MPCs with behavioural agents*

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Abstract

I use survey questions on spending in hypothetical scenarios to study differences in marginal propensities to consume out of positive and negative income shocks. I find a sizeable asymmetry in spending responses driven by large adjustments following income losses compared to small adjustments following income gains. This asymmetry occurs irrespective of the position in the wealth distribution and is not driven by liquidity constraints. As such, it stands in stark contrast to predictions of traditional models of consumption behaviour. I develop a model with dissaving-averse households, a behavioural feature consistent with mental accounting, that rationalizes this asymmetry and simultaneously generates low MPCs out of income news, low MPCs out of wealth and high MPCs out of income gains for households that are not liquidity-constrained. I show through the lens of a quantitative model that asymmetric MPCs dampen the effectiveness of redistributive fiscal policy.

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1 Introduction

The marginal propensity to consume (MPC) plays a central role in the transmission of fiscal and monetary policy. In quantifying MPCs, 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 documenting an additional puzzle: consumption responds more strongly to income losses than to income gains irrespective of the degree of liquidity-constraints. It then resolves this divide by proposing a unifying theoretical framework of consumption behaviour that addresses several empirical puzzles at once.

I begin by documenting large differences in hypothetical spending responses to positive and negative income shocks for a sample of households from the Fed Survey of Consumer Expectations (SCE). MPCs are asymmetric driven by large adjustments following income losses compared to small adjustments following income gains. The average MPC out of positive income shocks is rather small at 0.2, while the average MPC out of negative income shocks is substantially larger at 0.73. These asymmetries are also widespread. Around 85 percent of households indicate that they would adjust consumption more strongly in response to negative than to positive income shocks.

Notably, consumption responds asymmetrically across all levels of wealth. While the level of the MPC asymmetry, defined as the difference between the MPC out of income losses and income gains, decreases from 0.60 for the bottom thirty percent to 0.33 for the top five percent of the wealth distribution, this decrease is small compared to the absolute level of the asymmetry. Larger holdings of wealth primarily reduce the MPC out of losses, but insufficiently so to close the gap with the MPC out of gains. These patterns cannot 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). Even the most liquid households in the sample display sizeable asymmetries.

Several features of the data corroborate the robustness of the survey evidence on MPCs. First, spending out of the hypothetical scenario is comparable to reported spending out of tax refunds. This direct comparison is possible as survey participants are asked to indicate both their spending response to a hypothetical income change and their actual spending response to a realized tax refund. Second, households' ex-ante planned expenditure predicts their ex-post realized expenditure, suggesting that households form accurate spending plans. Finally, asymmetric consumption responses are not driven by the presence of financially illiterate households.

While small sign asymmetries in MPCs, particularly for liquidity-constrained households, are consistent with standard models of consumption behaviour (Kaplan and Violante, 2010), large asymmetries for unconstrained households are at odds with the predictions of conventional consumption models. Several extensions have been suggested that can generate large MPCs out of income gains for unconstrained agents (Kueng, 2018; Ilut and Valchev, 2020; Laibson et al., 2021), but they fail to generate large asymmetries, i.e. MPCs out of losses that are considerably larger.

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; McDowall, 2019). Households hold different mental accounts with regards to their current income and asset position. Funds pertaining to the asset account are not perfect substitutes for funds in the current income account, i.e. mental accounting introduces non-fungibility between income and assets. In particular, consuming out of the asset account is costly, with the cost governed by a parameter that indicates the level of dissaving-aversion.

The partition between the income and the asset account is given by a savings rule against which households benchmark their savings decisions. This partition delivers a flexible distinction between the income and the asset account and allows, for example, regular retirement savings to fall under the asset account. In the model, I assume that savings plans are formed endogenously by households and adjust flexibly to changes in wealth, but only imperfectly to changes in income. The combination of dissaving-aversion and rigidity in savings plans generates rich non-linearities in the consumption response to income shocks. Empirically, the presence of savings rules is strongly backed by the data. A large majority of households in the SCE sample states to plan their savings.

I show analytically that the mental accounts model generates predictions that are in line with several empirically documented patterns. 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 the standard model would predict. Third, it predicts MPCs out of wealth that are lower than MPCs out of income.

Heterogeneity in the presence of savings plans across households in the SCE sample furthermore allows me to test the prediction that households with a savings plan display higher MPC asymmetries than households without a savings plan. I provide suggestive evidence that this is supported by the data. Households with a savings plan have MPCs that are significantly more asymmetric.

To study the implications of dissaving-aversion in a quantitative setup, I incorporate mental accounting into a life-cycle model with income risk and borrowing constraints. The model generates large MPC asymmetries that closely match the ones observed in the data. In particular, it predicts large MPCs out of losses across all levels of wealth while keeping MPCs out of gains moderate. Importantly, the asymmetry of MPCs is not explicitly targeted in the calibration exercise. The dissaving-aversion motive is only disciplined by matching the average MPC out of losses and shares of households with a savings plan in the SCE.

A comparison with a model without mental accounting preferences shows that the mental accounting model performs well across several dimensions. First, the standard model cannot generate asymmetric MPCs for households that are not liquidity-constrained. Second, the mental accounting model predicts relatively large MPCs out of gains for unconstrained households (Lewis et al., 2019; Fagereng et al., 2021). Third, and in line with the predictions of the analytical model, the mental accounting model generates lower MPCs out of income news and wealth (McDowall, 2019; Di Maggio et al., 2020; Chodorow-Reich et al., 2021; Christelis et al., 2021; Fuster et al., 2021). Crucially, this does not come at the cost of missing other moments of the data. The mental accounting model preserves the dynamics of the frictionless model with respect to the life-cycle profiles and dispersion of consumption and savings.

The policy implications of widespread MPC asymmetries are considerable. First, they suggest a cautious approach to redistributive fiscal policies as the traditional logic of redistributing from the wealthy (low MPC) to the poor (high MPC) does not necessarily hold in this framework. Because MPCs out of losses are large even for the wealthy, the increase in consumption by the poor might not be enough to offset the reduction in consumption by the wealthy. A simulation of the mental accounting model suggests that the effectiveness of a simple redistributive policy in which the bottom 50 percent of the income distribution receives stimulus checks crucially depends on who bears the burden of financing the transfers and the type of tax. Levying a one-off income tax on the wealthiest 25 percent of households substantially reduces aggregate consumption, while taxing income-rich households instead increases aggregate consumption, but less so than in the frictionless model. Taxing wealth instead of income yields the largest effects on aggregate consumption due to low MPCs out of wealth, but high MPCs out of income. Second, 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).

The remainder of this section relates this paper to the literature. Section II describes the data. Section III presents empirical results. Section IV introduces the analytical framework. Section V presents the quantitative model and the fiscal experiment. Section VI concludes.

Literature. This paper is closely related to the empirical literature on MPC asymmetries. Christelis et al. (2019) and Fuster et al. (2021) 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) provide similar evidence from reported consumption responses to actual income changes. Baugh et al. (2021) finds asymmetric responses to expected income changes using transaction-level data. 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.

The theoretical framework outlined in this article connects to a wider literature that finds consumption patterns that are inconsistent with predictions of traditional consumption models. First, MPCs out of income gains can be large even for households that are not liquidity constrained (Lewis et al., 2019; Fagereng et al., 2021). Second, several studies suggest that MPCs out of wealth are lower than MPCs out of income (Di Maggio et al., 2020; Chodorow-Reich et al., 2021; Christelis et al., 2021). Third, there is ample evidence that consumption 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; McDowall, 2019; Fuster et al., 2021).

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., 2021), near-rationality (Kueng, 2018), or imperfect reasoning (Ilut and Valchev, 2020). Lian (2020) proposes a mechanism through which anticipation of future mistakes amplifies both MPCs out of gains and losses. Ganong and Noel (2019) introduce households with present bias to generate high MPCs out of predictable income losses. Most closely related to my model, McDowall (2019) introduces a mental accounting friction to explain high MPCs out of predictable income gains. In contrast to these papers, my model explicitly addresses MPC asymmetries. At the same time, it is also consistent with the previously mentioned consumption patterns.

2 Data

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 household heads. 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, 2020), 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* negative 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 MPCs.

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. (2021) 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.

2.1 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.[1]

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. As such, I remain agnostic on which type of consumption the MPC measure is capturing. It could equivalently be interpreted as a marginal propensity to spend (MPX) (Laibson et al., 2022). 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.[2] 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, as discussed in the next section. 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.[3]

2.2 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.[4] I only keep households which respond to both MPC questions. Lastly, I winsorize balance sheet 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).

[1] Appendix A provides more detailed information on the qualitative response options.

[2] Interestingly, Graziani et al. (2016) and Bunn et al. (2018) find that the distinction between persistent and transitory shocks does not critically affect MPC levels.

[3] 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).

[4] MPCs are similar between 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 change little 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	82,139	65,000	69,547	150	400,000	3,630
Bank holdings	28,348	8,000	69,363	0	1,600,000	2,623
Liquid assets	90,409	10,000	234,445	0	1,600,000	3,450
Liquid 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.

3 Empirical results

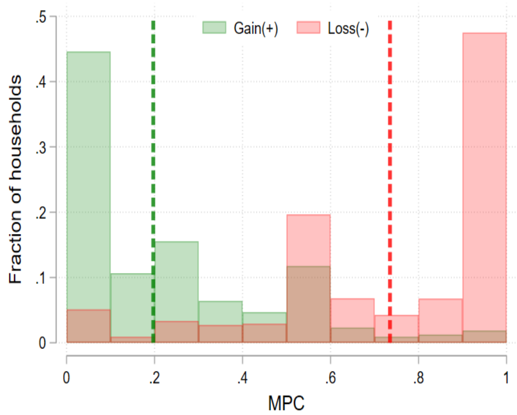
This section presents the main results of the empirical analysis. I first show cross-sectional evidence on MPC asymmetries. I then illustrate that MPC asymmetries are only weakly related to observable characteristics and are present irrespective of the household's position in the wealth distribution.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

3.1 MPC asymmetries

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 at the lower end of empirical estimates (see for example the review in Jappelli and Pistaferri (2010)), but in line with the notion that larger income windfalls induce lower relative consumption responses. Almost half of the households indicate little to no consumption adjustment in response to a positive income shock, while only a negligible share indicates to spend all additional income.

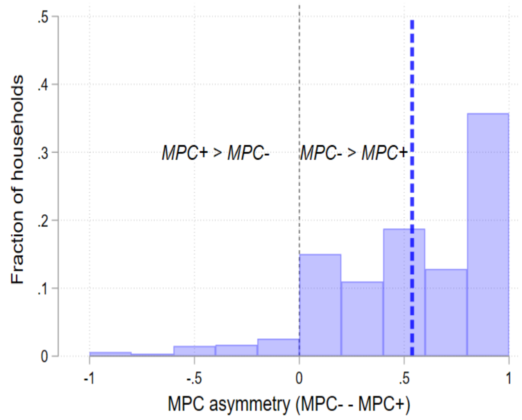
This pattern flips completely for MPCs out of income losses. Almost half of the households fully absorb the income loss by cutting consumption, with only few households not adjusting

Figure 1: Distribution of MPCs out of income gains and income losses



Notes: Dashed lines denote the average MPC^+ and MPC^- in the sample.

Figure 2: Distribution of MPC asymmetries



Notes: The dashed line denotes the average MPC asymmetry in the sample.

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, Figure 2 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 more than a third of households fully cuts consumption in response to negative income shocks, but does not increase consumption at all in response to positive income shocks.

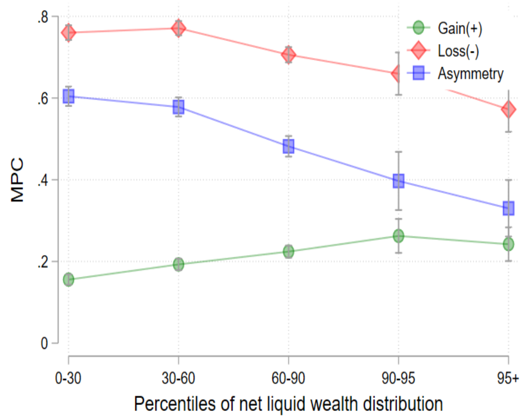
3.2 Heterogeneity across the wealth distribution

The existence of sign asymmetries is by itself not a surprising result. 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 3 plots the average MPC asymmetry across percentiles of the net liquid wealth distribution.[5] The asymmetry is present irrespective of the position in the wealth distribution. It decreases in wealth, but only marginally compared to the

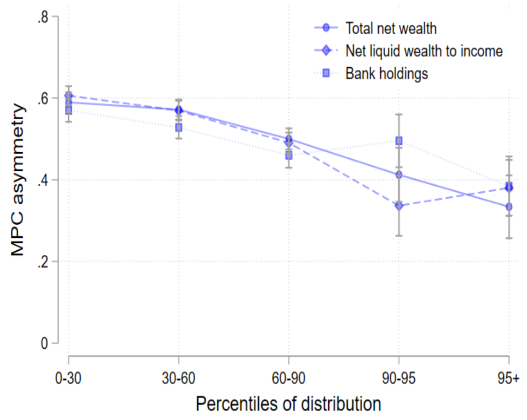
[5]Net liquid wealth is defined as the sum of bank deposits, stocks and bonds minus liquid debt, i.e. most types of debt excl. mortgages.

Figure 3: MPCs across the net liquid wealth distribution



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.

Figure 4: MPC asymmetries across measures of liquidity-constraints



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.

absolute level of the asymmetry, and much less than theory would predict. While a standard consumption model would predict perfectly symmetric MPCs, the data suggest that even the wealthiest five percent have an asymmetry of 0.33.

Figure 3 also decomposes the asymmetry into MPCs out of gains and out of losses. While MPCs out of gains are rather constant across wealth levels, MPCs out of losses are decreasing in wealth.[6]. As such, it is the MPC out of losses that 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.

Irrespective of which wealth measure one looks at, consumption always responds more strongly to income losses than to gains (Figure 4). 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 driving 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 except for cash, MPCs are still highly

[6]The finding that the relationship between MPC^+ and wealth is weak at best has been documented before (Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2021). Low MPCs for households with little wealth are primarily driven by households that hold net debt. These households predominantly use the income windfall to repay debt. This could be due to aversion towards holding debt or differential interest rates on debt and assets, for example. Once one excludes net debtors, the relationship between MPCs out of gains and wealth is almost flat, see Figure B1.

asymmetric. Finally, Figure 4 shows that also households with substantial liquid wealth relative to income do not smooth consumption in response to income losses. The top five percent hold liquid wealth that covers several years of annual income and should in theory be capable of buffering a loss that amounts to only 10 percent of annual income.

3.3 Heterogeneity across other dimensions

MPC asymmetries could in principle be associated with observable characteristics other than wealth such as income, homeownership status or age. Figures B2, B3 and B4 show graphically that MPC asymmetries persist nevertheless across these dimensions. To study the relationship 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.[7]

Table 2 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 and 2). This difference primarily stems from the negative correlation of MPCs out of losses with wealth (Column 5 and 6), but also partly the positive correlation between MPCs out of gains and wealth (Column 3 and 4). Columns 2, 4 and 6 adds controls. 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.

3.4 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 my empirical findings.

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

[7] While the data have a time dimension, I do not control for time effects in the main specification as there is negligible variation over time.

Table 2: MPCs and household characteristics

	(1) MPC^{Asy}	(2) MPC^{Asy}	(3) MPC^{+}	(4) MPC^{+}	(5) MPC^{-}	(6) MPC^{-}
Net liq. asset quintile 2	-0.050**	-0.047*	0.024*	0.012	-0.026	-0.035*
	(0.025)	(0.026)	(0.014)	(0.014)	(0.020)	(0.020)
Net liq. asset quintile 3	-0.033	-0.031	0.046***	0.025	0.013	-0.005
	(0.025)	(0.027)	(0.015)	(0.016)	(0.019)	(0.020)
Net liq. asset quintile 4	-0.160***	-0.145***	0.078***	0.072***	-0.082***	-0.073***
	(0.026)	(0.027)	(0.015)	(0.015)	(0.020)	(0.021)
Net liq. asset quintile 5	-0.193***	-0.160***	0.080***	0.066***	-0.113***	-0.094***
	(0.027)	(0.029)	(0.015)	(0.016)	(0.022)	(0.023)
Age between 35-55		0.030		0.006		0.035*
		(0.023)		(0.014)		(0.018)
Age > 55		-0.044*		0.050***		0.005
		(0.025)		(0.015)		(0.020)
Income		-0.019**		-0.006		-0.025***
		(0.009)		(0.005)		(0.006)
Mortgager		0.058***		-0.056***		0.002
		(0.022)		(0.013)		(0.018)
Homeowner		0.002		-0.012		-0.011
		(0.024)		(0.015)		(0.018)
Income expectations		0.010		0.010		0.020
		(0.017)		(0.010)		(0.014)
Constant	0.636***	0.811***	0.146***	0.218***	0.782***	1.029***
	(0.018)	(0.099)	(0.009)	(0.062)	(0.014)	(0.069)
R-squared	0.03	0.04	0.02	0.04	0.02	0.04
Observations	3444	3370	3444	3370	3444	3370

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observations are weighted using survey weights.

actual income gain. Figure B5 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 my sample to only the most financially literate households, I again find that the MPC asymmetry is sizeable (Figure B6).

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 B1 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 model of mental accounts

4.1 General framework

The data suggest that asymmetric consumption responses are prevalent across most households, irrespective of their wealth levels. These asymmetries allude to a systematic behavioural pattern that induces households to save large fractions of income windfalls, but deters households from using savings to buffer income losses. A conventional consumption framework would predict the former, but not the latter.

In order to make sense of these empirical patterns, I propose an extension of the standard consumption model that incorporates mental accounting (Shefrin and Thaler, 1988; Thaler, 1990; McDowall, 2019). Within this framework, households hold different mental accounts with regards to their current asset and current income position. Funds pertaining to the current asset account are not perfect substitutes for funds in the current income account. As such, mental accounting introduces non-fungibility.

To operationalize the notion of mental accounting, I follow McDowall (2019) and assume that households benchmark their savings decisions against a savings rule, which serves as the mental partition between the income and the asset account.[8] This rule can be thought of as a mental rule-of-thumb that households use to facilitate decision-making. Negative deviations from the savings rule are assumed to be costly, i.e. households are *dissavings-averse* (DA). 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.[9] This generates non-linearities in the consumption response to income shocks.

Formally, I introduce the mental accounting friction through a modified utility function:

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

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

where $u(c)$ denotes a standard utility function over consumption and $\lambda(a)d(a', a^{plan})$ denotes the disutility from deviating from a predetermined savings plan. The disutility term consists of two elements: a non-linear penalty function $d(a', a^{plan})$, which takes as arguments the actual savings decision a' and the savings according to the savings plan a^{plan}. This can equivalently be re-mapped into a function of actual consumption c and the consumption level that the household obtains following strictly the savings plan, c^{plan}. $d(a', a^{plan})$ is non-linear in the sense that only negative deviations from the savings plan, i.e. dissaving, is penalized. Saving more than planned does not affect household's utility directly. The second element of the disutility term $\lambda(a)$ denotes the strength of the dissavings-aversion motive. By allowing this parameter to vary with the asset position, I leave open the possibility that the mental costs associated with savings plan deviations can be related to wealth. 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 $\lambda = 1$.

Discussion: Several features of the mental accounting framework deserve further discussion. First, there is ample empirical evidence that households behave as if they were subject to mental accounting. As an early example, Shefrin and Thaler (1988) tests and confirms several predictions of mental accounting for both liquidity-constrained and unconstrained households. A set of more recent studies finds numerous empirical patterns that can be reconciled by mental accounting behaviour, such as low MPCs out of wealth (Chodorow-Reich et al., 2021; Christelis

[8] While I use a mental accounting model to study MPC asymmetries, McDowall (2019) uses it to explain the timing of consumption responses. My specification differs in the design of the savings rule and allows for a more flexible penalty term, as discussed later.

[9] The asymmetric deviation cost can alternatively be interpreted through the lens of reference-dependent preferences with loss aversion, as explored, for example, in Kőszegi and Rabin (2006).

Table 3: Share of households with budget or savings/debt repayment plan

Percentile of net liquid wealth distribution	0-30	30-60	60-90	90-95	95+
Keeps budget	66.3%	70.7%	64.6%	59.2%	55.5%
Has savings/debt repayment plan	69.1%	61.0%	62.9%	49.4%	45.7%

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?"

et al., 2021), differences in spending propensities out of capital gains and dividends (Di Maggio et al., 2020), little reaction to income news (Ganong and Noel, 2019; McDowall, 2019; Baugh et al., 2021; Fuster et al., 2021), and saving rates that are increasing in permanent income (Straub, 2019). Some of these predictions are discussed in later sections.

Data from the SCE also support the idea that households follow a savings rule. The survey asks participants whether they keep a budget or follow a savings or debt repayment plan. Table 3 shows that a large majority of households indeed keeps a budget and plans their savings and debt repayments, and that this share is decreasing in wealth. But why would households budget according to a saving plan? One can imagine several underlying motives, such as temptation or self-control problems (Gul and Pesendorfer, 2001), bounded rationality (Gabaix, 2014) or rational inattention (Sims, 2003). For the purpose of this paper, I will remain agnostic on the precise motive.

Finally, households that explicitly state to keep a budget or follow a savings or debt repayment plan are associated with a substantially larger MPC asymmetry (Table 4). This suggests that households subject to mental accounting distinguish more strongly between positive and negative income changes in their consumption response.

4.2 Two-period model

This section presents a simple two-period model to illustrate the mechanism through which mental accounting generates asymmetric MPCs. The two-period model also allows me to derive several propositions with regards to the predictions of the model.

Households in this economy live for two periods $t \in \{0, 1\}$ and are born with zero initial wealth.[10] 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,

[10] This assumption is purely made for expositional clarity. Appendix C.2 solves for the case with initial wealth.

Table 4: MPCs and savings plans

	(1) MPC^{Asy}	(2) MPC^{+}	(3) MPC^{-}
Keeps budget	0.093***	-0.045***	0.049***
	(0.02)	(0.01)	(0.01)
Has savings/debt repayment plan only	0.049**	-0.043***	0.006
	(0.02)	(0.01)	(0.02)
R-squared	0.06	0.05	0.04
Observations	3370	3370	3370
Controls	YES	YES	YES

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.

augmented by the penalty term for deviating from the savings plan.[11] For simplicity, I assume that households face no penalty in the second period and that the dissaving-aversion parameter λ is constant.[12] Finally, households discount the future with the subjective discount factor β and save at an exogenous gross interest rate R. This yields the following problem:

$$\max_{c_0, c_1, a_0^{plan}} \quad u(c_0) - \lambda d(a_0, a_0^{plan}) + \beta u(c_1) \tag{3}$$

$$\text{s.t.} \quad c_0 + a_0 = y_0; \quad c_1 = R a_0; \tag{4}$$

Taking derivatives with respect to a_0 yields the following Euler equation:

$$\beta R u'(c_1) = \begin{cases} u'(c_0) & \text{if} \quad a_0 \geq a_0^{plan} \\ (1-\lambda) u'(c_0) & \text{if} \quad a_0 < a_0^{plan} \end{cases} \tag{5}$$

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 Euler equation and budget constraint, we can derive

[11] Appendix C.3 solves for the case with CRRA utility.

[12] 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 C.4.

an expression for c_0:

$$c_0 = \begin{cases} \frac{y_0}{1+\beta} & \text{if } a_0 \geq a_0^{plan} \\ \frac{y_0}{1+\frac{\beta}{1-\lambda}} & \text{if } a_0 < a_0^{plan} \end{cases} \tag{6}$$

The final element that is missing is the savings plan itself. 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 saving plan is formed endogenously based on the household's current income and wealth position.[13] Formally, it is derived as the solution to the following problem:

$$\max_{c_0, c_1} \quad u(c_0) + \beta u(c_1) \tag{7}$$

$$\text{s.t.} \quad c_0 + a_0 = y_0; \quad c_1 = Ra_0; \tag{8}$$

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

$$a_0^* = y_0 - \frac{y_0}{1+\beta} \equiv a_0^{plan} \tag{9}$$

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:

$$c_0^{plan} = y_0 - a_0^{plan} \tag{10}$$

This definition will be useful for providing the intuition behind the results. To derive an expression for the MPC, assume that income in $t = 0$ unexpectedly changes by a fraction ϵ. Because savings plans are assumed to be rigid, households cannot adjust their savings plan in response to this shock.[14] Under this assumption, we can compute the MPC as:

$$MPC = \frac{\Delta c_0}{\Delta y_0} = \frac{\tilde{c}_0(y_0 + \epsilon y_0) - c_0(y_0)}{\epsilon y_0} = \begin{cases} \frac{1}{1+\beta} & \text{if } \epsilon \geq 0 \\ \min\left\{ \frac{1}{1+\beta} \left(\frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 1 \right\} & \text{if } \epsilon < 0 \end{cases} \tag{11}$$

This yields the following 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 $|\epsilon| \in (0, 1)$.

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

[14] Rigidity in savings plans can be micro-founded with models of rational inattention or bounded rationality, for example, in particular to small shocks.

Proof. See Appendix C.1. □

Proposition 1 suggests that the MPC depends on the direction of the income change, i.e. the sign of ϵ. To gain intuition, 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.

The magnitude of the asymmetry 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 next proposition elaborates on the role of ϵ.

Proposition 2 (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. See Appendix C.1. □

Proposition 2 states that MPCs out of losses are lower for larger shocks. Given that MPCs out of gains are independent of the shock size, MPC asymmetries are 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 (due to increased salience, for example), which brings the MPC closer to the one in a conventional model. The negative relationship between MPC^- and shock size established here goes slightly against conventional predictions of a positive relationship. 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 MPCs out of wealth and income news that are consistent with the data.

Proposition 3 (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 savings rule responds one-to-one to changes in wealth: $MPC^{+,wealth} < MPC^{+}$ and $MPC^{-,wealth} < MPC^{-}$ for any level of dissaving-aversion $\lambda \in (0, 1]$ and income change $|\epsilon| \in (0, 1)$.

Proof. See Appendix C.1. □

Proposition 3 shows that under certain assumptions on the savings plan, the mental accounting model generates MPCs out of wealth that are smaller than MPCs out of income, for both gains and losses. This prediction is supported by a large body of empirical evidence (Di Maggio et al., 2020; Chodorow-Reich et al., 2021; Christelis et al., 2021). While most theoretical explanations are based on differences in liquidity between income and wealth, the mental accounting model introduces non-fungibility through differential responses of the savings plan.[15] Because unexpected changes in wealth are assumed to 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.

Proposition 4 (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 the savings rule is unresponsive to news: $MPC^{+,news} < MPC^{+}$ and $MPC^{-,news} < MPC^{-}$ 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 C.1. □

Proposition 4 suggests that under certain assumptions on the savings plan, also MPCs out of income news are smaller than MPCs out of contemporaneous income changes. Several papers have documented the insensitivity of consumption to income news (Ganong and Noel, 2019; McDowall, 2019; Baugh et al., 2021; Fuster et al., 2021). Conventional consumption models 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.[16] 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 the specification of the savings plan: the savings plan 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

[15] The differential response of the savings rule to changes in income and wealth can be interpreted as another consequence of holding different mental accounts with respect to income and assets.

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

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.

5 Quantitative evaluation

This section introduces a quantitative life-cycle model with mental accounting and studies implications for fiscal policy.

5.1 Life-cycle model with mental accounting

To explore to what extent the mental accounting model can quantitatively match the MPC asymmetry observed in the data, I incorporate mental accounting into a life-cycle model with idiosyncratic income risk and borrowing constraints.

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 $y_{i,t}$. During retirement, income is deterministic. Households can save in a risk-free asset a that pays an interest rate r. Borrowing is not allowed in this economy, i.e. $\underline{a} = 0$. Households have mental accounting preferences given by:

$$u^{DA}(c_{i,t}) = u(c_{i,t}) - \lambda_0 e^{a_{i,t}\lambda_1} d(a_{i,t+1}, a_{i,t+1}^{plan}) \tag{12}$$

In contrast to the two-period model, I allow the strength of the dissavings aversion parameter to vary with the level of wealth that the household holds. In particular, dissavings 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 dissavings aversion at the intensive margin, i.e. the same household exhibiting different degrees of dissavings aversion for different levels of wealth or, at the extensive margin, different shares of behavioural households compared to fully rational households for different levels of wealth.

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. Wages are normalized to 1. The innovations to the persistent and transitory component are orthogonal to each other and independent over time and across households.

$$\log Y_{i,t} = \bar{y}_t + z_{i,t} + e_{i,t} \tag{13}$$

$$z_{i,t} = \rho_z z_{i,t-1} + u_{i,t}, \quad u_{i,t} \sim N(0, \sigma_z^2) \quad e_{i,t} \sim N(0, \sigma_e^2) \tag{14}$$

This yields the following recursive formulation:

$$V(j, z, e, a) = \max_c u^{DA}(c) + \beta \mathbb{E} V(j+1, z', e', a') \tag{15}$$

$$\text{s.t.} \quad c + a' = (1+r)a + y, \quad a' \geq \underline{a} \tag{16}$$

where j indicates age. The final element that needs to be defined is the savings plan. Similarly to the stylized framework in Section 4, I specify the savings plan as the optimal savings policy from an equivalent household problem as in Equation 15 in which the transitory shock is set to zero. The savings plan responds to persistent income changes, but not to transitory income changes. [17]

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

The key rationale behind specifying the savings rule in this way is to give the household sufficient flexibility to adjust saving plans in response to important events. One could equivalently posit simpler rules, such as keeping wealth constant or saving a constant fraction of income, but a more flexible savings rule is arguably closer to reality. While I remain agnostic on the precise mechanism that generates such planning, models of bounded rationality (Gabaix, 2014) or rational inattention (Reis, 2006), for example, would generate rigidity in savings plans.

Calibration: Table 5 provides an overview of the calibrated parameters. The model period is one year. Households work for 40 years and then spend 20 years in retirement. I first calibrate several parameters outside of the model. The interest rate is set to 0.02. 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 and is determined by the persistent component of income earned in the final period before retirement. 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

[17] Think of receiving a permanent salary increase compared to a one-time bonus. You might change your saving habits in response to the former, but not in response to the latter.

Table 5: 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 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	0.70	Avg. MPC^-
λ_1	Dissaving aversion - decay	-0.0195	Top-bottom ratio of households with savings plan

the discount factor β to match the average net wealth-to-income ratio in the SCE sample.[18] 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 households that follow a savings plan between the bottom 30 percent and top 5 percent of the wealth distribution from Table 3. The moment selection is conservative in the sense that I neither target the asymmetry of MPCs per se nor the behaviour of MPCs across the wealth distribution. In particular the latter moment allows me to externally discipline the dissaving-motive without any targeting of MPCs.

The level of dissaving-aversion λ_0 is calibrated to 0.7, with a moderate decay in wealth of $\lambda_1 = -0.0195$. The average level of dissaving-aversion across the simulated households of $\bar{\lambda} = 0.62$ turns out to be above the one estimated in McDowall (2019), who finds a value of 0.346. This is not surprising given that the models are not only structurally different across several dimensions - specification of the savings rule, the dissaving-aversion motive and other life-cycle components - but are also calibrated based on different moments. Targeting a lower MPC level as in McDowall (2019) would result in a lower dissaving-aversion parameter. Table D1 shows that the model moments match the targeted data moments very well.

Results: I compute MPCs out of income gains and losses by simulating households' consumption paths in which I exogenously increase and decrease income by 10 percent, in line with the survey questions from the empirical section. Figure 5 plots the model-generated MPCs across the wealth distribution. The model matches the empirically observed MPCs closely. In particular, it successfully generates large MPCs out of negative income shocks that are decreasing moderately in wealth. At the same time, it produces consumption responses to positive income shocks that are substantially smaller. Figure 6 makes this explicit by plotting the asymmetry

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

itself.

Comparing MPCs from the mental accounting model to MPCs from a model without behavioural frictions illustrates the importance of including dissaving-aversion in the utility function.[19] The standard model generates much smaller MPCs out of income losses than the data would suggest, in particular for unconstrained households. It furthermore fails to generate sizeable differences between MPCs out of gains and out of losses. Hence, it neither matches the asymmetry for liquidity-constrained households nor any of the empirically observed MPCs for unconstrained households.

Two observations regarding the MPC out of income gains deserve further discussion. First, the mental accounting model not only generates higher MPCs out of losses compared to the standard model, but also higher MPCs out of gains across all levels of wealth. This is due to some households saving less than prescribed by their savings plan. These households would ideally consume more, but do not do so due to dissavings-aversion. Being constrained by their savings plan, they behave similarly to liquidity-constrained households - any additional income windfall is largely consumed. Hence, mental accounting provides a potential rationale for the empirically observed large consumption responses of households with high levels of liquid wealth. Second, the model-generated MPCs out of gains for constrained households are higher than what the SCE data would suggest, but largely in line with findings in other empirical studies (Parker et al., 2013). This is due to the mental accounting model preserving the negative relationship between MPCs out of gains and net wealth.

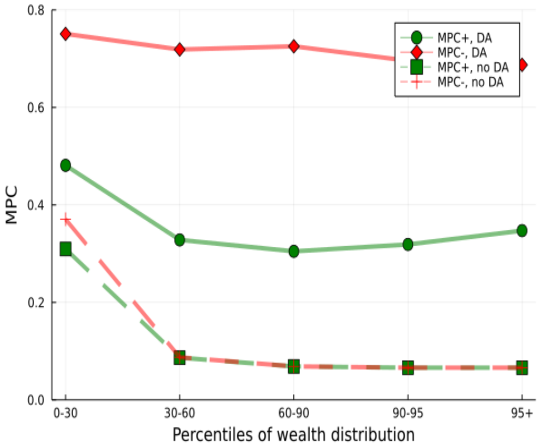
The model also matches fairly well the distribution of MPCs across households. Figure 7 shows that the model produces MPCs out of gains and losses that are concentrated around 0 and 1 respectively, closely resembling the patterns in the data.[20] Figure 8 furthermore shows that the model not only replicates the asymmetry in the cross-section but also at the household level. It predicts a high share of households with fully asymmetric MPCs, i.e. asymmetries of close to one. At the same time, it also predicts a significant share of households with symmetric MPCs, i.e. households resembling permanent income consumers.

Other predictions: The life-cycle version of the mental accounting model delivers several other notable predictions. Consistent with the stylized theoretical framework, it generates MPCs out of income news and wealth that are substantially smaller than MPCs out of income under the assumption that savings plans do not react to news about future income, but respond 1:1 to changes in wealth. Figure 9 plots MPCs out of a wealth shock for both gains and losses and compares it to the respective MPC out of income. MPCs out of wealth are substantially lower

[19] 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.

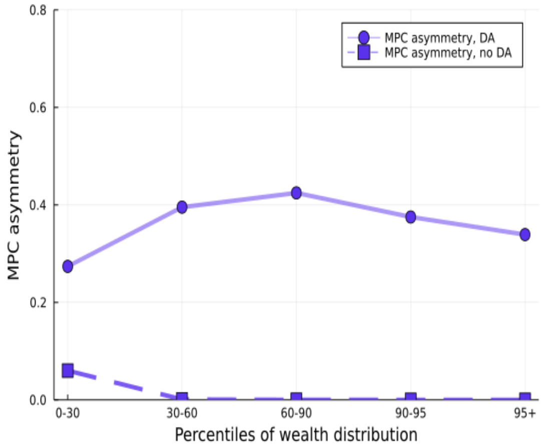
[20] Note that some households have MPCs that are marginally larger than one. This is due to numerical inaccuracies of the solution algorithm.

Figure 5: Model MPCs



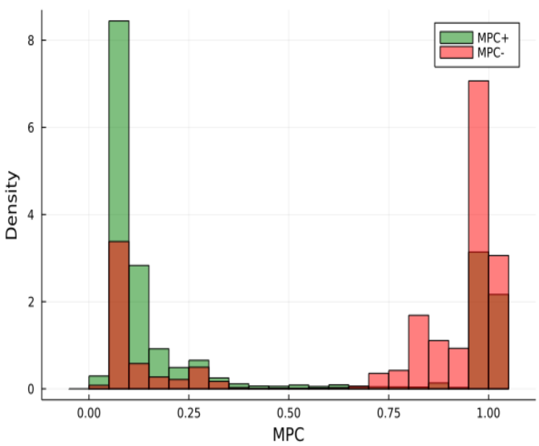
Notes: MPCs are computed by simulating a transitory 10% income shock. DA refers to the model with mental accounting preferences while no DA refers to the frictionless model.

Figure 6: Model MPC asymmetries



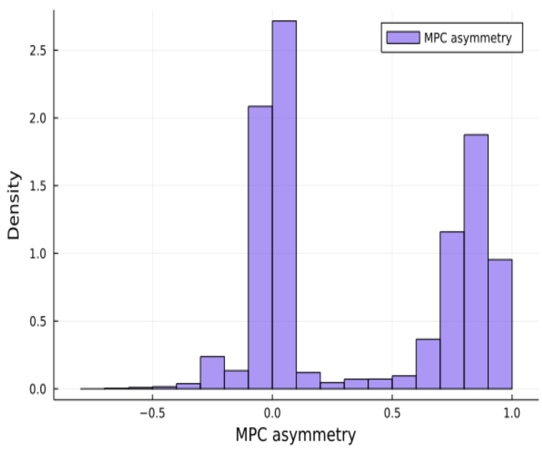
Notes: MPCs are computed by simulating a transitory 10% income shock. DA refers to the model with mental accounting preferences while no DA refers to the frictionless model.

Figure 7: Distribution of model MPCs



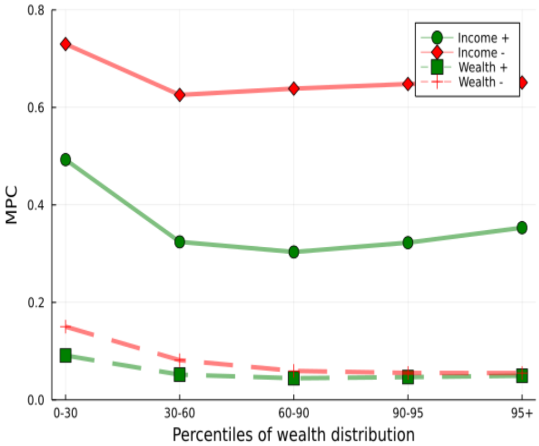
Notes: MPCs are computed by simulating a transitory 10% income shock.

Figure 8: Distribution of model MPC asymmetries



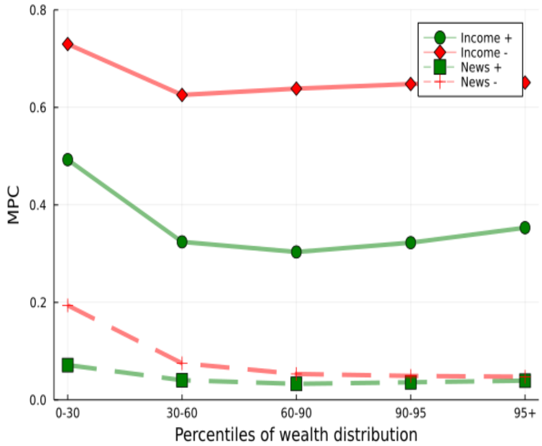
Notes: MPCs are computed by simulating a transitory 10% income shock.

Figure 9: MPC out of wealth



Notes: MPCs are computed by simulating a transitory lump-sum shock of around 5% of median annual income.

Figure 10: MPC out of news



Notes: MPCs are computed by simulating a transitory lump-sum shock of around 5% of median annual income.

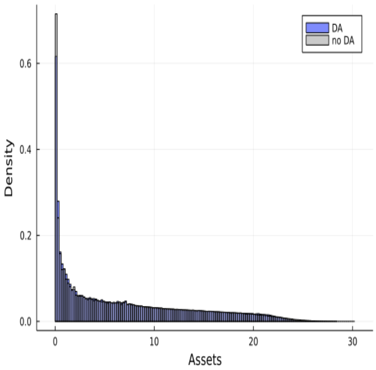
than MPCs out of income across all levels of wealth. Figure 10 plots MPCs out of income news instead. Again, consumption reacts much less to news about future income than to current income changes. The model also partly preserves the asymmetry in the consumption response to income news. This resonates with the empirical evidence in Fuster et al. (2021) that finds that households adjust consumption in response to negative, but not positive income news.

The lower sensitivity of consumption to income news relates to recent empirical evidence on the reaction to predictable income changes. McDowall (2019) finds that consumption primarily responds upon the receipt of income, but not upon the arrival of income news and explains this fact with a model of mental accounting. Ganong and Noel (2019) finds similar evidence for predictable income losses, but explains the findings with present bias. Present bias cannot explain the sluggish reaction to positive income news, however. Baugh et al. (2021) study asymmetric responses to positive and negative predictable income changes and find the reverse asymmetry that I find for unpredictable income changes: consumption responds more to predictable gains than to losses. The asymmetric response to news suggests that the mental accounting model produces similar patterns.

The model without mental accounting fails to generate substantial differences between MPCs out of current income, income news and wealth. Because wealth and income are perfectly fungible in the standard framework, the MPC out of wealth is identical to the MPC out of income. The MPC out of income news is identical to the MPC out of income adjusted for discounting, and as such only marginally lower.

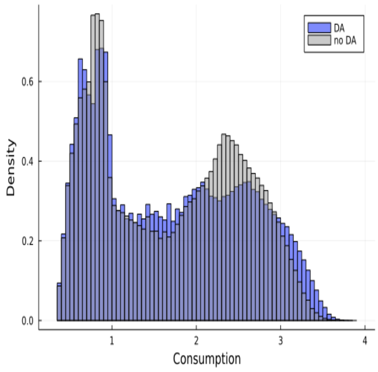
Importantly, introducing mental accounting preferences to match consumption responses

Figure 11: Wealth dispersion



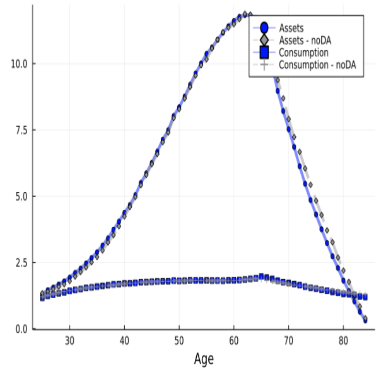
Notes: DA refers to the model with mental accounting preferences while no DA refers to the frictionless model.

Figure 12: Consumption dispersion



Notes: DA refers to the model with mental accounting preferences while no DA refers to the frictionless model.

Figure 13: Consumption and savings over the life-cycle



Notes: DA refers to the model with mental accounting preferences while no DA refers to the frictionless model.

does not come at the cost of missing other moments. The consumption-savings dynamics are close to the ones in the frictionless life-cycle model. Figure 11 and 12 show that the mental accounting model produces a comparable dispersion of wealth and consumption, while Figure 13 shows that it also predicts a similar life-cycle profile of consumption and savings.

5.2 Implications for fiscal policy

Large asymmetries in MPCs carry important implications for the design of fiscal policies, in particular for redistributive measures. The commonly held view that redistribution from the rich to the poor, for example through targeted stimulus checks financed by a one-off tax on the rich, boosts aggregate demand due to redistribution from low to high MPC households, does not necessarily apply. If rich households have large MPCs out of income losses, their reduction in consumption following the introduction of the tax could more than compensate for the increase in consumption by the recipients of the transfer payments. To assess the quantitative significance of this argument, this section compares the effectiveness of three different fiscal policies.

Policy design: I evaluate policies in which the government gives targeted lump-sum transfers to the bottom 50 percent of the income distribution. The size of the transfer is calibrated to roughly 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: a one-off proportional

[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 is 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.

income tax on the top 25 percent of the income distribution, a one-off proportional income tax on the top 25 percent of the wealth distribution, and a one-off proportional wealth tax on the top 25 percent of the wealth distribution.

Results: Table 6 reports the 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 25% of the income distribution raises aggregate consumption by 0.15 percent in the model with mental accounting preferences. It is substantially less effective than in the standard model due to larger consumption reductions by the rich.

The second policy design shows that the targeting of policies not only matters on the spending, but also on the financing side. The effectiveness of transfers decreases even more when they are financed by taxing the income of the wealthy instead of the income of the rich. Aggregate consumption now in fact *decreases* by 0.31%. Taxing the wealthy leads to larger consumption reductions in the mental accounting framework because they have higher MPCs out of losses than the income-rich.

The last policy design suggests that also the type of tax matters. Financing the transfers through a wealth tax instead of an income tax leads to the largest increase in aggregate consumption as consumption is much less sensitive to changes in wealth than to changes in income. The effect is also stronger than in the standard model because MPCs out of gains are larger.

6 Conclusion

This paper documented that consumption responds asymmetrically to changes in income. Consumption is smoothed less in response to income losses than in response to income gains. A simple extension of the standard consumption framework that incorporates mental accounting can generate the empirically observed asymmetry. The model also predicts consumption responses to changes in wealth and income news that are consistent with empirical evidence.

A quantitative evaluation of the model with mental accounting illustrated that the implications for fiscal policy are far-reaching. Redistributive fiscal policy can be less effective in stimulating aggregate demand than in a conventional framework if the consumption of households that are taxed to finance the policy is sensitive to income changes. As such, adequate targeting of population segments is critical both on the spending and the financing side for effective fiscal policy. More broadly, asymmetric MPCs suggest that fiscal contractions potentially

Table 6: Effects of redistributive fiscal policy

	% change in aggregate consumption	Required tax rate
Income tax on the rich		
DA model	0.15	3.3
Standard model	0.23	3.3
Income tax on the wealthy		
DA model	-0.31	4.9
Standard model	0.23	5.0
Wealth tax on the wealthy		
DA model	0.55	0.6
Standard model	0.23	0.6

Notes: This table reports changes 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) one-off proportional income tax on the top 25 percent of the wealth distribution or (iii) one-off proportional wealth tax on the top 25 percent of the wealth distribution.

translate into stronger aggregate consumption responses than fiscal expansions, as for example documented in Barnichon et al. (2022).

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APPENDIX

A Data

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?*

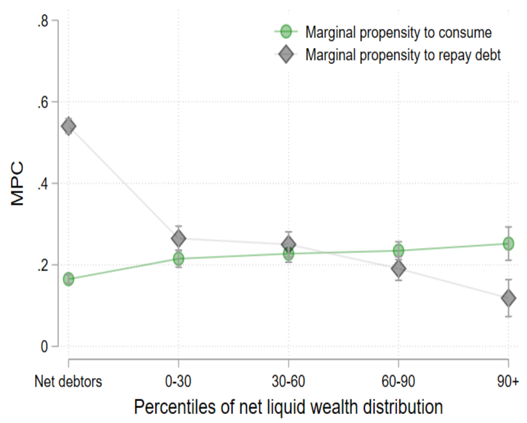
1. Save or invest all of it
2. Spend or donate all of it
3. Use all of it to pay down debts
4. Spend some and save some
5. Spend some and use part of it to pay down debts
6. Save some and use part of it to pay down debts
7. Spend some, save some, and use some to pay down debts

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

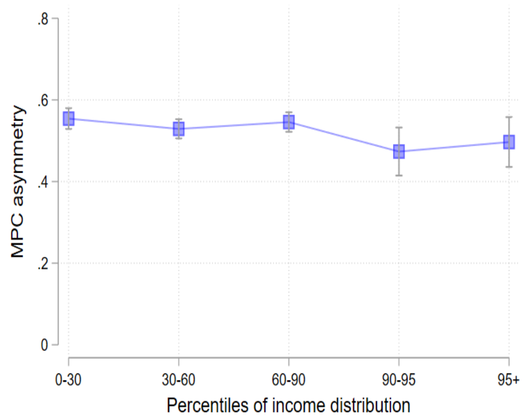
B Additional empirical results

Figure B1: 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 B2: MPC asymmetries across the income distribution



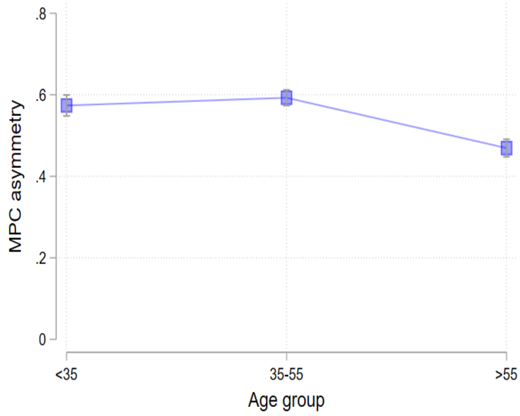
Notes: Grey bars indicate 95% confidence bands.

Table B1: 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	0.30***	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)
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

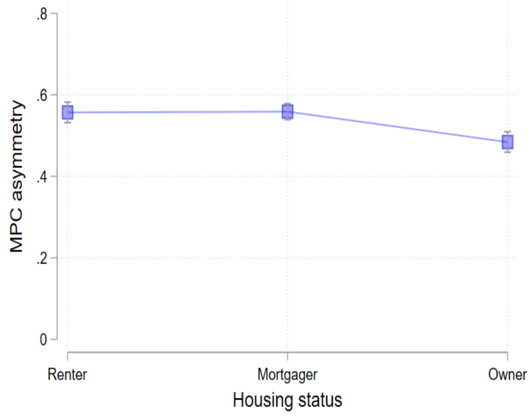
Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure B3: MPC asymmetries across age groups



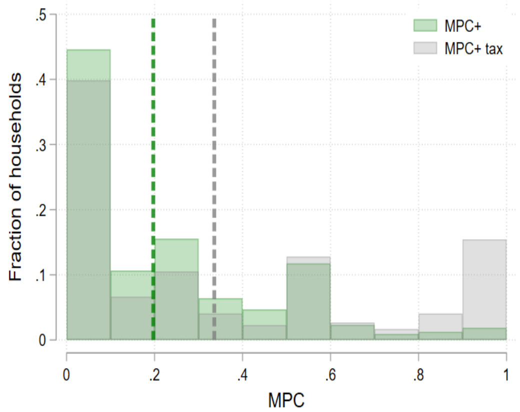
Notes: Grey bars indicate 95% confidence bands.

Figure B4: MPC asymmetries across housing status



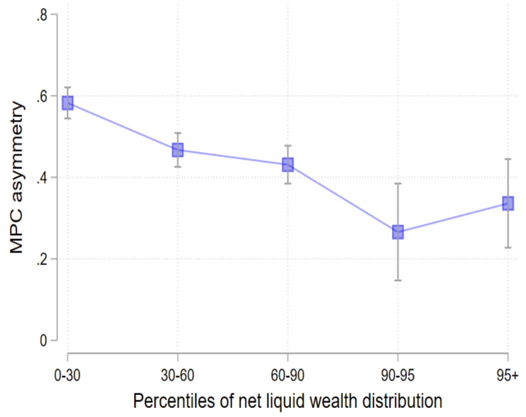
Notes: Grey bars indicate 95% confidence bands.

Figure B5: MPCs out of tax refunds versus hypothetical scenarios



Notes: Dashed lines denote the average MPC out of gains and tax refunds, respectively.

Figure B6: 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)

C Theory

C.1 Proofs

The proofs in this section assume a positive discount factor, i.e. $\beta > 0$.

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:

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

$\tilde{c}(y_0 + \epsilon y_0)$ 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 $a_0^{plan}(y_0 + \epsilon y_0)$. Hence $\tilde{c}(y_0 + \epsilon y_0)$ and $c(y_0 + \epsilon y_0)$ are not necessarily equal.

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:

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

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:

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

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 $\beta > 0$. □

Proposition 2 (Shock size):

Proof. First, we want to show that the derivative of MPC^{-} with respect to ϵ is increasing 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.

□

Proposition 3 (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:

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

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 $\lambda \in (0,1]$. □

Proposition 4 (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} 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 $R \geq 1$. □

C.2 DA model with initial wealth

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

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

Solving this problem yields the following consumption allocation: The consumption allocation is given by:

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

The savings plan is derived as in the benchmark problem and given by $a_0^{plan} = w + y_0 - \frac{w+y_0}{1+\beta}$. 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.

C.3 DA 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:

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

The MPC is given by:

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

C.4 DA model with DA in t=0,1

Introducing DA in $t = 1$ yields the following optimization problem:

$$\max_{c_0, c_1, a_0^{plan}, a_1^{plan}} \quad u(c_0) - \lambda d(a_0, a_0^{plan}) + \beta \left(u(c_1) - \lambda d(a_1, a_1^{plan}) \right)$$

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

The savings plan is formed at the beginning of each period. We already know a_0^{plan} from the problem without DA 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. $a_1^{plan} = 0$. DA 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.

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

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 DA in $t = 1$.

D Additional model results

Table D1: 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
Share of households with savings plan/dissaving-aversion ratio between bottom 30 and top 5 percent of wealth distribution	1.51	1.52