterogeneity in λ across households, where $\lambda = \bar{\lambda}$.

Figure C3: MPCs with $a^{plan} = (1+r)a$
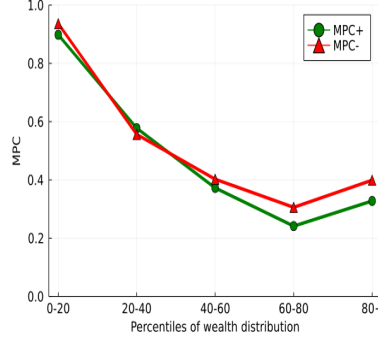
Notes: MPCs from a transitory 10% income shock in a model with savings rule $a^{plan} = (1+r)a$.

Figure C4: MPCs with transaction costs
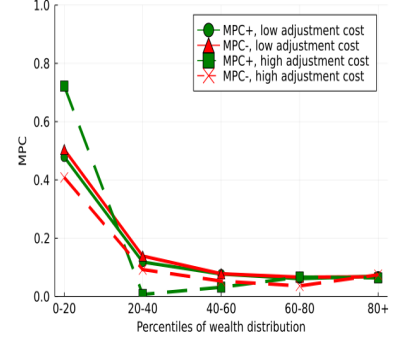
Notes: MPCs from a transitory 10% income shock in a model without mental accounting, but with asymmetric portfolio adjustment cost, where households pay a fixed cost κ if $a' < (1+r)a$.

D   Other Theories

This section discusses briefly (and non-exhaustively) other common models of consumption behaviour in the context of MPC asymmetries.

D.1   Standard extensions

Most standard extensions generate larger MPCs and MPC asymmetries by generating a higher share of liquidity-constrained households, i.e. by shifting households along the wealth distribution. Kaplan and Violante (2022) provides an excellent overview of this literature. These extensions do not address, however, why households that are not liquidity-constrained respond asymmetrically to changes in income. In what follows, I discuss each extension in more detail.

Risk aversion: The effect of changes in risk aversion on MPC asymmetries is theoretically ambiguous and quantitatively small. Higher risk aversion concavifies the consumption function, but at the same time shifts households away from the borrowing constraint due to a stronger precautionary savings motive. These forces have off-setting effects on the MPC and MPC asymmetry and are therefore relatively small, as discussed in Kaplan and Violante (2022).

Discount-factor heterogeneity: Heterogeneity in the discount factor (e.g. Aguiar et al. (2020) for a recent example) primarily affects the distribution of wealth, but has little bearing on MPC asymmetries. It shifts a larger share of (impatient) households

Figure C5: Comparison of saving rules: a^{plan} versus $(1+r)a$

A) Low z B) High z
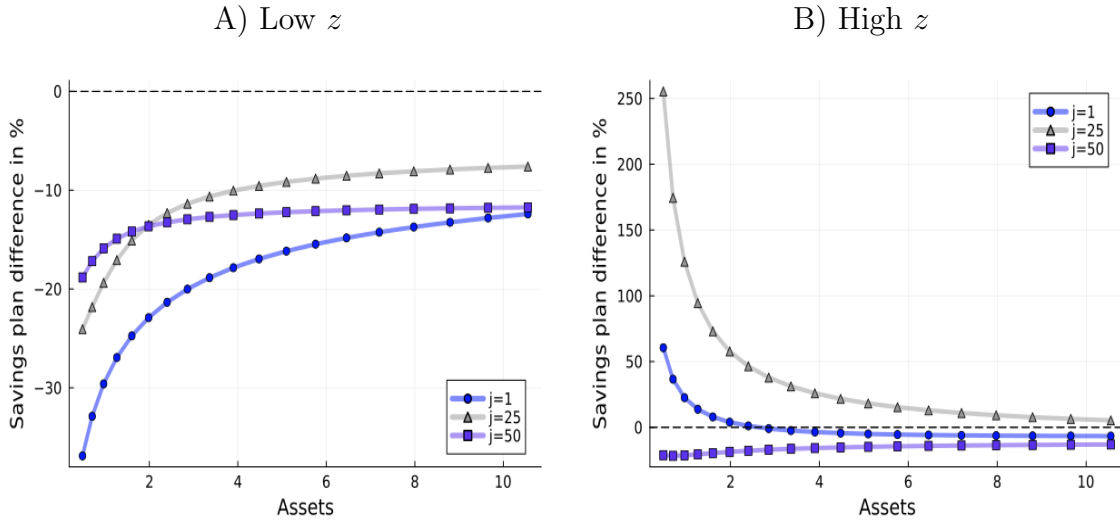
Notes: This figure reports the percentage difference between a^{plan} and $(1+r)a$ for households of different ages and wealth levels, where the transitory income shock is fixed at the average. The left panel reports the difference for a household with a low, the right panel for a household with a high persistent income realization.

closer to the borrowing constraint and generates a set of (patient) households with large wealth holdings. As such, it suffers from the missing-middle problem, i.e median wealth that's substantially below average wealth in excess of what the data suggest (as discussed in Kaplan and Violante (2022)). Apart from these shifts along the wealth distribution, discount factor heterogeneity only affects the level, but not the asymmetry of MPCs.

Return rate heterogeneity: Heterogeneity in returns generates similar results as discount-factor heterogeneity (Kaplan and Violante, 2022). Because a few high-return households hold most of the wealth in the economy, this pushes down the discount factor that is necessary to match average wealth in the economy. A lower discount factor increases the MPC, but does not per se introduce asymmetries.

Two-asset model: A model featuring both a liquid and illiquid asset in the spirit of Kaplan and Violante (2014) generates a larger share of liquidity-constrained households by introducing wealthy hand-to-mouth households. This roughly triples the share of liquidity-constrained households to one-third of the population (Kaplan et al., 2014). It does not provide an explanation for why the remaining two-thirds of households which are unconstrained would respond asymmetrically to changes in income. One could hypothesize that for the majority of households liquid resources are not sufficient to fully absorb the income loss, but this seems to be at odds with the data.

Consumption adjustment costs: Fuster et al. (2021) introduces a fixed utility cost to adjusting consumption and shows that it generates a larger sign asymmetry than a model without adjustment costs. However, this asymmetry is quantitatively small.

The symmetric adjustment cost primarily addresses the extensive margin of consumption adjustment and increases the share of households that do not adjust consumption in response to a change in income. This affects both the response to positive and negative income shocks. A large shock of 10% of annual income is likely to be large enough to induce most households to pay the fixed cost and adjust consumption as the benefits of consumption smoothing outweigh the cost of consumption adjustment.

Consumption commitments: Chetty and Szeidl (2007) introduces a model that features consumption commitments. This introduces 'sticky' consumption and if anything, lowers MPCs out of losses. Intuitively, the consumption loss is concentrated on one good, which for the same reduction in total consumption implies a larger utility loss than if that loss were distributed across both goods.

D.2 Behavioural explanations

Hyperbolic discounting: Hyperbolic discounting, as for example studied in Laibson et al. (2021), increases MPCs, but does not generate meaningful asymmetries as it amplifies both the response to gains and losses. In the simple two-period framework from Section 4, the MPC with hyperbolic discounting would be given by:

$$MPC = \frac{1}{1 + \delta\beta}$$

where δ denotes the hyperbolic discount factor. Compared to a standard model, present bias increases MPCs by discounting future consumption at a higher rate, but it equally does so for gains and losses.

Rational inattention: Reis (2006) introduces a theory of inattentive households in which households only sporadically update their consumption plans due to a cost to processing information. Inattention introduces stickiness to consumption plans and lowers MPCs out of unexpected shocks, for both gains and losses. Alternatively, one can introduce households that plan savings instead of consumption. This increases MPCs out of both gains and losses as now most of the income change is absorbed through consumption instead of savings. Neither specification, sticky consumption plans nor savings plans generates meaningful asymmetries, however.

Temptation preferences: Temptation preferences introduce a demand for commitment and are similar in spirit to hyperbolic discounting with sophisticated agents. Attanasio et al. (2020) uses such preferences to generate demand for illiquid assets. By locking away their wealth in housing, which is associated with a fixed cost, households can reduce the utility cost of temptation. As such, temptation preferences present one way to generate a large share of wealthy hand-to-mouth households without assuming excessively large

returns on illiquid assets. Given that temptation preferences introduce an element of present bias, they tend to increase MPCs for both gains and losses, similar to hyperbolic discounting. Moreover, a larger share of wealthy hand-to-mouth households implies a larger share of households with asymmetric MPCs. But similarly to the two-asset model in Kaplan and Violante (2014), it does not explain why unconstrained households have asymmetric MPCs.

Expectations-based reference-dependence and loss aversion: Pagel (2017) studies a life-cycle model with expectations-based reference-dependent preferences, building on previous work by Koszegi and Rabin (2009). Within this framework, household's period utility not only consists of the standard utility from consumption, but additionally of gain-loss utility, i.e. the deviation of consumption relative to a reference point. This reference point is given by the household's previous expectations about both present and future consumption. The preference structure generates excess smoothness and sensitivity in consumption. However, because unexpected losses in present consumption are more painful than expected losses in the future, households delay unexpected losses in consumption until expectations have adjusted in the future. This lowers the MPC out of losses and therefore does not address the MPC asymmetry discussed in this paper.