Monetary Policy with Mental Accounting: Reconciling the MPC with the EIS*

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Abstract

This paper studies the monetary transmission to consumption in a heterogeneous-agent new Keynesian (HANK) environment with illiquid assets, enriched with mental accounting of income and wealth. In standard models, a realistic elasticity of intertemporal substitution (EIS) depresses the share of hand-to-mouth households and the marginal propensity to consume (MPC). Mental accounting resolves this tension, with the following implications for monetary policy: a weaker intertemporal substitution channel reduces the total effects by 38%, consistent with aggregate estimates, while the labor income channel carries a 20pp larger weight. Consequently, a given monetary stance becomes less contractionary vis-à-vis government spending, yielding larger multipliers.

Keywords: Monetary policy; mental accounting; EIS; MPC; HANK; fiscal-monetary interactions.
JEL codes: D15, D31, E12, E21, E22, E24, E43, E52, E62, E70.

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1. Introduction

A central question in macroeconomics is concerned with how monetary policy, implemented through changes in the nominal interest rate, shapes business cycles. At the core of these economic fluctuations is aggregate demand and, in particular, consumption – its largest component.

To quantify the power of monetary policy and its transmission channels to consumption, the literature has proposed heterogeneous agent models with idiosyncratic income risk, incomplete markets, liquidity constraints, and illiquid assets (Kaplan, Moll, and Violante, 2018; Kaplan and Violante, 2022). This approach rests on the idea that, by disciplining these models with microeconomic evidence on the marginal propensity to consume (MPC) from transfers, they generate more reliable macroeconomic implications about the monetary transmission channels operating through household income. An additional, indirect implication of these models is the relatively smaller weight of transmission channels operating through interest rates.

In fact, and following the same logic, the intertemporal substitution channel of monetary policy would be more reliably characterized in a model disciplined with empirical estimates of the elasticity of intertemporal substitution (EIS). In fact, a model consistent with estimates of *both* the MPC and the EIS would paint a more complete picture of the relative strength of each transmission channel, of the overall effects of monetary policy, and of its interactions with other shocks. However, the aforementioned theories with liquidity constraints and illiquid assets have a difficulty matching MPC and EIS estimates at the same time.

In light of this tension, this paper asks whether the evidence on the MPC and the EIS can be reconciled in a heterogeneous-agent model with mental accounting of income and wealth (Gimeno-Ribes, 2025b; see also Shefrin and Thaler, 1988; Thaler, 1990) and, if so, what the implications are for monetary transmission. Mental accounting is a natural candidate to consider because previous research has shown that it can rationalize empirical facts on MPCs, both at the microeconomic level across the household distribution as well as in the aggregate (Gimeno-Ribes, 2025b; Graham and McDowall, 2026). Under mental accounting, households treat income and assets as non-fungible resources and have a preference for consuming their income rather than their assets. Models featuring mental accounting are a legitimate way of tackling questions related to household finance (Campbell, 2006) and, moreover, they are empirically justified, as the non-fungibility of money is a well-documented phenomenon in household decisions (Thaler and Imas, 2025).

To address the aforementioned research questions, the paper starts by considering the

quantitative framework with household heterogeneity and mental accounting in Gimeno-Ribes (2025b). This environment is set up in partial equilibrium and it features incomplete markets, idiosyncratic income risk, and asset illiquidity, and nests the workhorse incomplete-markets model. Mental accounting is modelled using the tools of reference-dependence and loss aversion, and incorporates two main features: first, households partition and classify their liquid resources into the 'income' or the 'asset' mental accounts, whose balances are the relevant state variables; second, households experience a psychological cost whenever they consume from their asset account. These features modify intertemporal incentives in a way that generates hand-to-mouth behavior.

In this environment, the first result of the paper is that the standard 2-asset model cannot match at the same time an MPC of 25% and an EIS below 0.5 as estimated empirically, whereas mental accounting can reconcile these two empirical moments.

In particular, the standard the 2-asset model generates a high MPC by virtue of the poor hand-to-mouth (HtM), whose consumption tracks income because of the liquidity constraint, and the wealthy HtM, who choose to consume their income and invest their savings in the higher-return illiquid asset. Crucially, however, the poor and wealthy HtM are willing to let consumption fluctuate with the idiosyncratic income shocks as long as the EIS coefficient in the utility is sufficiently high, i.e. 1. But with a lower EIS coefficient closer to the evidence, households reduce the exposure of their consumption to income fluctuations by accumulating larger liquid buffers, even if doing so means foregoing some returns on the illiquid asset. As a result, the share of poor HtM and the share of households who are optimally wealthy HtM drop substantially, and the aggregate MPC becomes unrealistically small.

In contrast, mental accounting can generate hand-to-mouth households with an MPC of 100%, even when the EIS coefficient is relatively low, which compensates the decrease in the share of poor and wealthy HtM, delivering a realistic MPC. At the same time, the hand-to-mouth households contribute to further reducing the model EIS. These properties are also present in a 1-asset environment.

The second set of results include the mapping from the aforementioned consumption properties of the model, i.e. MPCs and EIS, to the corresponding Jacobians in sequence space (Auclert et al., 2021), which constitute key inputs for the subsequent business cycle analysis.

As for the consumption sensitivity to interest rates, the model EIS (from small shocks) can be expressed as a function of different elements of the Jacobian, independently of the structure of the model. This property allows to empirically discipline the interest-rate Jacobian with evidence on the EIS, in addition to MPCs from capital gains on liquid assets. As for the

consumption sensitivity to earnings, the gap between the MPC and the Jacobian depends on the model MPCs across income levels. While such gap can be relatively large in the standard 2-asset model, it narrows with mental accounting because high MPCs appear across income levels.

This consumption behavior has implications for monetary transmission, which are explored in a "mental accounting HANK" (for heterogeneous-agent New Keynesian) model. Because the model with mental accounting and household heterogeneity is formulated as a PEEM, i.e. a portable extension of an existing model (Rabin, 2013), it can be introduced into a general-equilibrium environment. The resulting framework is otherwise standard for business cycle analysis: building on the workhorse Bewley-Aiyagari-Huggett[1] setup with an illiquid asset, it incorporates a supply side with nominal rigidities in prices and wages as well as capital adjustment costs, a central bank operating a Taylor rule, and a fiscal authority.

In this environment, the third set of results concern the effects of monetary policy, which are substantially smaller and with a different composition than implied by standard models.

In a model with a high MPC and a high EIS, the income and interest-rate channels are approximately of the same magnitude, generating overall effects on consumption that are too large when compared to evidence from vector auto-regressions (VAR). A standard 2-asset model calibrated to a more realistic EIS features a weaker intertemporal substitution and smaller aggregate effects in line with VAR estimates, but at the cost of reducing the income channel by half, owing to the lower MPC. In comparison, in a model with mental accounting that matches both the MPC and the EIS, the intertemporal substitution channel is substantially weaker, while the other channels remain approximately the same. As a result, the smaller overall effects are consistent with a VAR, while the rest of the channels – especially labor income– become relatively more important.

The fourth set of results characterize how the interaction of monetary policy with government spending delivers larger multipliers.

After an increase in government spending, the central bank raises the nominal rate to counteract inflation. With the lower EIS, the monetary reaction has a much smaller effect on consumption, yielding larger responses of consumption and output. At the same time, the associated inflationary effect triggers a stronger monetary tightening, which crowds out investment by more. Yet, overall, the stronger consumption response dominates, resulting in larger output multipliers.

[1] See Bewley (1987), Aiyagari (1994), and Huggett (1993). See also Imrohoroğlu (1989) for a related environment in partial equilibrium.

Literature. – This paper contributes to several strands of the literature. A literature on mental accounting documents instances of the non-fungibility of money. Applications range from financial market behavior (e.g. Barberis and Huang, 2001; Shefrin and Statman, 1985) to retirement savings (Choi, Laibson, and Madrian, 2009). In the realm of consumption, the closest paper is Gimeno-Ribes (2025b), which characterizes the effect of mental accounting of income and wealth (Shefrin and Thaler, 1988; Thaler, 1990) on marginal incentives, optimal behavior, wealth accumulation, and MPCs in environments with 1 and with 2 assets. Building on those results, this paper makes two contributions. First, it obtains new mental accounting predictions for the EIS and evaluates them with the evidence.[2] Second, it integrates the mental accounting model in Gimeno-Ribes (2025b) into a general equilibrium setup with nominal rigidities, and presents the implications for the transmission of monetary policy and other shocks.

Several years after this paper was first circulated, Pieroni and Violante (2025) also study the implications of mental accounting for business cycles, with the following differences. First, they consider a 1-asset model in continuous time, whereas this paper considers both 1- and 2-asset models in discrete time. Second, they build on previously available results on mental accounting in partial equilibrium, and remain silent on the EIS. This paper presents new partial-equilibrium results on the EIS, and how it relates to the MPC and HtM shares, in standard and mental accounting models. Third, they focus on the aggregate implications of MPC heterogeneity, whereas this paper studies the implications of matching the MPC and the EIS for the macroeconomic transmission to consumption. Fourth, both papers rely on the sequence-space method, but this paper also addresses explicitly the mapping between the MPCs and EIS and the corresponding Jacobians.

A second strand of the literature uses facts on consumption and the wealth distribution to discriminate between competing heterogeneous-agent models (Kaplan and Violante, 2014; 2022; Kaplan, Moll, and Violante, 2018; Auclert, Rognlie, and Straub, 2024; Campbell and Hercowitz, 2019; Ilut and Valchev, 2023; Boutros, 2026; Attanasio, Kovacs, and Moran, 2024; Laibson, Maxted, and Moll, 2025; Pfäuti, Seyrich, and Zinman, 2024; Gimeno-Ribes, 2025b). This paper builds on this literature, but differs from it in two ways. First, while previous papers focus on MPCs, this paper also addresses the EIS explicitly. Second, this paper documents the tension between the EIS and the MPC in standard 1- and 2- asset models, and argues that such

[2] Other papers on mental accounting include Graham and McDowall (2026) and Mijakovic (2025). They consider a partial-equilibrium 1-asset environment and they focus only on MPCs while remaining silent on the EIS. For a discussion of their limitations and further differences with the model employed here, see Gimeno-Ribes (2025b).

tension can be resolved by adding mental accounting.[3,4,5]

A literature on business cycles has developed models with nominal rigidities that incorporate departures from consumption-smoothing behavior: these departures take the form of limited household heterogeneity[6], or full heterogeneity with incomplete markets and, in some cases, illiquid assets[7].[8] This paper follows their lead and makes several contributions. First, this paper introduces a departure from consumption smoothing via mental accounting into an otherwise standard HANK model. Second, previous papers focus on MPCs, thereby imposing more empirical discipline on the household-income transmission channels; this paper matches the model with MPC and EIS evidence to impose more discipline on both the income and interest-rate transmission channels, and thus on the overall effects.[9] Third, previous work (Auclert, Rognlie, and Straub, 2025) has acknowledged the difference between MPCs and Jacobians; this paper (i) quantifies that difference, and (ii) proposes that the interest-rate Jacobian be disciplined with evidence on the EIS, in addition to MPCs from liquid capital gains.

A related strand of the literature studies the determinants and effects of monetary and fiscal policy, to which this paper also contributes. First, this paper finds that the intertemporal substitution channel of monetary policy as well as its overall effects on consumption are

[3] Kaplan and Violante (2014) do not report the model EIS, but they justify an EIS coefficient above 1 based mostly on the asset pricing literature, where the EIS is calibrated to avoid counterfactual reactions of asset prices to shocks. In turn, Kaplan, Moll, and Violante (2018) assume log utility and, although they cite evidence suggesting that the EIS is below 0.5, they conjecture that those findings do not necessarily imply a low EIS coefficient, as other forces might reduce the sensitivity of consumption to interest rates, such as: (i) wealth effects of opposing sign among liquid households, (ii) portfolio rebalancing, and (iii) the poor and wealthy HtM. They quantify these forces across the household distribution for a monetary shock (in Figure 6), but they remain silent on how these forces affect the model EIS. This paper finds that these forces, as captured by a 2-asset model, are not enough to bridge the gap between an EIS coefficient of 1 and a model EIS below 0.5. Moreover, this paper shows that a lower EIS coefficient substantially reduces the share and the MPC of the poor and wealthy HtM.

[4] In Huntley and Michelangeli (2014), a 2-asset model with an EIS coefficient of 0.5 generates a realistic MPC from transfers, but their model is calibrated to a measure of wealth that excludes housing. But housing is a large component of aggregate wealth, which is a better target for macro models (Kaplan and Violante, 2014; 2022). This paper shows that, in a 2-asset model matching aggregate wealth and an EIS coefficient of 0.5, the MPC is too low.

[5] Flynn, Schmidt, and Toda (2023) contains a discussion of the EIS. The differences with this paper are as follows. First, their definition of the EIS differs from the conventional one used here. Second, they consider a general setup with uninsurable income risk and multiple financial assets, whereas this paper features illiquid assets explicitly, as well as mental accounting. Third, they conduct a qualitative analysis and suggest strategies for empirical identification; in contrast, this paper is quantitative in nature and compares model predictions with evidence on the EIS and other magnitudes. Fourth, they argue that a change in the opportunities to hedge income shocks impacts the EIS; this paper shows that easing the illiquidity friction has a quantitatively small effect.

[6] See Galí, López-Salido, and Vallés (2007); Bilbiie (2008); Acharya and Dogra (2020).

[7] See Oh and Reis (2012); Werning (2015); McKay, Nakamura, and Steinsson (2016); McKay and Reis (2016); Guerrieri and Lorenzoni (2017); Ravn and Sterk (2017); Den Haan, Rendahl, and Riegler (2018); Kaplan, Moll, and Violante (2018); Bayer et al. (2019); Auclert, Rognlie, and Straub (2024); among many others.

[8] Another departure from consumption smoothing is introduced via an overlapping generations structure with perpetual youth, reinterpreted as occasionally binding constraints (Angeletos, Lian, and Wolf, 2024).

[9] Winberry et al. (2025) calibrate the EIS coefficient in a 1-asset model to match the peak consumption response to a monetary shock with VAR evidence; in turn, this paper disciplines the EIS with evidence, uncovers the associated properties of the 2-asset model, and compares the response to a monetary shock with VAR evidence.

substantially smaller than previously thought, as implied by a standard 2-asset model. Second, previous research (Auclert, Rognlie, and Straub, 2024) shows that, holding the EIS constant, intertemporal MPCs are sufficient statistics for fiscal multipliers; this paper argues that, holding the intertemporal MPC constant, a smaller EIS yields higher multipliers and a weaker monetary policy. Third, prior work (e.g. Woodford, 2011) has highlighted the effects of monetary policy on the size of fiscal multipliers; this paper shows that, for the same responsiveness of monetary policy, the multiplier depends on the consumption sensitivity to interest rates.[10]

Finally, a recent set of papers study business-cycle implications of behavioral biases. The closest to this paper are Farhi and Werning's (2019) HANK model with level-k thinking, and Pfäuti and Seyrich's (2024) HANK model with cognitive discounting.[11] Both of these papers study biases in households' beliefs about aggregate shocks in a 1-asset model calibrated to match MPC estimates. In contrast, this paper focuses on a bias in households' preferences in 1- and 2-asset environments calibrated to both the MPC and the EIS. Also related is Laibson, Maxted, and Moll (2025), who study stabilization policies in a partial-equilibrium 2-asset model with present bias that matches the MPC. The model here is set up in general equilibrium with nominal rigidities, it features mental accounting, and it also matches the EIS.[12]

Outline. – The rest of the paper is organized as follows. Section 2 introduces the household model and discusses the MPC and EIS in light of the empirical evidence. Section 3 presents the general equilibrium environment. Section 4 obtains the implications for monetary transmission. Section 5 reports the monetary interaction with government spending. Section 6 concludes.

2. Consumption with Mental Accounting in Partial Equilibrium

This section presents the partial equilibrium environment with household heterogeneity, illiquid assets, and mental accounting (as in Gimeno-Ribes, 2025b), and discusses the model's ability to match empirical estimates on the MPC, EIS, and related moments.

2.1 Environment

Households make consumption and savings choices to maximize:

[10] Other papers on fiscal policy focus on the role of liquidity premia (Bayer, Born, and Luetticke, 2023), of tax progressivity and labor supply elasticities (Ferriere and Navarro, 2023), and of nominal government bonds (Hagedorn, Manovskii, and Mitman, 2025).
[11] Other papers analyze deviations from the full-information rational-expectations benchmark, but they typically consider representative-agent environments (see Angeletos and Lian, 2023; see also Bianchi, Ilut, and Saijo, 2024).
[12] Also related is Santoro et al. (2014), who propose a representative agent New Keynesian model with loss aversion to explain asymmetric effects of monetary policy.

$$E_0 \sum_{t=0}^{\infty} \beta^t U_t$$

subject to

$$c_{h,t} + b_{h,t+1} = y_{h,t} + Tr_{h,t} + \left(1 + R_t^b\right) b_{h,t} - d_{h,t} \mathbf{1}_{\{adj \quad\}},$$

$$a_{h,t+1} = (1 + R_t^a) a_{h,t} + d_{h,t} \mathbf{1}_{\{adj = A\}},$$

$$a_{h,t+1} \geq 0, \; b_{h,t+1} \geq \underline{b},$$

where $c_{h,t}$ is the consumption of household h at time t. Households receive lump-sum transfers $Tr_{h,t}$ and labor earnings $y_{h,t} = l_{h,t} e_h$, where e_h is the idiosyncratic labor productivity and $l_{h,t} = (1 - \tau_t) w_t n_{h,t}$, the labor earnings per efficiency unit, is the product of the tax rate τ_t, the real wage w_t, and the labor supply $n_{h,t}$. Productivity follows a Markov chain with a transition matrix of conditional probabilities $\Pr(e_{h,t+1} | e_{h,t})$, where the initial distribution is set equal to chain's ergodic distribution. Expectations are taken over all possible productivity realizations.

Households can save either in the liquid asset b, which pays net return R_t^b between periods $t - 1$ and t, and features a borrowing constraint $\underline{b} = 0$; or in illiquid asset a, which pays net return R_t^a between periods $t - 1$ and t, and has a short-sale constraint. Asset illiquidity is modelled similarly to Bayer, Born, and Luetticke (2024) (see also Auclert, Rognlie, and Straub, 2024): opportunities to participate in capital markets are random and i.i.d., creating two types adj of households. Within each period, a fraction υ of 'Adjuster' households ($adj = A$) have access to all their asset holdings and can make deposits $d_{h,t}$ into or out of the illiquid asset; whereas the other fraction $1 - \upsilon$ of 'Non-Adjuster' households ($adj = NA$) only has access to the liquid asset, while the returns on the illiquid asset capitalize.

The incomplete-markets case arises when both assets yield the same return ($R_t^a = R_t^b$) and all households $\upsilon = 1$ can adjust asset a in all periods.

2.1.1 Mental Accounting

Utility in period t is:

$$U(c_t | r_t) = \begin{cases} u(c_t) + \eta [u(r_t) - u(c_t)] & \text{if} \quad c_t \leq r_t \\ u(c_t) + \eta \lambda [u(r_t) - u(c_t)] & \text{if} \quad c_t > r_t \end{cases},$$

where c_t and r_t are the household h's consumption and the reference point in period t, respectively (the sub index h is dropped from here on onwards to ease notation). Utility is the

sum of the "intrinsic" consumption utility $u(c_t)$ and of gain-loss utility $u(r_t) - u(c_t)$, where $u(c)$ is an increasing and concave function with constant elasticity of substitution $\frac{1}{\gamma}$. If consumption is below or at the reference point ($c_t \leq r_t$), the household derives gain utility $u(r_t) - u(c_t) > 0$ with weight η, where $0 \leq \eta < \frac{1}{\lambda}$. If consumption is above the reference point ($c_t > r_t$), the household derives loss utility $u(r_t) - u(c_t) < 0$ with weight $\eta\lambda$, where $\lambda > 1$ is the loss aversion parameter.

The reference point is household-specific and equal to the balance of the mental 'income' account, $r_t = y_{m,t}$. This reference point captures the budget that households have mentally defined for consumption. Intuitively, households experience additional contentment when their consumption is 'within their income'; and they experience a relatively larger guilt when they draw down their savings. The utility function features a non-differentiability point, or kink, at $c = y_m$: the downward jump in marginal utility, $\frac{1-\eta\lambda}{1-\eta}$, determines the strength of the mental accounting friction. The standard model obtains as a special case when $\eta = 0$.

Resources are classified into mental accounts as follows:

$$y_m = y + Tr^y, \qquad y_m > 0,$$

$$b_m = (1 + R^b)b + Tr^b, \qquad b_m \geq 0.$$

The income account (y_m) includes current labor earnings. The asset account (b_m) contains the holdings of (liquid) assets and the returns earned on them. Tr^y and Tr^b, respectively, are placeholders for a transfer classified in either mental account.

2.1.2 Recursive Formulation

Households earn a return on liquid wealth and a face a borrowing constraint when deciding on their liquid savings. Those two pieces of information related to the 'physical' balance b are captured by the mental liquid balance b_m. Because mental accounts are non-fungible, households respond differently to shocks to either mental account. Therefore, it is necessary to take a stand on how resources are mentally classified. Moreover, since the balances of mental accounts (y_m, b_m) pin down household choices, they are the state variables of the individual problem. $\Gamma_t(y_m, b_m, a, adj)$ denotes the distribution at time t.

The timeline within a model period is as follows. First, households receive their idiosyncratic income, transfers, and returns on assets. Then households classify these resources into the mental accounts as above. Finally, households make the decisions to consume and save.

Table 1. Calibration of household model

Model	S2A				MA2A			MA1A		S1A	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(1)	(2)
Preferences											
η (gain-loss utility)	0				0.102	0.254	0.249	0.169	0.265	0	0
λ (loss aversion)	2.5				2.5			2.5		2.5	
β (discount factor)	0.984	0.975	0.974	0.975	0.990	0.984	0.983	0.991	0.985	0.990	0.981
$1/\gamma$ (EIS coeff.)	1	0.5	0.5	0.5	1	0.5	0.5	1	0.5	1	0.5
Financial Markets											
number of assets	2				2			1		1	
υ (probability of adj.)	9%	9%	26%	26%	9%	9%	26%	-		-	
R^b (liquid int. rate)	-3.0%	-3.0%	-3.0%	-1.0%	-1.0%			2.0%		2.0%	
R^a (illiquid int. rate)	5.2%	5.2%	5.2%	2.8%	2.8%			-		-	
Income Process											
ρ (persistence)	0.9656				0.9656			0.9656		0.9656	
σ (std. dev.)	0.92				0.92			0.92		0.92	
τ (income tax rate)	0.33				0.33			0.33		0.33	
Wealth Target											
Assets / ann. income	4.10				4.10			4.10		4.10	

The recursive problems with the optimality conditions is in Online Appendix A. The algorithm used to solve the household problem follows Gimeno-Ribes (2025b).

2.1.3 Calibration

The calibration is summarized in Table 1. The model has quarterly frequency. Each model is denoted with an acronym based on the type of preferences ('S' for standard or 'MA' for mental accounting), and the number of assets ('2A' for 2 assets or '1A' for 1 asset). For instance, MA2A denotes the 2-asset model with mental accounting, whereas S1A denotes the 1-asset incomplete-markets model with standard preferences.

The idiosyncratic process for log productivity has an autoregressive coefficient of 0.9657 and an unconditional cross-sectional standard deviation of 0.92 (Auclert et al., 2024), and it is discretized on a Markov chain with 11 states. The income tax rate is 33% and transfers are zero in steady state. The product of wage and labor supply is normalized to one for all households.

The returns on wealth are calibrated as follows. The S2A model has an 8.2% return spread between liquid and illiquid assets, as proposed in Kaplan and Violante (2022) despite being too high, to match the aggregate MPC. In turn, the MA2A model is calibrated with an 3.8% return spread (estimated in Kaplan and Violante, 2014), which is enough to generate a realistic

aggregate MPC (Gimeno-Ribes, 2025b). In both cases, the probability of portfolio adjustment is 9%, which is a standard value in the literature, and generates a share of poor and wealthy hand-to-mouth within the empirical estimates (Kaplan and Violante, 2014; 2022); alternative calibrations of the adjustment probability are considered in Section 2.2. In the 1-asset environment, the rate of return is 2% (annualized).

The preferences are calibrated as follows. The discount factor is chosen such that the ratio of total assets to annual pre-tax income is 4.1 (Kaplan and Violante, 2022). For the EIS coefficient in the utility function, values of 1 and 0.5 are both considered (see Section 2.2). The mental accounting friction is determined jointly by the loss aversion parameter λ and the weight of the gain-loss utility η, hence the former is set to a standard value of 2.5 whereas the latter is chosen to match an MPC of 25% from an average \$500 labor income gain.

2.2 Disciplining the Model: the MPC and the EIS

This section briefly discusses the evidence on microeconomic consumption moments, including the EIS and different MPCs, as well as related empirical facts, and evaluates the ability of different models to explain such evidence.[13] It also addresses the mapping from the MPCs and EIS to the corresponding sequence-space Jacobians (Auclert et al., 2021) used for the business-cycle analysis. A summary of the findings is provided in Table 2.

2.2.1 Evidence

EIS. – Empirical work using aggregate data has found that consumption reacts very little, if at all, to changes in the real interest rate after controlling for fluctuations in income: Hall (1988) finds values of the EIS below 0.2; Yogo's (2004) preferred estimates are smaller than 0.5; and Campbell and Mankiw (1989) find that 'savers' have an EIS close to zero. In turn, the estimates based on microeconomic data are somewhat larger, e.g. Vissing-Jørgensen (2002) finds an EIS of 0.3-0.4 among stockholders, and a higher yet more imprecise EIS for bondholders.[14]

In turn, Havránek's (2015) meta-study finds that: (i) the most precise estimates of the EIS are clustered around 0-0.5; (ii) after correcting for selective reporting as well as for a variety of econometric biases, a likely EIS estimate from asset-holders is 0.3-0.4.

However, while estimates based on samples of asset-holders may be directly informative for asset-pricing models, asset-holders need not be representative of the entire household

[13] For a more detailed discussion of these MPC facts and associated model predictions, see Gimeno-Ribes (2025b).
[14] Another frequently cited study is Gruber (2006), but the estimates are imprecise especially for larger values of the EIS, and the estimated range of values is rather broad (from 0.3 to 2.6).

population: for instance, in Vissing-Jørgensen's (2002) sample the stockholders represent an approximate share of 20% of the households. Estimates obtained in more representative samples, which may be more directly informative for macroeconomic models, are in the same range: Best et al. (2020) find an EIS of 0.1 for the universe of mortgagors in the United Kingdom; Crump et al. (2023) estimate a very precise EIS of 0.5 using data from the Survey of Consumer Expectations of the New York Fed; and Beck et al. (2026) estimate an EIS below 0.09 from Germany's temporary VAT cut. This paper sets an EIS coefficient of 0.5 such that the effective EIS of the model, taking the different frictions into account, will be below 0.5.[15]

Poor and Wealthy Hand-to-Mouth. – The poor and wealthy HtM are defined as the households whose liquid wealth is equal to or less than half of their pay-period earnings. The sum of poor and wealthy HtM represents 17.5-35% of the total household population; whereas the share of poor HtM measured in terms of net worth is 4-14% (Kaplan and Violante, 2014).

Liquid Wealth. – The ratio of mean liquid wealth over annual earnings is 0.56 as reported in Kaplan and Violante (2022).

MPCs from Transfers and Labor Income. – The point estimate for aggregate MPC from transfers is 25% (Kaplan and Violante, 2014). In addition, the empirical literature has documented that some households display individual MPCs from transfers close to 100% (e.g. Jappelli and Pistaferri, 2020). In turn, estimated MPCs from shocks to labor income include: Bräuer et al. (2022), who report an aggregate MPC of 23% after 5 weeks; Ganong et al. (2025), who estimate an aggregate MPC of 18% after 3 months, yet a distribution of MPCs across liquid asset deciles that sums to 29%.

Liquid Hand-to-Mouth. – The liquid HtM are the households whose liquid wealth is above half their pay-period earnings, and whose MPC has been estimated to be higher than the annuity value of the income windfall (e.g. Ganong et al., 2025). As discussed in Gimeno-Ribes (2025b), they contribute approximately half of the entire aggregate MPC.

Intertemporal MPCs. – Baugh et al. (2021) find that the responses to tax rebates and payments display non-anticipation, are concentrated within the first 5 months after the shock, and afterwards they fade out completely for the rest of their estimation horizon (2.75 years). Braeuer et al. (2022) also find non-anticipation and quick responses within the first 5 weeks of

[15] The values targeted here are consistent with Hall (2016), and more recently with Elias et al. (2026), who choose an even lower EIS coefficient (0.25).

shocks to labor income. Boehm et al. (2025) find that the responses to unanticipated transfers are concentrated in the first 3 weeks and then become not different from zero for the rest of the quarter. Even Fagereng et al.'s (2021) evidence contains frontloaded responses with small lagged effects once the estimation weights are accounted for; however, size and imputation procedure make it less relevant for business cycles, as discussed in Gimeno-Ribes (2026).

2.2.2 Model Predictions

This section considers MPCs and EIS from different shocks. The MPCs are defined as the change in consumption caused by a \$500 change in a household input, which appears as a superscript. The MPCs from transfers, labor income, liquid asset, and illiquid assets, are:

$$MPC_t^T = \int \frac{\Delta C_{h,t}^T}{\Delta T_t} d\Gamma_t, \qquad MPC_t^l = \int \frac{\Delta C_{h,t}^l}{e_h \Delta l_t} d\Gamma_t.$$

where Δ denotes a change in a given variable, the subscript h indicates a household-level variable and its absence indicates an aggregate variable, while the superscripts denote the household input that receives the shock. Note that shocks to transfers are uniformly distributed, whereas the labor income shock is proportional to the idiosyncratic productivity e_h.

In turn, the EIS is (see Online Appendix C) the change in consumption growth between periods *t* and *t+1* caused by a 1 bps change in the (liquid) interest rate between *t* and *t+1*:

$$EIS_{t,t+1}^{R^b} = \frac{\Delta log\left(C_{t+1}^{R^b}/C_t^{R^b}\right)}{\Delta log\left(R_{t+1}^b\right)},$$

which is different from the EIS coefficient in the utility function because of the various frictions.

The MPCs and the EIS in different model environments are discussed next.

Incomplete Markets. – The standard incomplete markets model with 1 asset (S1A) features a share of households with low liquid holdings – the poor HtM–, either at the liquidity constraint or close to it. These households have either zero assets or have a high change of ending up at the constraint in the near future, and therefore do not respond much to interest rates. But the model is calibrated to match aggregate wealth as is standard in general equilibrium applications, hence the share of low-liquidity households is relatively small (6.9%), although within the estimated range. As a result, the EIS of the model is 0.991, which is only slightly lower than its EIS coefficient of 1, and well above the empirical estimates. As is well-known, the model also predicts too low an MPC (4.0%). Reducing the EIS coefficient to 0.5 brings the EIS close to

the empirical evidence, although the model MPC remains very low (2.9%). While the difference in MPCs is small, it reflects that the share of poor HtM has decreased from 6.9% to 1.9%.

Intuitively, the EIS coefficient captures the preference for a smooth consumption profile. In the presence of uninsurable idiosyncratic income risk the EIS coefficient regulates the share of the income risk that households want to transmit to their consumption vs. the share of the income risk that they prefer be absorbed by their liquid wealth instead.

In the 1-asset environment, the idiosyncratic income shocks transmit more directly to consumption for the poor HtM, as they are close to the liquidity constraint. With a lower EIS coefficient, households reduce the exposure of their consumption to income fluctuations by avoiding the liquidity constraint, for which they accumulate larger buffers of liquid assets. A related, more powerful mechanism appears in the presence of illiquid assets.

Illiquid Assets. – Adding a higher-return illiquid asset to the standard incomplete markets environment generates two types of low-liquidity households, poor and wealthy HtM, whose shares are within the estimated ranges (34.0%). As a result, the S2A generates a relatively high MPC from transfers (17.2%) and a reasonable amount of liquid wealth (0.66). Aside from the poor HtM already mentioned, the wealthy HtM hold most of their savings in the illiquid asset and have little liquid wealth, hence they do not respond much to interest rates either. Their presence generates an EIS (0.937) that is further below the EIS coefficient of 1 yet still too high compared to the empirical estimates. Crucially, however, the shares of poor and wealthy HtM and the MPCs depend critically on the assumed EIS coefficient, as discussed next.

In a 2-asset environment, consumption is particularly exposed to income risk among the poor and the wealthy HtM. For the former, reducing the EIS coefficient has a precautionary effect as in the 1-asset model. For the latter, a lower EIS coefficient modifies the tradeoffs governing the portfolio choice. In particular, with an EIS coefficient of 1 it is optimal for some households, i.e. the wealthy HtM, to invest most savings in the illiquid asset to earn the higher returns, as they are willing to let their consumption fluctuate with income. But with a lower EIS coefficient some of these households no longer find it optimal to be a wealthy HtM because their consumption would fluctuate too much, and they are better off keeping more savings liquid. The additional liquid savings are more valuable as consumption insurance than the foregone returns from investing them in the illiquid asset. By the same token, windfalls are smoothed out over time, generating a smaller MPC among the poor and wealthy HtM.

Quantitatively, with an EIS coefficient of 0.5 households accumulate nearly twice as much liquid wealth (1.19) and the share of poor and wealthy HtM drops substantially (by 24pp) to

8.3%, both at odds with the estimates. Moreover, among the poor and wealthy HtM the average MPC from a transfer approximately half as before (21.5%). For these reasons, the aggregate MPC from transfers drops to 6.2% (by 11pp), which is unrealistically low. Accordingly, the presence of poor and wealthy HtM has a smaller impact on the model EIS (0.487).

One way to potentially address this tension between the MPC and the EIS could be to make the illiquid asset relatively more liquid, such that households can use it more to smooth their income shocks and do not need to accumulate as much liquid wealth. To explore this possibility, the adjustment probability is raised to 26% in order to match the mean liquid wealth to income ratio in the data (0.56). The share of poor and wealthy HtM increases to 17.1%, which is near the lower bound of the estimated range, but their average MPC continues to be smaller (15.6%) because of the lower EIS coefficient. As a result, the aggregate MPC increases only marginally and is still too low (7.4%). The model EIS (0.472) is consistent with the estimates, but the poor and wealthy HtM still have a small impact on it. Thus, changes along this dimension only have a moderate impact on the model predictions and ultimately do not resolve the tension.

Note that the results above are obtained with a return spread of 8.2% (see calibration), which is admittedly too high but necessary to generate a sufficiently high MPC for an EIS coefficient of 1. Yet, with a more realistic return spread of 3.8% and an EIS coefficient of 0.5 the model performs worse: even with an adjustment probability of 26%, the share of poor and wealthy HtM is 10.9% and the MPC from transfers is 5.0%.

Finally, several additional remarks are in order. The discussion above is focused on the more transparent case of MPCs from uniform transfers, but the tension with the EIS also applies to the MPC from labor income; only the MPC from labor income can be somewhat larger because the shocks to low-income households are smaller and generate a higher MPC. As for the EIS, a robust finding across models is that the intertemporal substitution component drives the EIS almost entirely, whereas the wealth component is negligible.[16]

Mental Accounting. – Adding mental accounting to the 1-asset and 2-asset environments can achieve a better fit with the evidence on MPCs and EIS.

Consider first the incomplete markets environment with mental accounting (MA1A) and an EIS coefficient of 1. On one hand, mental accounting can match the aggregate MPC from transfers and labor income of 25%. The preference against dissaving embedded in mental accounting modifies the marginal incentives in a way that generates HtM households across the

[16] The model EIS is broken down into an intertemporal substitution and a wealth component by changing, respectively, the interest rate that enters the optimality condition between t and $t+1$ and the interest rate that enters the budget constraint in $t+1$.

distribution of income and liquid wealth. In particular, these HtM households find it optimal to consume their income, do not touch their assets, and have an MPC of 100%. At the same time, the non-fungibility delivers realistic MPCs from wealth. On the other hand, many of these HtM do not change their consumption growth in response to interest rate changes, such that the model EIS (0.814) is substantially below the EIS coefficient. Zero consumption growth obtains with mental accounting as per the following proposition.

PROPOSITION 1: *Mental accounting induces zero consumption growth across two periods if the realized income is the same across periods* ($y_m = y'_m$) *and the following conditions hold:*

$$\lim_{c' \to (y'_m)^-} \frac{\partial U(c'|r')}{\partial c'} > \beta \frac{\partial}{\partial b} E[V(b'', y'')|y'] > \lim_{c' \to (y'_m)^+} \frac{\partial U(c'|r')}{\partial c'},$$

and

$$\lim_{c \to (y_m)^-} \frac{\partial U(c|r)}{\partial c} > \beta \frac{\partial}{\partial b} E[V(b', y')|y] > \lim_{c \to (y_m)^+} \frac{\partial U(c|r)}{\partial c}.$$

Proof. The conditions above ensure that $c' = y'_m$ and $c = y_m$ are optimal choices, as shown in Gimeno-Ribes (2025b). Hence, if the income realizations are such that $y_m = y'_m$, then $c = c'$ and consumption growth is zero. Q.E.D.[17]

The proposition establishes that HtM households induced by mental accounting display zero consumption growth across two periods *t* and *t+1* if they receive the same income realizations in each period. Now consider a small shock to the interest rate R^b_{t+1} between *t* and *t+1*. The wealth increase in *t+1* only affects the asset mental account, but not the income account, and as long as the HtM condition in *t+1* continues to hold after the shock, consumption in *t+1* does not change. In addition, the change in savings and in the interest rate shift the expected marginal value function in *t*, but as long as the HtM condition continues to hold in *t*, consumption in *t* does not change either. The effect of the interest rate shock on *t+1*'s consumption and on *t*'s marginal incentives are displayed in Figure 1 Panels B and A, respectively. Due to the persistence of income, for many HtM consumption does not change in either period and, thus, they do not contribute to the consumption growth after an interest rate shock, pushing the model EIS (0.814) substantially below the EIS coefficient (1). In a nutshell, as long as households remain at the kink across periods, their consumption does not grow with interest rate changes.

For the effects of mental accounting on the EIS in a simpler, 2-period environment, see Online Appendix B.

[17] This proposition obtains in the 2-asset model by simply introducing the two additional state variables.

While mental accounting has a larger impact on the model EIS, to achieve a value in line with the estimates it is necessary to set a lower EIS coefficient, in particular 0.5 to make the exercise comparable with the previous ones. Here the EIS coefficient performs a similar function in regulating how income risk is absorbed by consumption. In particular, the HtM households due to mental accounting are willing to let consumption fluctuate with their income, but that willingness is reduced with a lower EIS coefficient. Hence, households need to experience a larger utility penalty from dissaving to generate an MPC that is on target (25.0%). The resulting EIS is 0.39, where again the effect of mental accounting is more noticeable, working in the same way as exemplified above. Thus, mental accounting provides a way to resolve the aforementioned tension between the MPC and the EIS.

These effects of mental accounting carry over to the 2-asset environment (MA2A). With an EIS coefficient of 1, mental accounting can deliver a high MPC of 25% with a lower return spread of 3.8%, a realistic share of poor and wealthy HtM (22.8%), and an EIS (0.85) that is noticeably below the EIS coefficient, albeit still too high. Lowering the EIS coefficient to 0.5, again, incentivizes households to accumulate more liquid wealth (1.23) for consumption insurance purposes and, concomitantly, the share of poor and wealthy HtM drops to 6.3% (by 16.5pp). Analogously to the standard 2-asset model, increasing the adjustment probability of the illiquid asset to 26% brings the share of poor and wealthy HtM (17.8%) and the liquid wealth (0.53) to more realistic levels. In the two latter cases, the lower EIS coefficient of 0.5 also requires a stronger penalty for dissaving to achieve a realistic MPC of 25%.

Finally, several additional remarks are in order. The discussion above is focused on the more transparent case of MPCs from uniform transfers, but the tension with the MPC from labor income is also resolved with mental accounting. Here again, the intertemporal substitution component drives the EIS.

2.2.3 Mapping MPCs and EIS into Jacobians

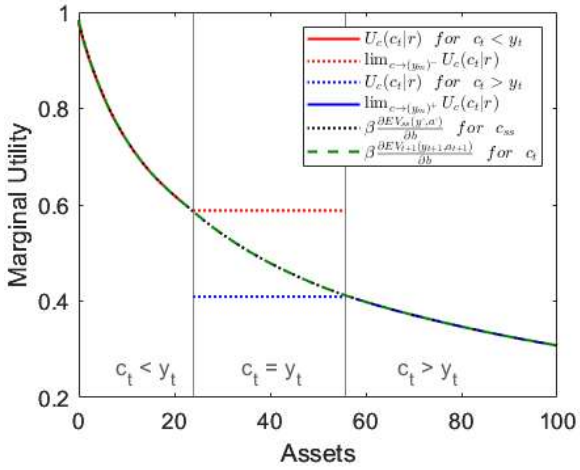
These model properties are captured by the following consumption Jacobians:

$$J_{t,s}^{C,T} = \frac{\int \Delta C_{h,t}^{T} d\Gamma_t}{\Delta T_s}, \qquad J_{t,s}^{C,l} = \frac{\int \Delta C_{h,t}^{l} d\Gamma_t}{\Delta l_s}, \qquad J_{t,s}^{C,R^b} = \frac{\int \Delta C_{h,t}^{R^b} d\Gamma_t}{\Delta R_s^b},$$

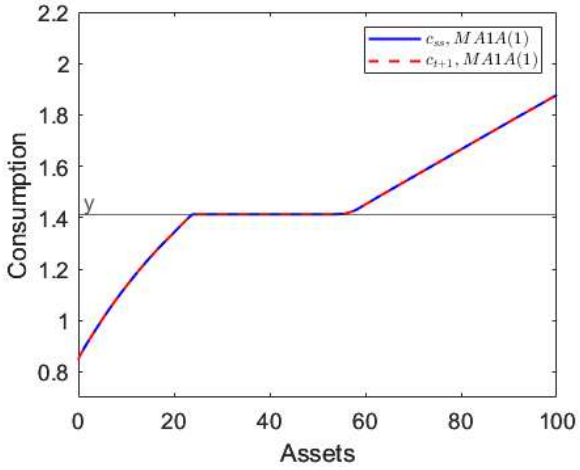
where the subscripts s and t denote, respectively, the period when the shock is received and the period when consumption responds; whereas the superscripts denote the household input experiencing a shock obian, that it measures changes in aggregate consumption. The shocks are of size 10^{-4} (Auclert et al., 2021), which correspond to a \$1.67 income a 1bps interest rates.

Table 2. Household model: empirical facts vs. predictions

Model		S2A				MA2A			MA1A		S1A	
		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(1)	(2)
Parameters												
1 / γ (EIS coeff.)		1	0.5	0.5	0.5	1	0.5	0.5	1	0.5	1	0.5
η (gain-loss utility)		0	0	0	0	0.107	0.254	0.249	0.169	0.265	0	0
return spread		8.2%	8.2%	8.2%	3.8%	3.8%	3.8%	3.8%	-	-	-	-
prob. adj.		9%	9%	26%	26%	9%	9%	26%	-	-	-	-
Predictions	***Evidence***											
share of P&WHtM	17.5-35%	34.0%	8.3%	17.1%	10.9%	22.6%	6.3%	17.8%	7.7%	2.2%	6.8%	1.9%
Liquid wealth / mean ann. earnings	0.56	0.66	1.19	0.56	0.63	0.78	1.23	0.52	-	-	-	-
MPC (Tr = \$500)	25%	17.2%	6.2%	7.4%	5.0%	25.6%	26.3%	26.1%	26.3%	26.4%	4.0%	2.9%
Avg. MPC (Tr) P&WHtM / Liquid		36.6 / 7.2%	21.7 / 4.7%	15.5 / 5.7%	12.1 / 4.1%	60.9 / 15.4%	62.2 / 23.9%	42.3 / 22.7%	74.6 / 22.3%	78.3 / 25.2%	23.8 / 2.6%	17.6 / 2.6%
$J_{1,1}^{C,Tr}$		22.9%	7.4%	8.4%	5.6%	24.3%	24.1%	24.4%	24.4%	24.5%	5.9%	3.3%
MPC (labor income avg. = \$500)	25%	21.1%	7.0%	8.1%	5.4%	25.0%	25.0%	25.0%	25.0%	25.0%	5.3%	3.2%
$J_{1,1}^{C,l}$		11.8%	4.2%	5.2%	3.4%	18.9%	24.6%	25.6%	24.0%	26.8%	2.5%	2.2%
$\sum_{t=1}^{t=4} J_{t,1}^{C,l}$		26.5%	13.2%	16.0%	11.5%	27.3%	29.9%	31.8%	28.4%	31.2%	8.4%	8.3%
$EIS_{1,2}$ (1 bps)	< 0.5	0.937	0.487	0.472	0.478	0.852	0.390	0.381	0.797	0.383	0.991	0.493
$EIS_{1,2}$ - substitution / wealth eff.		0.945 /-0.008	0.495 /-0.008	0.480 /-0.009	0.483 /-0.005	0.857 /-0.005	0.395 /-0.005	0.385 /-0.004	0.800 /-0.003	0.388 /-0.005	0.995 /-0.004	0.5 /-0.007
$\frac{1}{C_{ss}}\left(J_{2,2}^{C,R^b} - J_{1,2}^{C,R^b}\right)$		0.944	0.486	0.475	0.479	0.854	0.387	0.383	0.793	0.381	0.986	0.491
MPC Liq. wealth (ann.)	12.9%	40.6%	20.1%	21.8%	16.2%	24.1%	12.2%	13.3%	10.4%	8.0%	13.7%	11.0%
$\frac{1}{B_{ss}}\sum_{t=1}^{t=4} J_{t,1}^{C,R^b}$		17.5%	11.1%	14.9%	10.9%	11.0%	7.5%	9.7%	5.0%	5.4%	6.2%	7.0%
MPC Illiq. wealth (ann.)	3-7%	7.0%	7.3%	9.8%	9.5%	6.1%	5.8%	7.2%	10.4%	8.0%	13.7%	11.0%
$\frac{1}{A_{ss}}\sum_{t=1}^{t=4} J_{t,1}^{C,R^a}$		3.7%	5.5%	6.9%	6.2%	3.4%	4.2%	5.0%	5.0%	5.4%	6.2%	7.0%

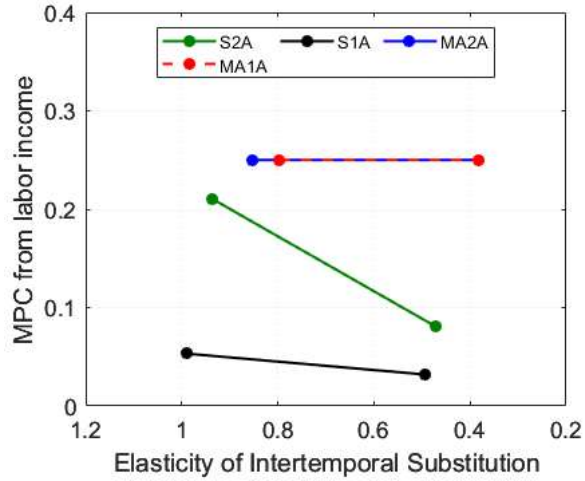


Panel A. Marginal incentives in period *t*.

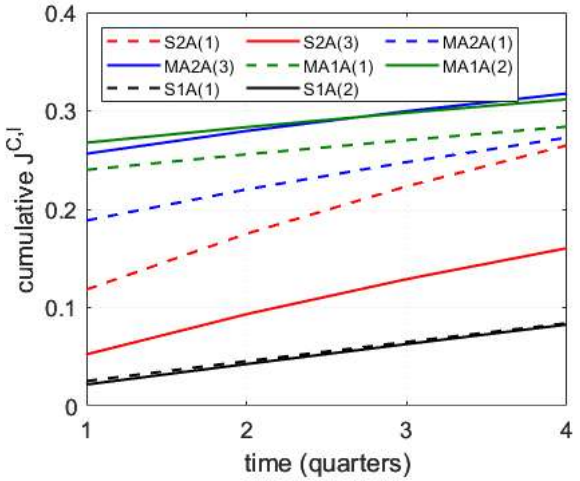


Panel B. Consumption change in period *t+1*.

Figure 1. The EIS with mental accounting: effect in periods *t* and *t+1*, on a given household, in MA1A(1).



Panel A. MPC from labor income vs. EIS.



Panel B. Jacobian cumulated over one year.

Figure 2. EIS, MPC from labor income and consumption Jacobian from labor income across models.

For the liquid interest rate, the Jacobian relates to the model EIS as follows.

LEMMA 1: *The Elasticity of Intertemporal Substitution of the model with respect to a small shock to the (liquid) interest rate between periods t and t+1 can be recovered from the Sequence-Space Jacobian of consumption with respect to the (liquid) interest rate, as follows:*

$$EIS^{R^b}_{t,t+1} \approx \frac{1}{C_{ss}}\left(J^{C,R^b}_{t+1,t+1} - J^{C,R^b}_{t,t+1}\right).$$

Proof. See Online Appendix C.

Intuitively, $J^{C,R^b}_{t,t+1}$ captures the consumption response in *t* in anticipation of the shock in *t+1*, whereas $J^{C,R^b}_{t+1,t+1}$ is the consumption response at impact in *t+1*. The former is dominated by an intertemporal substitution effect with an opposite sign to the interest rate shock, hence it is

preceded by a negative sign. Moreover, this equivalence holds for any model, offering a way to discipline the Jacobian directly with evidence on the EIS.

In turn, for uniform transfers, the aggregate MPC and the Jacobian are the same by definition, although the different sizes are more visible in the S2A models than in in the MA2A models (see also Gimeno-Ribes, 2025b). In turn, for labor income shocks the aggregate MPC and the Jacobian are different magnitudes, yet comparable because the average idiosyncratic productivity is normalized to 1. In the S2A(1) model households in the bottom half of the income distribution contribute substantially to the aggregate MPC, but their individual MPCs get diluted when normalizing by the average shock, thereby generating a gap of 9.3p.p. between the MPC (21.1%) and the Jacobian (11.8%). This gap is compensated over time, due to counterfactually strong lagged effects. However, with an EIS coefficient of 0.5, the gap becomes smaller because the MPCs are too low in the first place (see Figure 2 Panel A). Conversely, mental accounting generates high MPCs among households across income levels (see also Gimeno-Ribes, 2025b), hence the normalization by the average shock is a better approximation: the largest gap is 6.3p.p. between an MPC of 25.0% and a Jacobian of 18.9%, but the gap becomes smaller than 1.8p.p. for all the other models (see Figure 2 Panel B).

2.3 Further MPC Concepts: Liquid and Illiquid Capital Gains

In addition to the MPCs from current income, and to the extent that monetary policy is also transmitted through asset prices, this section discusses MPCs that, while playing a smaller role, still matter for the analysis.

Evidence. – The best available evidence on MPCs from capital gains on liquid assets are probably the estimates from directly held stocks (e.g. DiMaggio et al., 2020). Two comments about the relevance of these estimates for the purposes of this paper are in order. On one hand, these estimates are obtained on a subset of the population, namely direct stockholders, hence they may be of limited use to discipline the behavior of the entire household population in a macroeconomic model. On the other hand, in the sample they find evidence of low-liquidity households with high MPCs, which is why the estimate may be more representative than at first sight. Hence, their annual estimate of a 12.9% MPC is used as indicative evidence.

In turn, evidence on MPCs from capital gains in illiquid assets can be found among the estimates from housing wealth (Mian et al., 2013). These studies find that the yearly MPCs are in the range 3-7%.

Model Predictions. – MPCs from liquid and illiquid transfers are defined as follows:

$$MPC_t^{Tr^b} = \int \frac{\Delta C_{h,t}^{Tr^b}}{\Delta Tr_t^b} d\Gamma_t, \qquad MPC_t^{Tr^a} = \int \frac{\Delta C_{h,t}^{Tr^a}}{\Delta Tr_t^a} d\Gamma_t.$$

In the standard 2-asset model, the MPCs from liquid wealth are not directly comparable with the evidence from a subsample of direct stockholders, the model MPCs are probably too large for an EIS coefficient of 1, and become smaller for an EIS coefficient of 0.5. In turn, the MPCs from illiquid wealth are mostly in line with the evidence, although they become somewhat too large as the illiquid asset becomes more accessible and as it regains its weight in the household portfolio.

In turn, with mental accounting, the MPCs from liquid wealth are substantially smaller because of non-fungibility, a property discussed at length in Gimeno-Ribes (2025b). This property also helps align the MPCs from illiquid wealth with the evidence.

Overall, the Jacobian is scaled with liquid wealth, which varies, making the interpretation less easy.

From MPCs to Jacobians. – At the same time, the interest-rate Jacobian, normalized with a measure of aggregate wealth B_{ss} for comparability, captures an MPC from liquid capital gains. Such a shock is proportional to the liquid asset holdings. Hence, dividing by the average shock amplifies the consumption response of households with asset holdings larger than 1, while diluting the consumption response of the rest, especially of the zero-liquidity households whose resources do not change. Thus, the Jacobians are smaller than the corresponding MPCs across models. In addition, mental accounting dampens the response to wealth shocks because of non-fungibility, a property documented at length in Gimeno-Ribes (2025b).

As for the Jacobian with respect to illiquid interest rates, it is defined as:

$$J_{t,s}^{C,R^a} = \frac{\int \Delta C_{h,t}^{R^a} d\Gamma_t}{\Delta R_s^a}.$$

similar comments apply in terms of comparability with MPCs from illiquid (e.g. housing) capital gains, although they are smaller in absolute value due to the asset illiquidity friction. However, the average holding of illiquid assets is larger than of liquid assets and also larger than the average transfer, hence the effects in the Jacobian are stronger than for the corresponding uniform transfer; otherwise, they change with the degree of asset illiquidity.

3. A Mental Accounting HANK

This section introduces the rest of the model used for the analysis in general equilibrium.

3.1 Environment

Households. – Households face the same environment described in Section 2.1, only that here the wage and labor supply are determined by labor unions as specified below.

Firms. – There is a two-tier production structure, where final-goods producers in perfect competition aggregate the intermediate inputs, which in turn are produced by intermediate-goods producers operating under monopolistic competition (see Online Appendix C for details and derivations). The production function is:

$$Y_t = F_t(K_{t-1}, N_t) = Z_t K_{t-1}^{\alpha} N_t^{1-\alpha} - FC,$$

where K is capital, N is labor, Z is total factor productivity, and FC is a fixed cost used to target a steady state level of firm equity.

Intermediate-goods producers hire labor at wage w_t. Intermediate firms also own the stock of capital, which evolves according to the law of motion:

$$I_t = K_t - K_{t-1}(1 - \delta^K),$$

where I_t denotes investment and any changes to the capital stock are subject to quadratic adjustment costs:

$$\Psi_t(K_t, K_{t-1}) = \frac{\psi}{2} K_{t-1} \left(\frac{K_t}{K_{t-1}} - 1 \right)^2.$$

Finally, intermediate firms face price-adjustment costs Θ_t à la Rotemberg (1982).

Intermediate-goods producers hire labor, set prices, and choose next period's stock of capital in order to maximize their equity value $J_t = \frac{J_{t+1} + X_{t+1}}{1 + R_t^e}$, where R_t^e is the expected interest rate between periods *t* and *t+1* as defined further below and X_t are the per-period profits:

$$X_t = Y_t - w_t N_t - I_t - \Theta_t - \Psi_t.$$

This problem delivers a set of standard q-theory equations:

$$Q_t = 1 + \psi \left(\frac{K_t}{K_{t-1}} - 1 \right),$$

$$Q_t = \frac{1}{1 + R_t^e} \left\{ MP_{t+1}^K - \frac{I_{t+1}}{K_t} - \frac{\psi}{2} \left(\frac{K_{t+1}}{K_t} - 1 \right)^2 + Q_{t+1} \frac{K_{t+1}}{K_t} \right\},$$

where the marginal product of capital is defined as $MP_t^K = MC_t F_{K,t}$, the marginal product of

labor equals the wage $w_t = MC_t F_{N,t}$, and the Phillips Curve for prices is:

$$\pi_t(1+\pi_t) = \kappa_P\left(MC_t - \frac{1}{\mu_P}\right) + \frac{1}{1+R_t^e}E_t\left\{\frac{Y_{t+1}}{Y_t}\pi_{t+1}(1+\pi_{t+1})\right\},$$

where $\pi_t = \frac{P_t}{P_{t-1}} - 1$ denotes inflation, P_t is the price level, and ϵ_t^π is an innovation term that allows for shocks to inflation.

Labor Market. – Labor unions set wages in order to maximize utility of a representative agent (as in Auclert et al., 2025) with standard preferences over aggregate consumption, $u(C)$, and aggregate labor, $v(N) = \xi N^{1+1/\nu}$, and subject to quadratic wage adjustment costs. The union allocates all labor hours uniformly across agents, so that $n_{it} = N_t$. This setup (see Online Appendix C) results in a Phillips curve for wages:

$$\pi_t^w(1+\pi_t^w) = \kappa_w N_t\left(\xi N_t^{1/\nu} - \frac{1}{\mu_w}(1-\tau_t)w_t C_t^{-\gamma}\right) + \beta E_t\{\pi_{t+1}^w(1+\pi_{t+1}^w)\}$$

where wage inflation is defined as $1+\pi_t^w = (1+\pi_t)\frac{w_t}{w_{t-1}}$.

Monetary Authority. – The central bank sets the nominal interest rate and responds to inflation following a Taylor rule:

$$i_t = i_{SS} + \phi\pi_t + \epsilon_t^i.$$

The nominal rate and the expected inflation pin down the expected real interest rate as per the Fisher equation:

$$1 + R_t^e = E_t\left[\frac{1+i_t}{1+\pi_{t+1}}\right].$$

Fiscal Authority. – The government issues long-duration bonds B_t^g at price q_t^B that pay $(1+\delta^B q_{t+1}^B)$ the following period and levies taxes on labor income in order to finance government expenditures G_t, in accordance to the following budget constraint:

$$q_t^B B_t^g + \tau_t w_t N_t = (1+\delta^B q_t^B)B_{t-1}^g + G_t.$$

Whenever government debt deviates from its steady-state value, the government implements changes in taxes according to the following fiscal rule:

$$\tau_t - \tau_{ss} = \varphi q_{ss}^B \frac{B_{t-1}^g - B_{ss}^g}{Y_{ss}}.$$

Long-duration bonds ensure that changes in the interest rate only have a moderate impact on the government budget constraint; whereas with 1-period bonds all government debt is counterfactually refinanced every period, leaving too large a fiscal print when the rate changes.

Financial Intermediary. – The financial intermediary takes deposits from households and invests them in government bonds and firm equity. By non-arbitrage, the expected returns on both securities are equalized:

$$1 + R_t^e = E_t\left[\frac{1 + \delta^B q_{t+1}^B}{q_t^B}\right] = E_t\left[\frac{X_{t+1} + J_{t+1}}{J_t}\right].$$

The ex-post returns R_t earned on the portfolio and provided by the intermediary are:

$$1 + R_t = \frac{q_{t-1}^B B_{t-1}^g}{q_{t-1}^B B_{t-1}^g + J_{t-1}} \frac{1 + \delta^B q_t^B}{q_{t-1}^B} + \frac{J_{t-1}}{q_{t-1}^B B_{t-1}^g + J_{t-1}} \frac{X_t + J_t}{J_{t-1}},$$

which corresponds to the return earned on household wealth in the 1-asset environment. In turn, in the 2-asset case, the liquid and illiquid rates of return are:

$$R_t^b = R_t - \omega^b, \qquad R_t^a = R_t + \omega^a,$$

where ω^b and ω^a are, respectively, the liquidity penalty and illiquidity premium with respect to the interest rate R_t. The return spread between liquid and illiquid assets is constant over time.

3.1.1 Equilibrium

The clearing condition for the asset market is:

$$A_t + B_t = q_t^B B_t^g + J_t,$$

where household asset supply $A_t + B_t$ must equal the asset demand from firms and government. In turn, the goods market clearing condition is:

$$C_t + I_t + G_t + \Theta_t + \Psi_t + \zeta_t = Y_t,$$

where aggregate private and public consumption of goods and services plus price and capital adjustment costs must equal aggregate production by firms. The liquidity transformation services provided by the financial intermediary are worth $\zeta_t = \omega^b b_t - \omega^a a_t$.

An equilibrium of this economy is defined by the policy functions and distributions that result from households, firms and labor unions solving their optimization problems, and a sequence of prices and policies consistent with the Taylor and fiscal rules, such that all markets

clear and the government budget constraint holds.

3.2 Calibration

The calibration of the model is summarized in Table 3 below.

The model frequency is quarterly. The annualized real interest rate is 2%. The household block is calibrated as in Section 2 (see Table 1), with household wealth amounting to 4.1 times the annual household pre-tax income, which in turn is normalized to 1.

In the supply side, productivity is normalized to 1. The price markup is set to 1.10 (McKay and Reis, 2016), and the slope of the Phillips Curve is 0.09 (Bayer et al., 2019). The fixed cost of production is chosen such that the steady-state firm equity clears the asset market. With a capital share of 0.30, capital over annual GDP is 2.27, similarly to Auclert et al. (2024). Capital depreciation is 0.028 to equate the marginal product of capital net of depreciation and the real rate in steady state. The capital adjustment cost parameter is 15 (Ferriere and Navarro, 2025).

In the labor market, the wage Phillips Curve has a slope of 0.03 and a wage markup of 1.10. The Frisch elasticity is 1 and the disutility of labor is calibrated in each case to close the wedge between the marginal utility of income and the marginal disutility of labor in steady state.

The parameters governing the monetary and fiscal policy are as follows. The steady-state ratio of government bonds to annual output is 0.60, and the decay rate is calibrated to match an average government debt maturity of 20 quarters (Auclert et al., 2020). The Taylor rule coefficient on inflation takes a standard value of 1.5. The tax rate is 0.33, steady-state transfers are zero, and government spending is obtained as a residual from the government budget constraint. The fiscal rule parameter is chosen such that the government debt converges to its steady state level over the medium term after a monetary shock.

3.3 Computation

Aggregate responses are solved as perfect-foresight transition paths with respect to MIT shocks (Boppart, Krusell, and Mitman, 2018) using the sequence-space Jacobian method (Auclert et al., 2021).

4. Monetary Policy

This section considers a -0.60p.p. (annualized) shock to the nominal interest rate with a quarterly autocorrelation of 0.61 to match the change in the federal funds rate in Christiano, Eichenbaum, and Evans (2005).

Table 3. Calibration of HANK model

Parameter	Value	Target / Source
Model	*S2A* *MA2A* *MA1A* *S1A*	
Preferences		
$1/\gamma$ (EIS coefficient)	see Table 1	EIS < 0.5
β (discount factor)	see Table 1	Assets / annual pre-tax income = 4.10[a]
η (gain-loss utility)	see Table 1	Aggregate MPC = 25.0%[b]
λ (loss aversion)	see Table 1	Literature[c]
Financial Markets		
R (interest rate, ann.)	2%	Standard value
R^b (liq. int. rate, ann.)	see Table 1	Literature[a,b]
R^a (ill. int. rate, ann.)	see Table 1	Literature[a,b]
prob. adjustment	see Table 1	Literature[a] / internally calibrated
Production		
α (capital share)	0.30	Standard value
K (Capital / annual GDP)	2.27	Asset market clearing
Ψ (capital adj. cost)	15	Standard value
δ^K (capital depreciation)	0.028	internally calibrated
μ_p (price markup)	1.10	Literature[d]
κ_p (slope price Phillips Curve)	0.09	Literature[e]
FC (fixed cost)	0.14	Asset market clearing
Labor Market		
ν (Frisch elasticity)	1	Literature[f]
ξ (disutility of labor)	1.8 - 2.7	internally calibrated
κ_w (slope wage Phillips Curve)	0.03	Literature[g]
μ_w (wage markup)	1.10	Literature[g]
Policy		
ϕ (Taylor rule coeff.)	1.5	Standard value
qB^g (Bonds / annual GDP)	0.60	Standard value
δ^B (bond decay rate)	0.9548	Maturity = 20 quarters[h]
τ (tax rate)	0.33	Standard value
φ (fiscal rule)	0.10	B_{ss} at medium term

[a]Kaplan and Violante (2022).

[b]Kaplan and Violante (2014) and references therein.

[c]Gimeno-Ribes (2025b).

[d]McKay and Reis (2016).

[e]Bayer et al. (2019).

[f]Chetty (2012).

[g]Auclert et al. (2024).

[h]Auclert et al. (2020).

The interest rate cut stimulates both consumption, via intertemporal substitution, and investment. To meet the increase in aggregate demand, production increases, which raises the demand for labor. At the same time, the lower interest rates raise the price of government bonds and open up additional fiscal space, to which the fiscal authority responds by lowering taxes in a smooth manner over time. The increase in after-tax labor income stimulates consumption further, generating general-equilibrium multiplier effects on consumption.

The strength of the initial intertemporal substitution effects and of the labor income effects on consumption are mediated, respectively, by the EIS and by the MPC from labor income. To understand these better, the consumption responses are decomposed, following the literature, with respect to changes in the liquid interest rate, in pre-tax labor income, in the tax rate, and in the illiquid interest rate, one at a time. Such decomposition is shown in Figure 3 for selected calibrations of the 2-asset model, whereas the corresponding Figures for the 1-asset models are in Online Appendix D. In turn, Table 4 displays the responses and their decomposition cumulated over the first year for all models considered. Table 4 also shows the cumulated responses of investment and output.

Consider first the S2A(1) model, which generates a high MPC, and compare it with the S1A(1), with a low MPC. As is already known, the high MPC reduces the weight of the liquid interest-rate channel, in particular the intertemporal substitution, and increases the weight of the income channels, especially through the labor market, whereas the fiscal adjustment is relatively small owing to the long-duration bonds and it is deferred in time. Another prediction is that the interest-rate channel is the most important one: the effect is clearest in Figure 3, and becomes more muted when cumulated over time in Table 4. But more importantly, these interest-rate effects are too large because the underlying EIS coefficient is 1 and, as a result, the overall effects of monetary policy are also too large: the peak consumption response, which in these models occurs at impact, is 0.34% of steady state consumption, as opposed to 0.2% estimated in Christiano et al. (2005).[18]

Similar predictions obtain in models with mental accounting with a high MPC and an EIS coefficient of 1, i.e. MA2A(1) and MA1A(1). In these models, the aggregate response and the decomposition are similar to the S2A(1), as becomes visible in Figure 3 and, especially, when cumulated over the first year (Table 4). This is because the consumption Jacobians, while somewhat different at impact, become more similar over time due to stronger lagged effects in

[18] Christiano, Trabandt, and Walentin (2016) document a similar pattern: the peak consumption response is estimated to be approximately between 0.17 and 0.28, but for a slightly larger shock to the nominal interest rate, which suggests that for a shock considered here the estimated peak response would be smaller.

S2A(1). In the particular case of MA1A(1) there is only one interest rate, but owing to the non-fungibility of mental accounting, the associated channel is approximately the same as the sum of the liquid and illiquid interest rates in S2A(1) and in MA2A(1).

Thus, the mental accounting can be thought of as a mechanism that generates similar predictions than the standard illiquid-asset model for the monetary shocks considered here, without the need to assume an overly large return spread. The similarity in predictions implies that MA2A(1) and MA1A(1) face the same shortcomings as S2A(1) with respect to the EIS coefficient and the VAR evidence. Yet, the advantage is that all three models provide a more unified benchmark when comparing with alternative calibrations of the EIS coefficient.

Reducing the EIS coefficient to 0.5 in S2A(2) reduces the overall effects of monetary policy on consumption from 0.80pp to 0.43pp over the first year (see Table 4). This effect is primarily due to two forces: the liquid and illiquid interest-rate channels are a bit more than half, whereas the labor income channel has decreased to less than half. However, because this model's MPC is too small, the implied labor income channel is likely too small, as a result.

Making the illiquid asset more available in S2A(3) generates a similar aggregate consumption response, which is in line with empirical estimates, and a similar labor income channel (see Table 4 and Figure 3 Panel B). However, in this case the MPC is still too low and, thus, the labor income channel is likely too weak. In turn, some weight shifts from the liquid rate to the illiquid rate, because in S2A(2) too much wealth was held in the liquid asset, and in S2A(3) a larger share of household wealth is held in the illiquid asset.

In addition, the S2A(4) calibration is also included, where the return spread between liquid and illiquid assets is more realistic. In this case, because of an even lower MPC, the channels through labor income and fiscal adjustments are smaller, yielding smaller overall effects.

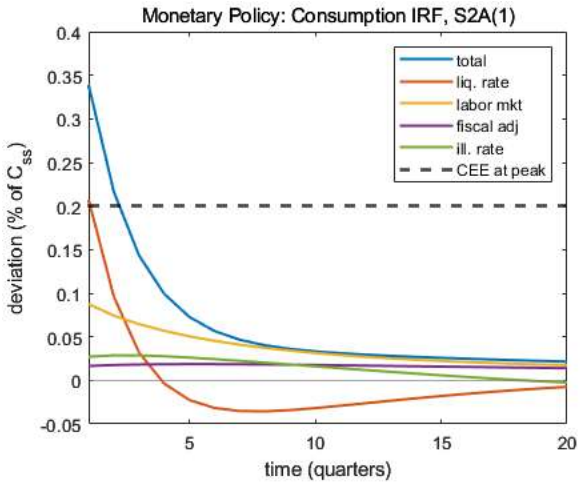
Note how the S2A(2)-(4) model predictions are not that different from the S1A(2) model. In the latter, the overall effects are only slightly smaller, the interest-rate channel is equivalent to the sum of liquid and illiquid rates in the former, and the labor income channel is somewhat smaller.

These results contrast with the mental accounting specifications matching the MPC and the EIS, in particular MA2A(2)-(3) and MA1A(2). In MA2A(3), which is the preferred calibration, the overall effects on consumption are 38% and 39% smaller than in S2A(1) at impact and cumulated over the first year, respectively; in the other two models, the overall effects are 39% smaller over the first year. These peak responses at impact are around 0.20-0.21%, i.e. much closer to the estimates reported in Christiano et al. (2005).

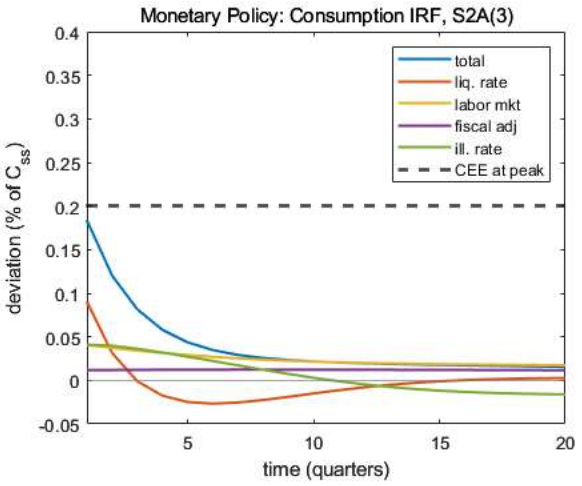
Table 4. Monetary Policy: IRFs (cum. over 1 year), and Decomposition

Model	S2A				MA2A			MA1A		S1A	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(1)	(2)
Parameters											
$1/\gamma$ (EIS coeff.)	1	0.5	0.5	0.5	1	0.5	0.5	1	0.5	1	0.5
return spread	8.2%	8.2%	8.2%	3.8%	3.8%	3.8%	3.8%	-	-	-	-
p. adj. (ill. asset)	9%	9%	26%	26%	9%	9%	26%	-	-	-	-
Cons. IRF	0.80 (100%)	0.43 (100%)	0.44 (100%)	0.41 (100%)	0.80 (100%)	0.49 (100%)	0.50 (100%)	0.79 (100%)	0.49 (100%)	0.74 (100%)	0.39 (100%)
R^b (liquid rate)	0.33 (42%)	0.19 (44%)	0.10 (23%)	0.10 (25%)	0.33 (41%)	0.14 (29%)	0.07 (15%)	0.44 (55%)	0.17 (35%)	0.58 (78%)	0.26 (67%)
R^b -- int. subs.	0.33 (41%)	0.22 (50%)	0.10 (23%)	0.11 (26%)	0.33 (42%)	0.16 (33%)	0.08 (15%)	0.47 (59%)	0.22 (44%)	0.61 (83%)	0.32 (82%)
R^b -- wealth eff.	0.01 (1%)	-0.03 (-6%)	0.00 (1%)	-0.00 (-1.0%)	-0.00 (-0%)	-0.02 (-5%)	-0.00 (-1%)	-0.03 (-4%)	-0.04 (-9%)	-0.04 (-5%)	-0.06 (-15%)
Labor inc.	0.28 (35%)	0.13 (31%)	0.14 (32%)	0.12 (28%)	0.30 (38%)	0.27 (55%)	0.28 (56%)	0.31 (38%)	0.27 (56%)	0.11 (15%)	0.09 (23%)
Fiscal adj.	0.07 (9%)	0.05 (12%)	0.05 (11%)	0.04 (11%)	0.06 (8%)	0.05 (10%)	0.05 (9%)	0.05 (6%)	0.04 (9%)	0.05 (6%)	0.04 (10%)
R^a (illiquid rate)	0.11 (14%)	0.06 (13%)	0.15 (34%)	0.15 (36%)	0.10 (13%)	0.03 (6%)	0.10 (20%)	-	-	-	-
Invmt. IRF	1.44	1.43	1.53	1.50	1.44	1.33	1.37	1.47	1.38	1.53	1.53
Output IRF	0.81	0.59	0.62	0.60	0.79	0.60	0.62	0.79	0.61	0.78	0.60

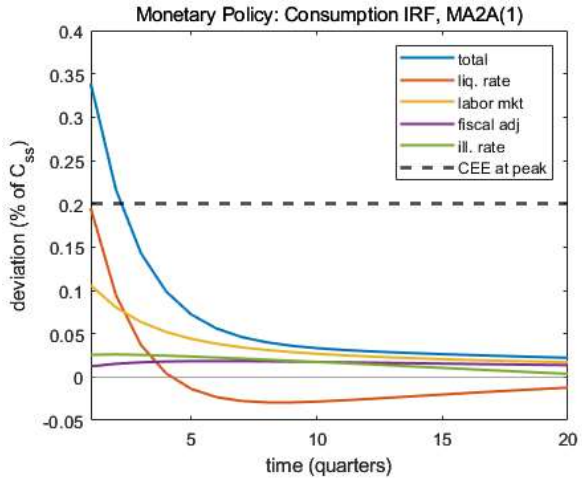
Note. The IRFs are expressed in percentage point deviations from steady state consumption, investment, and output, respectively, cumulated over the first year. Numbers inside brackets are the share of the total response.



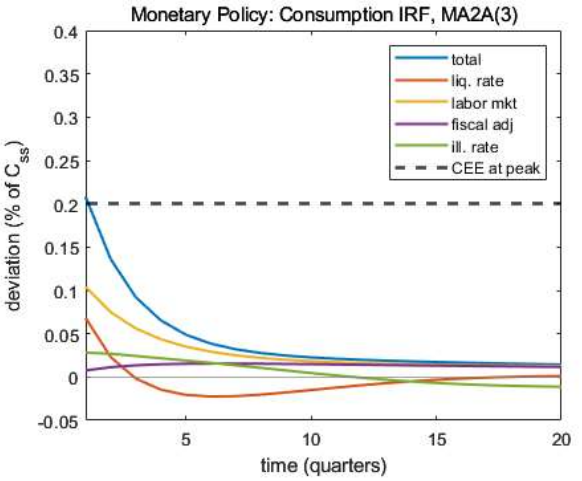
Panel A.



Panel B.



Panel C.



Panel D.

Figure 3. Monetary policy shock to consumption: total effects and decomposition over five years.

Note. 'CEE at peak' stands for the peak response estimated in Christiano, Eichenbaum, and Evans (2005).

In terms of the decomposition, these models still feature a high MPC, hence the size of the labor income channel is essentially the same as in S2A(1) or MA2A(1); but because the overall effects are now smaller, the labor channel carries a 20pp larger weight: from 35% to 55-56%. Therefore, the difference in overall effects is driven almost entirely by an intertemporal substitution response to liquid interest rates that has decreased by up to a factor of 4, and thereby carries a relatively smaller weight: from around 40% to 15% in the 2-asset cases. Here again, there is a shift between liquid and illiquid rate effects when moving from MA2A(2) to MA2A(3) because of the difference in the liquid vs. illiquid wealth holdings; yet the sum remains constant and is approximately equal to the interest rate channel in MA1A(2).

5. Government Spending

Building on the previous section documenting the power and transmission channels of monetary policy, this section addresses how government spending stimulates the economy in the presence of a monetary authority that responds to inflation. In particular, government spending is increased by 1% of GDP with a quarterly autocorrelation of 0.8 as in Debortoli and Galí (2025).

The increase in government spending is met by an increase in production, which in turn raises the demand for labor and, to a lesser extent, the wage. The increase in pre-tax labor income stimulates consumption, which increases aggregate demand further. At the same time, the increase in output puts upward pressure on prices, to which the central bank responds by raising the nominal interest rate more than 1-to-1 with inflation. Yet, the increase in the real rate has a negative impact on consumption via intertemporal substitution and, similarly, it crowds out investment. The tax hikes required to pay back the increase in government debt, which takes place over time, also have a negative effect on consumption.

For this exercise the consumption responses are decomposed with respect to changes in the liquid interest rate, the pre-tax labor income, the tax rate, and the illiquid interest rate, one at a time. Such decomposition is shown in Figure 4 over the first five years, whereas Table 5 displays the responses and their decomposition cumulated over one year for consumption, as well as for investment and output. In Table 5, the channels that generate a negative response are assigned a negative sign also as percentages to make the interpretation more intuitive. In addition, Table 5 shows the output multipliers at different horizons *H*, which are defined as:

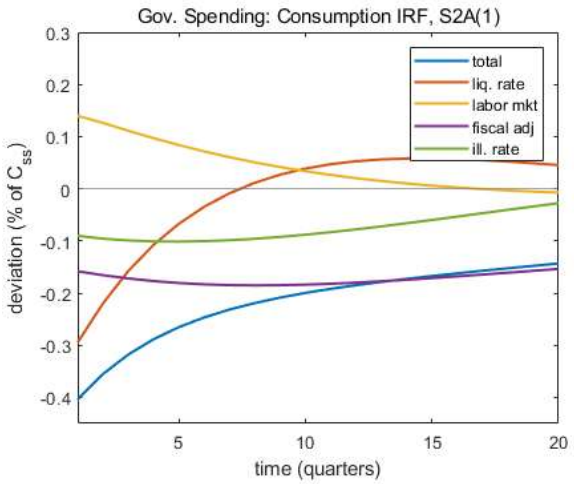
$$m_H = \frac{\sum_{t=0}^{H} \frac{\Delta Y_t}{(1+R_t)^t}}{\sum_{t=0}^{H} \frac{\Delta G_t}{(1+R_t)^t}}.$$

The natural starting point here again is the S2A(1) model. Again, introducing illiquid assets increases the MPC and reduces the EIS, such that, compared to S1A(1), monetary policy has a smaller dampening effect on consumption, while the rise in labor demand stimulates consumption more. However, at the same time, the counteracting effects are also stronger: the greater increase in output elicits a tighter monetary policy, which requires a larger fiscal adjustment and crowds out investment more.

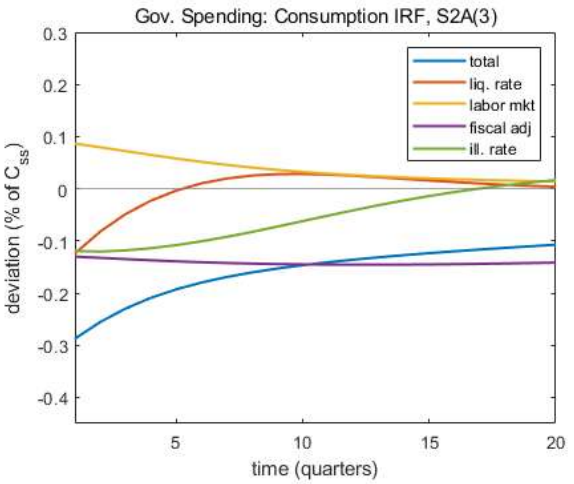
Table 5. Government Spending: IRFs (cum. over 1 year), Decomposition, and Multipliers

Model	S2A				MA2A			MA1A		S1A	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(1)	(2)
Parameters											
$1/\gamma$ (EIS coeff.)	1	0.5	0.5	0.5	1	0.5	0.5	1	0.5	1	0.5
return spread	8.2%	8.2%	8.2%	3.8%	3.8%	3.8%	3.8%	-	-	-	-
p. adj. (ill. asset)	9%	9%	26%	26%	9%	9%	26%	-	-	-	-
Cons. IRF	-1.37 (-100%)	-1.04 (-100%)	-0.98 (-100%)	-1.10 (-100%)	-1.23 (-100%)	-0.47 (-100%)	-0.43 (-100%)	-1.06 (-100%)	-0.40 (-100%)	-1.74 (-100%)	-1.14 (-100%)
R^b (liquid rate)	-0.78 (-57%)	-0.51 (-48%)	-0.28 (-28%)	-0.27 (-25%)	-0.79 (-64%)	-0.51 (-110%)	-0.27 (-62%)	-1.18 (-112%)	-0.72 (-181%)	-1.32 (-76%)	-0.78 (-68%)
R^b -- int. subs.	-0.71 (-52%)	-0.52 (-50%)	-0.24 (-24%)	-0.26 (-24%)	-0.75 (-61%)	-0.54 (-115%)	-0.25 (-58%)	-1.24 (-117%)	-0.80 (-203%)	-1.38 (-80%)	-0.91 (-80%)
R^b -- wealth eff.	-0.07 (-5%)	0.01 (1%)	-0.04 (-4%)	-0.01 (-1%)	-0.04 (-3%)	0.03 (6%)	-0.02 (-4%)	0.05 (5%)	0.08 (21%)	0.06 (4%)	0.13 (11%)
Labor inc.	0.47 (35%)	0.29 (28%)	0.30 (31%)	0.20 (18%)	0.53 (43%)	0.76 (162%)	0.77 (179%)	0.58 (54%)	0.76 (191%)	0.07 (4%)	0.11 (10%)
Fiscal adj.	-0.67 (-49%)	-0.59 (-56%)	-0.53 (-54%)	-0.51 (-47%)	-0.58 (-47%)	-0.50 (-106%)	-0.47 (-110%)	-0.45 (-42%)	-0.43 (-109%)	-0.49 (-28%)	-0.47 (-42%)
R^a (illiquid rate)	-0.39 (-28%)	-0.24 (-23%)	-0.47 (-48%)	-0.51 (-47%)	-0.39 (-32%)	-0.22 (-46%)	-0.46 (-107%)	-	-	-	-
Invmt. IRF	-2.90	-3.01	-3.23	-3.30	-2.89	-3.56	-3.65	-2.78	-3.66	-2.57	-3.66
Output IRF	1.51	1.66	1.65	1.55	1.58	1.80	1.81	1.69	1.81	1.38	1.53
Gov. Multipliers											
Impact	0.54	0.60	0.59	0.58	0.60	0.67	0.67	0.64	0.68	0.53	0.58
2-year horizon	0.44	0.49	0.49	0.44	0.45	0.54	0.54	0.48	0.54	0.38	0.43
4-year horizon	0.28	0.35	0.33	0.28	0.28	0.41	0.41	0.31	0.40	0.20	0.26

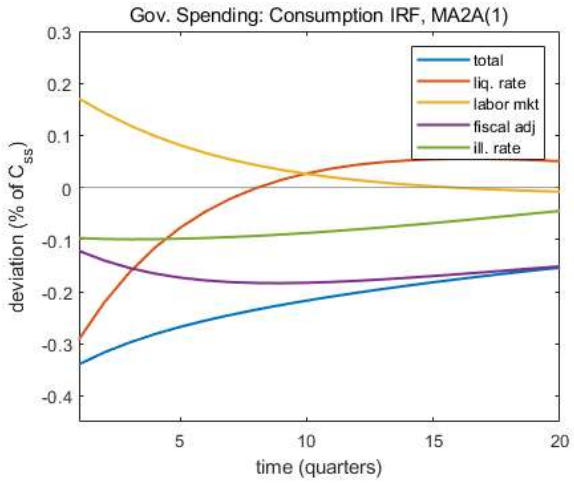
Note. The IRFs are expressed in percentage point deviations from steady state consumption, investment, and output, respectively. Numbers inside brackets are the share of the total response, where the negative signs correspond to negative responses.



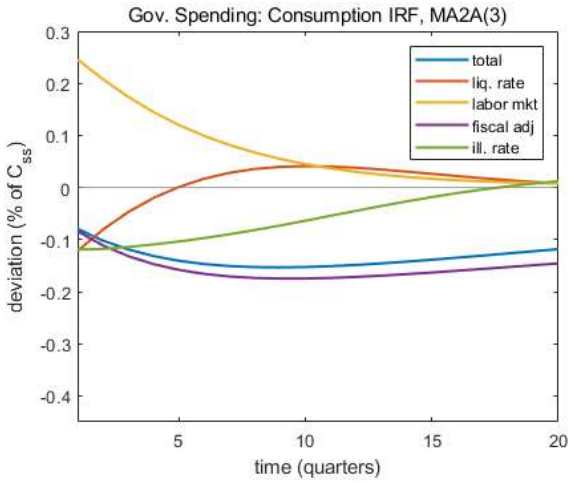
Panel A.



Panel B.



Panel C.



Panel D.

Figure 4. Government Spending shock to consumption: total effects and decomposition, cumulated over the first year.

In any case, in the S2A(1) model the EIS is still to high. Lowering the EIS coefficient reduces the strength of the interest-rate channel – operating mostly through intertemporal substitution– by 35% in S2A(2) and by 64% in S2A(3). As a result, the overall effects on consumption become stronger. However, because the MPC has decreased, the labor demand channel is, respectively, 39% and 36% weaker. For the same reason, the fiscal adjustment also has a smaller effect on consumption, even though the central bank raises interest rates more to counteract the higher output, which increases the need for adjustment.

Relatedly, and compared to S2A(3), the model S2A(4) displays an even weaker labor demand channel due to the lower MPC, which translates into a smaller output response.

Turning to models with mental accounting, MA2A(1) generates a response that is qualitatively similar to the S2A(1). However, the quantitatively more salient differences appear

in the models with a lower EIS coefficient, MA2A(2) and MA2A(3). In the latter, which is the preferred calibration, the intertemporal substitution response is about one third compared to S2A(1). In addition, the labor demand channel is 64% larger than in S2A(1). For these reasons, the consumption response is substantially less negative and output grows more, although the larger crowding out of investment counteracts this effect. Even after accounting for that, the output multiplier is 13pp larger across the horizons considered.

The main result of this section is that monetary policy, having a weaker effect on consumption than previously thought, counteracts less a government expansion, which leads to larger multipliers. The prediction that monetary policy matters for government multipliers is in line with recent empirical evidence (Donaldson, 2026).

6. Conclusion

Models that aspire to characterize the transmission of monetary policy to consumption, in particular the channels operating through labor income and interest rates, ought to match the empirical estimates of the corresponding MPC and of the EIS. This evidence, however, is at odds with a standard heterogeneous-agent model with illiquid assets. In particular, in this environment a realistic EIS reduces the amount of income risk that households are willing to transmit to their consumption, hence a smaller share of households finds it optimal to be a wealthy HtM, thereby generating an unrealistically small MPC. To resolve this tension, the framework is enriched with mental accounting of income and wealth, a psychological incentive that induces HtM households who consume their income and do not change their consumption growth in response to interest rate changes.

The implications of this finding are explored in a general-equilibrium environment with nominal rigidities. Compared to previous calibrations of the standard 2-asset model, monetary policy has 38% smaller effects on aggregate consumption, which is closer to aggregate estimates from VARs. The main source of this difference is the weaker intertemporal substitution channel, while the labor income channel has similar effects as before, only that now they represent a larger share of the total.

These differences manifest themselves also when monetary policy interacts with a government expansion. In particular, and for a given responsiveness to inflation, the central bank's rise in interest rates has a smaller contractionary effect on consumption, allowing a larger response of aggregate demand that operates through a stronger labor income channel. As a result, the fiscal stimulus generates larger output multipliers.

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Monetary Policy with Mental Accounting: Reconciling the MPC with the EIS

Online Appendix

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Contents

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A Recursive Problem: Household Model

This section presents the recursive formulation of the household problem, as in Gimeno-Ribes (2025).

The opportunities of portfolio adjustment are i.i.d., producing two types of households: Adjusters and Non-Adjusters. Each solves a different problem, as below.

The problem of the Non-Adjusters:

$$V(y_m, b_m, a, NA) = \max_{c,b'} U(c|r) + \beta E[V(y'_m, b'_m, a', adj')],$$

subject to

$$c + b' = (1 + R^b)b + y$$

and

$$a' = (1 + R^a)a,$$
$$b' \geq \underline{b}.$$

In turn, the problem of the Adjusters:

$$V(y_m, b_m, a, A) = \max_{c,b',a'} U(c|r) + \beta E[V(y'_m, b'_m, a', adj')],$$

subject to

$$c + b' + a' = (1 + R^b)b + (1 + R^a)a + y$$

and

$$a' \geq 0\ ,$$
$$b' \geq \underline{b}.$$

For both problems above, after-tax income and mental account balances are defined as in section 2.

The saving decisions are liquid savings for Non-Adjusters, and liquid and illiquid savings for Adjusters. Variables with a prime denote next-period variables. The expectations operator E is taken over the different adjustment types using their respective weights and over all the possible realizations of the stochastic income process using the conditional probabilities $\Pr(e'|e)$.

The First-Order Conditions (FOC) of the household problem are:

$$\frac{\partial}{\partial c} U(c|r) = \mu + \beta E\left[\frac{\partial}{\partial b} V(y'_m, b'_m, a', adj')\right], \text{ for } adj = NA, A$$

$$\frac{\partial}{\partial c}U(c|r) = \theta + \beta E\left[\frac{\partial}{\partial a}V(y'_m, b'_m, a', adj')\right], \text{ for } adj = A,$$

and the Envelope Conditions (EC) are given by:

$$\frac{\partial}{\partial b}V(y_m, b_m, a, adj) = (1 + R^b)\frac{\partial}{\partial c}U(c|r)\,, \text{ for } adj = NA, A$$

$$\frac{\partial}{\partial a}V(y_m, b_m, a, A) = (1 + R^a)\,\frac{\partial}{\partial c}U(c|r)$$

$$\frac{\partial}{\partial a}V(y_m, b_m, a, NA) = \beta(1 + R^a)E\left[\frac{\partial}{\partial a}V(y'_m, b'_m, a', adj')\right],$$

where $\forall\, c \neq y_m,\ \nexists \frac{\partial}{\partial c}U(y_m|r)$ applies to all the FOCs and ECs above. In addition, in the first two equations the multipliers are zero except for when $b = 0$ and $a = 0$, respectively. And the interior solutions of the Adjuster portfolio problem can be characterized by the following indifference condition:

$$E\left[\frac{\partial}{\partial b}V(y'_m, b'_m, a', adj')\right] = E\left[\frac{\partial}{\partial a}V(y'_m, b'_m, a', adj')\right]. \text{ for } adj' = A$$

The law of motion for the distribution is:

$$\Gamma_{t+1}(y'_m, b'_m, a', adj') = \int_{\{(y_m, b_m, a, adj):\, a', b' \in A\}} \Pr(e'|e)\, d\Gamma_t(y_m, b_m, a, adj), \text{ for all } A \subset \mathbb{R}.$$

In turn, aggregate consumption, liquid and illiquid wealth are, respectively:

$$C_t \equiv \int c_t(y_m, b_m, a, adj)\, d\Gamma_t(y_m, b_m, a, adj),$$

$$B_t \equiv \int b'_t(y_m, b_m, a, adj)\, d\Gamma_t(y_m, b_m, a, adj),$$

$$A_t \equiv \int a'_t(y_m, b_m, a, adj)\, d\Gamma_t(y_m, b_m, a, adj).$$

B Elasticity of Intertemporal Substitution with Mental Accounting in 2-period Model

Consider a simple environment where the consumer solves the following problem:

$$\max_{c_1,c_2} \quad U(c_1|r_1) + \beta U(c_2|r_2)$$

subject to

$$c_1 + \frac{c_2}{1+R} = e_1 + \frac{e_2}{1+R} = W_{LC}$$

where c_i and e_i denote i-period consumption and income, R is the net real interest rate, the utility function is of the form defined in the main text with r being the reference point, and W_{LC} is 'life-cycle' wealth.

Assume that R = 0%, $\beta = 1$, the income is the same in both periods $e_1 = e_2$, and the reference point in each period equals the corresponding income. In this case, because of symmetry, the household optimally sets consumption equal to income in each period. Such optimal choice of a hand-to-mouth consumer is schematically represented in Figure B.1. Point E on the budget constraint (blue line) represents both the endowment point and the optimal choice ($c_1^* = e_1$, $c_2^* = e_2$) which is marked with a circle. Typically, point E would be denoted as the "tangency point" between the budget constraint and the indifference curve, where the marginal rate of substitution (MRS) is equal to the marginal rate of transformation (MRT). However, the marginal utility of consumption, $U_c(e|r)$, is not defined at the kink where consumption is equal to income; instead, only the generalized derivative exists, which includes a right-hand and a left-hand derivative. Hence, at point E there are two marginal rates of substitution, one for each side of the derivative of utility. Instead of the tangency condition, the optimal choice at the kink is better characterized by the following inequality:

$$MRS_{LH} < -(1+R) < MRS_{RH}$$

where

$$MRS_{LH} = -\frac{U_c(e_1 - \varepsilon|r_1)}{U_c(e_2 + \varepsilon|r_2)} = -\frac{(1-\eta)}{(1-\eta\lambda)}\frac{u_c(e_1 - \varepsilon)}{u_c(e_2 + \varepsilon)}$$

and

$$MRS_{RH} = -\frac{U_c(e_1 + \varepsilon|r_1)}{U_c(e_2 - \varepsilon|r_2)} = -\frac{(1-\eta\lambda)}{(1-\eta)}\frac{u_c(e_1 + \varepsilon)}{u_c(e_2 - \varepsilon)}$$

for ε arbitrarily small. To verify the inequality, it suffices to consider the limit where ε goes to zero and realize that $\frac{(1-\eta\lambda)}{(1-\eta)} < 1$.

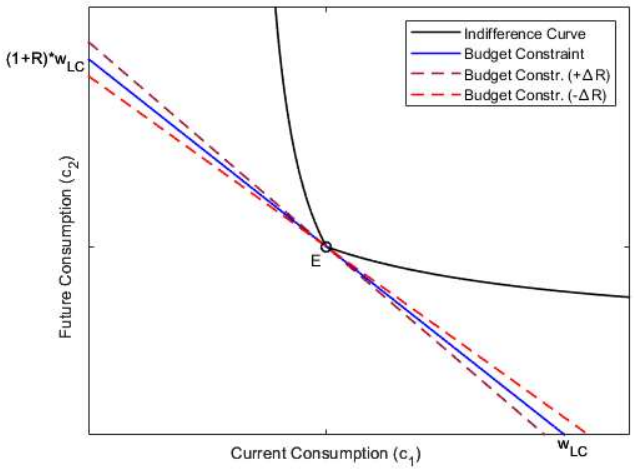


Figure B.1. Two-period model: optimal choice and sensitivity to the real interest rate of a hand-to-mouth consumer.

Intuitively, point E is the optimal choice when the slope of the budget constraint is between the two marginal rates of substitution. On one hand, the marginal utility of increasing c_1 above e_1 at the cost of reducing c_2 below e_2 is lower than the cost of the extra borrowing (1+R). On the other hand, the marginal disutility of decreasing c_1 below e_1 at the benefit of raising c_2 above e_2 is higher than the return on the extra saving (1+R). Graphically, the above inequality implies that point E is a kink in the indifference curve. This jump in the MRS manifests the wedge in the marginal utility introduced by the mental accounting friction.

For small changes in the real interest rate, the budget constraint rotates around the endowment point (Figure B.1). However, as long as the MRT is between the two MRS, point E is still the optimal choice, hence the Elasticity of Intertemporal Substitution is zero. Importantly, this lack of responsiveness to the real interest rate shocks is independent from liquidity constraints – or kinks in the budget set, more generally – and hence has the ability to affect household behavior regardless of their access to liquid wealth.

Finally, note that when the mental accounting friction vanishes ($\eta = 0$), the two MRSs collapse into one and the household faces the same trade-offs as in the standard model.

C Proofs and Model Derivations

C.1 Definitions of the EIS

$$EIS_{t,t+1}^{R^b} = \frac{\frac{d\left(C_{t+1}^{R^b}/C_t^{R^b}\right)}{C_{t+1}^{R^b}/C_t^{R^b}}}{\frac{d\left(R_{t,t+1}^b\right)}{R_{t,t+1}^b}} = \frac{d\left(log\left\{C_{t+1}^{R^b}/C_t^{R^b}\right\}\right)}{d\left(log\{R_{t,t+1}^b\}\right)} \approx \frac{\Delta\left(log\left\{C_{t+1}^{R^b}/C_t^{R^b}\right\}\right)}{\Delta\left(log\{R_{t,t+1}^b\}\right)}$$

$$= \frac{log\left\{C_{t+1}^{R^b}/C_t^{R^b}\right\} - log\{C_{ss}/C_{ss}\}}{\Delta log\left(R_{t+1}^b\right)} = \frac{log\left\{\int C_{h,t+1}^{R^b} d\Gamma_{t+1} / \int C_{h,t}^{R^b} d\Gamma_t\right\}}{\Delta log\left(R_{t+1}^b\right)},$$

where the approximation in the first line, obtained with the 1st-order Taylor series expansion of the $log(x)$, is valid when the shocks to the interest rate is small enough, like the 1bps shock considered in the paper.

C.2 Proof of Lemma 1

$$EIS_{t,t+1}^{R^b} = \frac{\Delta log\left(C_{t+1}^{R^b}/C_t^{R^b}\right)}{\Delta log\left(R_{t+1}^b\right)} = \frac{log\left\{C_{t+1}^{R^b}/C_t^{R^b}\right\} - log\{C_{ss}/C_{ss}\}}{\Delta log\left(R_{t+1}^b\right)}$$

$$\approx \frac{1}{\Delta\left(R_{t+1}^b - 1\right)} log\left(\frac{C_{t+1}^{R^b}}{C_{ss}} \Big/ \frac{C_t^{R^b}}{C_{ss}}\right) = \frac{1}{\Delta R_{t+1}^b}\left\{log\left(\frac{C_{t+1}^{R^b}}{C_{ss}}\right) - log\left(\frac{C_t^{R^b}}{C_{ss}}\right)\right\}$$

$$\approx \frac{1}{\Delta R_{t+1}^b}\left\{\frac{C_{t+1}^{R^b} - C_{ss}}{C_{ss}} - \frac{C_t^{R^b} - C_{ss}}{C_{ss}}\right\} = \frac{1}{C_{ss}}\left\{\frac{C_{t+1}^{R^b} - C_{ss}}{\Delta R_{t+1}^b} - \frac{C_t^{R^b} - C_{ss}}{\Delta R_{t+1}^b}\right\}$$

$$= \frac{1}{C_{ss}}\left(J_{t+1,t+1}^{C,R^b} - J_{t,t+1}^{C,R^b}\right),$$

where the approximations in the second and third lines, again obtained with a 1st-order Taylor series expansion of $log(x)$, are valid when, respectively, the shocks to the interest rate and the departures of aggregate consumption from its steady-state value are small enough. Strictly speaking, the last equality is also an approximation whenever the Jacobians are obtained using a 1st-order approximation to the change in aggregate consumption (as in Auclert et al., 2021), which is the case here. Q.E.D.

C.3 Firms

Final Goods Producers. – The final good is produced by a representative firm that aggregates intermediate inputs following:

$$Y_t = \left(\int_0^1 y_{j,t}^{1/\mu_P} \right)^{\mu_P}$$

where Y_t is the final good produced at time *t*, $y_{j,t}$ represents the intermediate good produced by firm *j* in period *t*, and μ_P is the price markup. Final goods producers solve a cost minimization problem, and the demand for intermediate good *j* is given by:

$$y_{j,t} = \left(\frac{p_{j,t}}{P_t} \right)^{\mu_P/(1-\mu_P)} Y_t \,,$$

where $p_{j,t}$ is the price charged by intermediate-good firm *j* in period *t*, and the aggregate price index is equal to:

$$P_t = \left(\int_0^1 p_{j,t}^{1/(1-\mu_P)} \right)^{1-\mu_P}.$$

Intermediate Goods Producers. – This setup is similar to Auclert et al. (2024). The producers of intermediate goods are monopolistically competitive firms. These firms hire labor in order to produce the intermediate good:

$$y_{j,t} = F\left(k_{j,t-1}, n_{j,t}\right) = z_{j,t} k_{j,t-1}^{\alpha} n_{j,t}^{1-\alpha} - fc,$$

where $k_{j,t-1}$ and $n_{j,t}$ denote the capital and labor used for production by firm *j* in period *t*, and *fc* is a fixed cost of production. For simplicity, F_t is used to denote $F\left(k_{j,t-1}, n_{j,t}\right)$.
Intermediate firms hire labor from a labor packer at wage w_t and own the stock of capital, which evolves according to the law of motion:

$$\iota_{j,t} = k_{j,t} - k_{j,t-1}(1 - \delta^K),$$

where investment $\iota_{j,t}$ is subject to quadratic adjustment costs:

$$\Psi_t(k_t, k_{t-1}) = \frac{\psi}{2}\, k_{t-1} \left(\frac{k_t}{k_{t-1}} - 1 \right)^2.$$

The intermediate goods firms are operated by a risk-neutral manager who discounts the future profits at rate R_t^e and each producer sets its price subject to price-adjustment costs (Rotemberg, 1982):

$$\Theta_{j,t}\left(p_{j,t}, p_{j,t-1}\right) = \frac{\theta_P}{2} \left(\frac{p_{j,t}}{p_{j,t-1}} - 1 \right)^2 Y_t.$$

Intermediate-goods producers choose the optimal price, the quantity of intermediate good produced, the demand for labor, and the capital for next period in order to maximize the sum of profits and its end-of-period (or ex-profit) value J_t:

$$J_{t-1}(p_{j,t-1}, k_{j,t-1}) = \max_{p_{j,t}, n_{j,t}, k_{j,t}} \frac{1}{1+R^e_{t-1}} E_{t-1}\left\{\frac{p_{j,t}}{P_t} y_{j,t} - w_t n_{j,t} - \iota_{j,t} - \Psi_{j,t} - \Theta_{j,t} + J_t(p_{j,t}, k_{j,t})\right\}$$

subject to the final good producers' demand for intermediate goods

$$y_{j,t} = F(k_{j,t-1}, n_{j,t}) = \left(\frac{p_{j,t}}{P_t}\right)^{\mu_P/(1-\mu_P)} Y_t.$$

The FOC with respect to labor ($n_{j,t}$) is:

$$0 = \frac{1}{1+R^e_{t-1}}\left[\frac{p_{j,t}}{P_t}\frac{\partial F_t}{\partial n_{j,t}} - w_t\right] - \chi_t \frac{\partial F_t}{\partial n_{j,t}},$$

where χ_t denotes the Lagrange multiplier on the production constraint. After imposing symmetry among all firms ($p_{j,t} = P_t$, $n_{j,t} = N_t$, $k_{j,t} = K_t$) and rearranging terms yields:

$$w_t = \frac{\partial F_t}{\partial n_t}(1 - \chi_t(1+R^e_{t-1})) = \frac{\partial F_t}{\partial n_t} MC_t,$$

where the marginal cost is implied to be $MC_t = 1 - \chi_t(1+R^e_{t-1})$.

In turn, the FOC with respect to prices ($p_{j,t}$) is:

$$0 = \frac{1}{1+R^e_{t-1}}\left[\frac{1}{P_t} y_{j,t} - \theta_P\left(\frac{p_{j,t}}{p_{j,t-1}} - 1\right)\frac{1}{p_{j,t-1}} Y_t + \frac{\partial J_t}{\partial p_{j,t}}\right] - \chi_t \frac{\mu_P}{1-\mu_P}\left(\frac{p_{j,t}}{P_t}\right)^{\frac{2\mu_P - 1}{1-\mu_P}} \frac{1}{P_t} Y_t,$$

and the Envelope condition (EC) with respect to $p_{j,t}$ is:

$$\frac{\partial J_t}{\partial p_{j,t}} = \frac{1}{1+R^e_t}\left[-\theta_P\left(\frac{p_{j,t+1}}{p_{j,t}} - 1\right)\frac{-p_{j,t-1}}{(p_{j,t})^2} Y_{t+1}\right].$$

Substituting into the FOC the EC and the marginal cost, imposing symmetry among all firms ($p_{j,t} = P_t$, $y_{j,t} = Y_t$), defining inflation as $\pi_t = \frac{P_t}{P_{t-1}} - 1$, and renaming parameters as $\kappa_P = \frac{\mu_P}{\theta_P(\mu_P - 1)}$ gives the Phillips curve for prices as in the main text:

$$\pi_t(1+\pi_t) = \kappa_P\left(MC_t - \frac{1}{\mu_P}\right) + \frac{1}{1+R^e_t} E_t\left\{\frac{Y_{t+1}}{Y_t}\pi_{t+1}(1+\pi_{t+1})\right\}.$$

Finally, the FOC with respect to capital ($k_{j,t}$) is:

$$0 = \frac{1}{1+R^e_{t-1}}\left[-1-\psi k_{j,t-1}\left(\frac{k_{j,t}}{k_{j,t-1}}-1\right)\frac{1}{k_{j,t-1}}+\frac{\partial J_t}{\partial k_{j,t}}\right],$$

and the Envelope condition (EC) with respect to $k_{j,t}$ is:

$$\frac{\partial J_t}{\partial k_{j,t}} = \frac{1}{1+R^e_t}\left[\frac{p_{j,t+1}}{P_{t+1}}\frac{\partial F_{t+1}}{\partial k_{j,t}}+(1-\delta^K)-\frac{\psi}{2}\left(\frac{k_{j,t+1}}{k_{j,t}}-1\right)^2-\psi k_{j,t}\left(\frac{k_{j,t+1}}{k_{j,t}}-1\right)\frac{-k_{j,t+1}}{(k_{j,t})^2}\right] - \chi_t\frac{\partial F_{t+1}}{\partial k_{j,t}}.$$

Defining the marginal value of capital as $Q_{j,t} = \frac{\partial J_t}{\partial k_{j,t}}$, imposing symmetry among all firms ($p_{j,t} = P_t,\ k_{j,t} = K_t,\ n_{j,t} = N_t,\ Q_{j,t} = Q_t,\ \iota_{j,t} = I_t$), and substituting the expression for marginal cost, gives the two q-theory equations in the main text:

$$Q_t = 1+\psi\left(\frac{K_t}{K_{t-1}}-1\right),$$

and

$$Q_t = \frac{1}{1+R^e_t}\left\{MP^K_{t+1}-\frac{I_{t+1}}{K_t}-\frac{\psi}{2}\left(\frac{K_{t+1}}{K_t}-1\right)^2+Q_{t+1}\frac{K_{t+1}}{K_t}\right\},$$

where $MP^K_t = MC_t\frac{\partial F_t}{\partial K_t}$ denotes the marginal product of capital.

C.4 Wage Phillips Curve

This section derives the wage Phillips curve based on Erceg et al. (2000). Labor comes in k varieties, which are imperfect substitutes with elasticity ε_w, and each of which is represented by a union. Each union sets a wage $W_{k,t}$ in order to maximize utility of an agent over aggregate consumption and aggregate labor, discounted with β, and subject to quadratic wage adjustment costs à la Rotemberg. A competitive labor packer then bundles these varieties of labor together into employment services and sells these to intermediate-goods firms at the wage rate W_t.

Union sets the nominal wage W_{kt} to maximize:

$$\sum_{\tau\geq 0}^{\infty}\beta^{t+\tau}\left(u(C_{t+\tau})-v(N_{t+\tau})-\frac{\theta_w}{2}\left(\frac{W_{k,t+\tau}}{W_{k,t+\tau-1}}-1\right)^2\right)$$

subject to the demand curve from the labor packer

$$N_{k,t} = \left(\frac{W_{k,t}}{W_t}\right)^{-\varepsilon_w} N_t,$$

where wage index is given by

$$W_t = \left(\int {W_{k,t}}^{1-\varepsilon_w}\, dk\right)^{\frac{1}{1-\varepsilon_w}}.$$

The FOC:

$$0 = \frac{\partial u_t}{\partial C_t}\frac{\partial C_t}{\partial W_{k,t}} - \frac{\partial v_t}{\partial N_t}\frac{\partial N_t}{\partial W_{k,t}} + \theta_w\left(\frac{W_{k,t}}{W_{k,t-1}} - 1\right)\frac{1}{W_{k,t-1}} - \beta\theta_w\left(\frac{W_{k,t+1}}{W_{k,t}} - 1\right)\frac{-W_{k,t+1}}{{W_{k,t}}^2}.$$

From the demand curve obtain the partial derivative of labor with respect to the wage:

$$\frac{\partial N_{k,t}}{\partial W_{k,t}} = -\varepsilon_w\left(\frac{W_{k,t}}{W_t}\right)^{-\varepsilon_w-1}\frac{N_t}{W_t}.$$

At the same time, as per the Envelope Theorem $\frac{\partial C_t}{\partial W_{k,t}} = \frac{\partial Y_{k,t}}{\partial W_{k,t}}$, which in turn is given by:

$$\frac{\partial Y_{k,t}}{\partial W_{k,t}} = (1-\tau_t)\left(\frac{N_{k,t}}{P_t} - \frac{W_{k,t}}{P_t}\frac{\partial N_t}{\partial W_{k,t}}\right).$$

Imposing a symmetric equilibrium, the two derivatives above simplify to:

$$\frac{\partial N_t}{\partial W_t} = -\varepsilon_w\frac{N_t}{W_t}$$

and

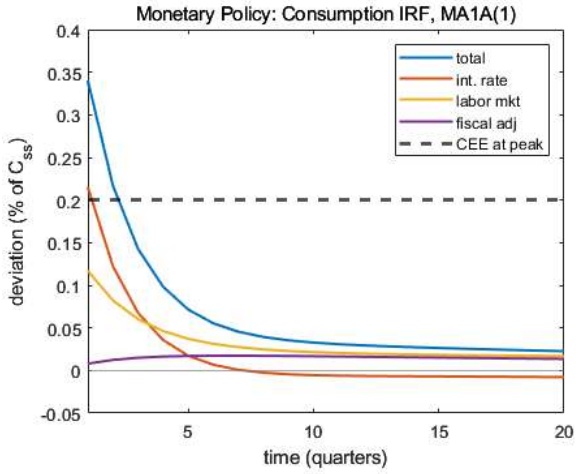
$$\frac{\partial Y_t}{\partial W_t} = (1-\tau_t)\frac{N_t}{P_t}(1-\varepsilon_w).$$

Substituting these into the FOC, rearranging terms, and renaming the parameters $\kappa_w = \frac{\varepsilon_w}{\theta_w}$ and $\mu_w = \frac{\varepsilon_w}{\varepsilon_w - 1}$ gives the wage Phillips curve in terms of the real wage w_t as in the main text:

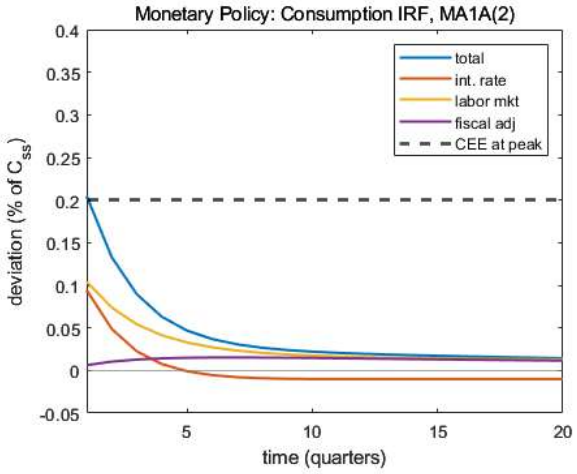
$$\pi_t^w(1+\pi_t^w) = \kappa_w N_t\left(\xi N_t^{1/\nu} - \frac{1}{\mu_w}(1-\tau_t)w_t C_t^{-\gamma}\right) + \beta E_t\{\pi_{t+1}^w(1+\pi_{t+1}^w)\}.$$

D Additional Figures

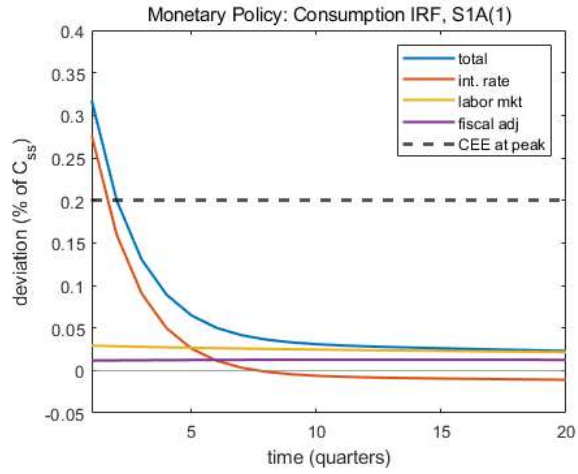
D.1 Monetary Policy in 1-Asset Environments



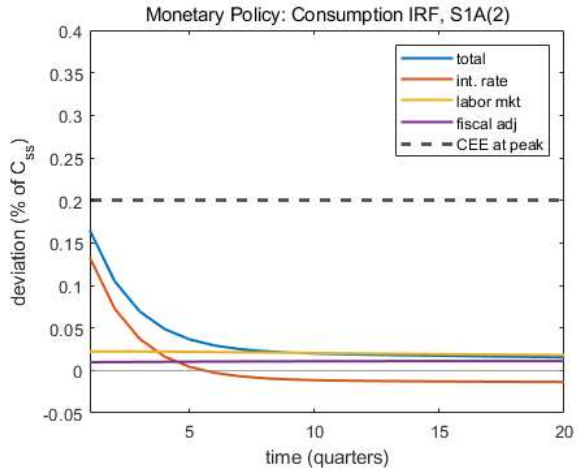
Panel A.



Panel B.



Panel C.

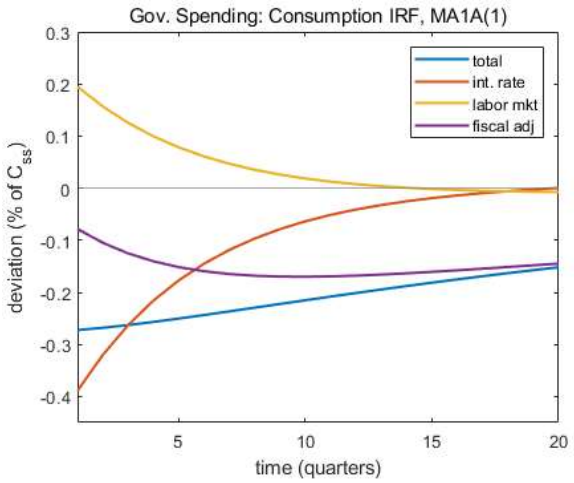


Panel D.

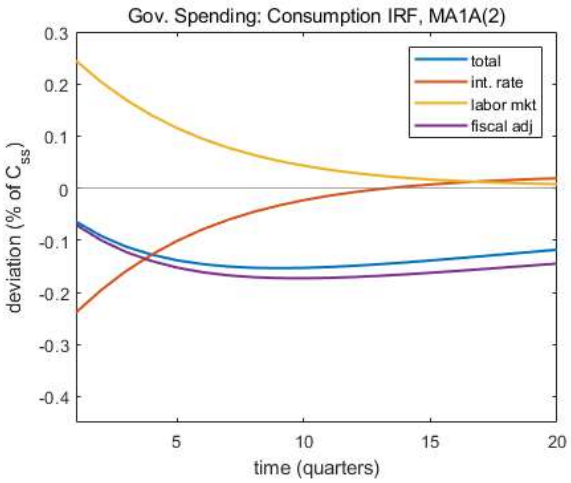
Figure D.1. Monetary policy shock to consumption: total effects and decomposition over five years.

Note. 'CEE at peak' stands for the peak response estimated in Christiano, Eichenbaum, and Evans (2005).

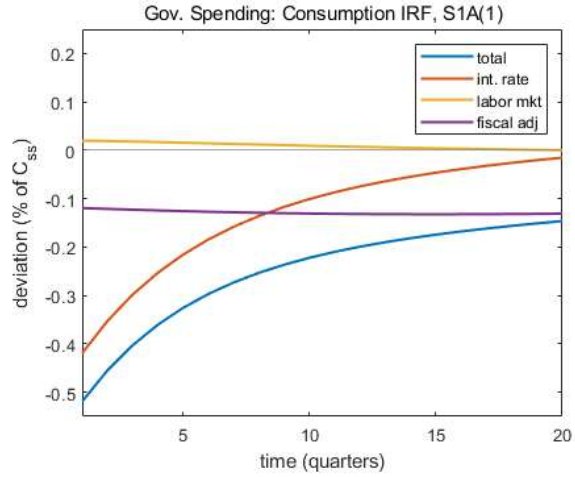
D.2 Government Spending in 1-Asset Environments



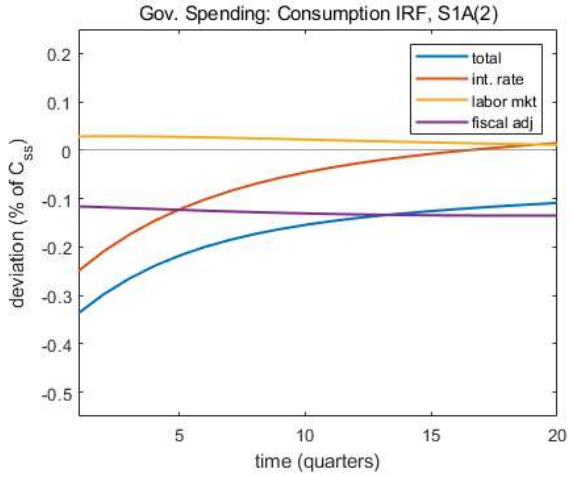
Panel A. Consumption IRF in MA1A(1).



Panel B. Consumption IRF in MA1A(2).



Panel C. Consumption IRF in S1A(1).



Panel D. Consumption IRF in S1A(2).

Figure D.2. Government spending shock: total effects on consumption and decomposition over five years.

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