Monetary and Fiscal Policy in a Mental Accounting HANK*

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Abstract

This paper studies how mental accounting of income and wealth affects the macroeconomic transmission to consumption in a heterogeneous-agent environment with nominal rigidities. After a monetary policy shock, mental accounting reduces the intertemporal substitution and amplifies the labor income effects, both among liquid households and in the aggregate. Future monetary policy announcements (i.e. forward guidance) are moderately less powerful than contemporaneous shocks. The government spending multiplier is determined by small anticipation and lagged effects in consumption. Relatedly, only a small share of fiscal deficits can finance themselves, requiring subsequent fiscal adjustment.

JEL codes: D15, D31, E12, E21, E22, E24, E43, E52, E62, E70.

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1. Introduction

How do macroeconomic policies affect household consumption? The literature on Heterogeneous Agent New Keynesian (HANK) models has emphasized that matching consumption moments is crucial to answer that question. More specifically, it is the marginal propensities to consume (MPC) across households, as well as the intertemporal MPCs, which allow models to capture better the policies' incidence across the household distribution (Kaplan, Moll, and Violante, 2018) as well as the policies' dynamic effects over time (Auclert, Rognlie, and Straub, 2024).

However, leading HANK models are at odds with pieces of micro-economic evidence on consumption behavior that are relevant for the questions above. First, households with enough liquid resources display high MPCs and low Elasticities of Intertemporal Substitution (EIS). Second, the intertemporal MPCs are non-Ricardian and short-lived: they present little anticipation, excess sensitivity, and small lagged effects. Third, one-asset models cannot generate realistic values for the aggregate MPC, aggregate wealth, and median wealth, which are desirable in general equilibrium applications (Kaplan and Violante, 2022).

To overcome these challenges, this paper proposes a 'mental accounting HANK' (MA-HANK) model to study the transmission of monetary and fiscal policy to consumption. This quantitative framework integrates a mental accounting incomplete-markets model of consumption (as in Gimeno-Ribes, 2025)[1] into a New Keynesian economy. Mental accounting is expressed as a variant of reference-dependence with loss aversion and it captures the preference for households to consume from their income account rather than from their asset account. Besides this behavioral friction, the framework builds on the workhorse Bewley-Aiyagari-Huggett[2] environment, and the supply side of the model features price and wage rigidity. In addition, the monetary authority operates a Taylor rule, and the government follows a fiscal rule.

Besides the mental accounting HANK, this paper considers additional environments to analyze macroeconomic policy shocks, namely a HANK with standard preferences, a two-agent model (TANK), and a representative-agent model (RANK). In aggregate terms, the relationship between MA-HANK and HANK is similar to that between TANK and RANK: while the incomplete markets irrelevance result (Werning, 2015) is roughly visible in HANK, the

[1] For literature on mental accounting, see also Shefrin and Thaler (1988); and Thaler (1990).
[2] See Bewley (1987), Aiyagari (1994), and Huggett (1993). See also Imrohoroğlu (1989) for a related setup in partial equilibrium.

presence of hand-to-mouth households brings the model closer to the evidence. However, the MA-HANK has the ability to match evidence on the distributional effects – substitution effects, wealth effects, and indirect income effects – which eludes the other models.

First, the paper considers a monetary policy shock. Its direct effects, i.e. via intertemporal substitution of consumption, are smaller than with standard preferences because hand-to-mouth households with a low EIS are spread across the entire asset and income distributions. These predictions are consistent with empirical evidence of small EIS both homogeneously across asset levels (Best et al., 2020) and in the aggregate (Havránek, 2015; Canzoneri, Cumby, and Diba, 2007; Yogo, 2005; Campbell and Mankiw, 1989; 1991; Hall, 1988).

The monetary policy shock also generates large indirect effects that are transmitted through the labor market through liquid households. Again, this result hinges on the presence of liquid hand-to-mouth households, who have a high MPC and, therefore, increase consumption substantially in response to the increase in labor earnings, an effect that becomes visible in the aggregate. This prediction is consistent with recent empirical evidence of large general-equilibrium income effects from monetary policy being transmitted through unconstrained liquid households (Holm, Paul, and Tischbirek, 2021).

In addition, the monetary expansion generates a positive reaction of stock prices, in line with the empirical literature (Bernanke and Kuttner, 2005). This asset price revaluation arises mainly from a lower discount rate and it generates a smaller effect on consumption because households have a small MPC out of capital gains. At the heart of these results is the property that households have account-specific MPCs, with the MPC out of income being around one order of magnitude larger than the MPC out of assets.

Second, the analysi turns to forward guidance, that is an announcement of a monetary policy shock in the future. Mental accounting reduces the overall EIS of the model, thereby reducing the effective discounting of future shocks. As a result, forward guidance is less powerful than contemporaneous shocks, although the effect is relatively small, attenuating the forward guidance puzzle (Del Negro, Giannoni, and Patterson, 2023).

Third, the paper addresses government spending. The deficit-financed multiplier is larger than the balanced-budget multiplier, showing that mental accounting introduces a violation of Ricardian Equivalence. The intertemporal MPC reveals that households do not consume out of anticipated future income shocks before they are realized, but their consumption does react substantially to current income shocks. Hence, in a deficit-financed fiscal expansion the anticipated future tax hikes have almost no effect on consumption when the shock occurs. Conversely, in the balanced-budget case the current tax hikes rein in consumption significantly.

Government spending multipliers differ depending on the type of monetary policy response, yet the associated deficit-financed multiplier at impact remains larger with "active" monetary policy. In terms of the transmission to consumption, this result provides further proof that households under mental accounting are more responsive to income changes and more immune to changes in the real interest rate.

Fourth, the paper considers a central yet perhaps understudied question in fiscal policy that acquired special relevance during the Great Recession and the implementation of austerity programs: namely, whether deficits are expansionary enough to finance themselves. In particular, the question is whether a deficit-financed fiscal transfer to households, on its own, provides enough aggregate stimulus and tax revenue to bring government debt back to its initial level without any further fiscal adjustment (as in Angeletos, Lian, and Wolf, 2024). I find that the expansion in aggregate demand increases the tax base, but only a small portion of the deficit can be self-financed. The demand boom is not persistent enough and, after some time, the debt interest payments outgrow the increase in tax revenues, requiring a fiscal adjustment to keep government debt from exploding in the long run. At the heart of this result is an intertemporal MPC (iMPC) without lagged effects. In an exercise with nominal government debt, the date-0 inflation surprise erodes somewhat the real value of the bonds, but it does not materially alter the results.

Literature. – This paper contributes to several strands of the literature. First, the literature on mental accounting studies violations of the fungibility of money (Thaler, 1999) across a range of household decisions. Mental accounting of income and wealth and its implications for consumption and saving choices were first discussed by Shefrin and Thaler (1988) and Thaler (1990). These intuitions are formalized in a partial-equilibrium heterogeneous-agent environment, and evaluated against the empirical evidence in Gimeno-Ribes (2025).[3] This paper builds on this line of inquiry and introduces the aforementioned mental accounting heterogeneous-household model into a general-equilibrium New Keynesian framework with nominal rigidities to analyze the transmission of macroeconomic policies.[4]

[3] For a discussion of related papers on mental accounting, see Gimeno-Ribes (2025).

[4] Several years after this paper was first circulated, many of the same issues are revisited in Pieroni and Violante (2025). The differences between the two papers are as follows. First, in terms of partial-equilibrium properties, their results on incentives at the kink, MPCs, and wealth distribution were already available in prior work, Gimeno-Ribes (2022), which they cite; in contrast, this paper reports new results on which they remain silent, in particular the elasticity of intertemporal substitution. Second, while they analyze the effect of mental accounting in a standard incomplete markets model, this paper additionally compares with alternative demand structures with a representative agent and with two agents. Third, they cast their model in continuous time, whereas this paper conducts the analysis in discrete time. Fourth, both papers decompose macroeconomic policy effects into direct and indirect effects, but this paper analyzes additional issues like the ability of fiscal deficits to finance themselves.

Second, a vast set of recent papers develops business cycle models that incorporate departures from consumption-smoothing behavior into models with nominal rigidities. These departures have taken the form of limited household heterogeneity in the form of a spender-saver structure (Campbell and Mankiw, 1989; 1991)[5], or full heterogeneity in an incomplete-markets environment[6], and an overlapping generations structure with perpetual youth reinterpreted as occasionally binding constraints[7]. This paper makes several contributions. First, while previous work emphasizes hand-to-mouth households with low holdings of liquid assets, mental accounting creates hand-to-mouth, non-smoothing behavior in low- and high-liquidity households. Second and related, previous papers attribute the difference between direct and indirect effects of monetary policy shocks to the low-liquidity households (Kaplan, Moll, and Violante, 2018; Auclert, 2019), whereas with mental accounting a large portion of this difference is due to the behavior of liquid households. Third, while previous departures from consumption smoothing have been shown to generate violations from Ricardian Equivalence[8], mental accounting constitutes a new violation thereof. Fourth, recent papers have shown that the intertemporal MPC is key in the transmission of fiscal policy (Auclert et al., 2024; Angeletos et al., 2024); this paper builds on this insight and obtains deficits cannot finance themselves when households have mental accounting.[9]

Third, another strand of the literature studies the macroeconomic implications of behavioral frictions. In the realm of preferences, an early contribution is Barro (1999), which studies a representative-agent neoclassical growth model with present bias. The closest to this paper is Laibson, Maxted, and Moll (2025), who study the transmission of monetary and fiscal policy to consumption in a partial-equilibrium heterogeneous-agent model with present bias with a focus on the mortgage refinancing channel. This paper follows their lead, but analyzes a general equilibrium model with a New Keynesian supply side and without housing.

A related subset of this literature studies business cycles with deviations from the full-information rational-expectations benchmark (see Angeletos and Lian, 2023, for a survey; see also Bianchi, Ilut, and Saijo, 2024). Almost the entirety of these papers consider representative-

[5] See Galí, López-Salido, and Vallés (2007); Bilbiie (2008); Acharya and Dogra (2020).
[6] See Oh and Reis (2012); Werning (2015); McKay, Nakamura, and Steinsson (2016); McKay and Reis (2016); Guerrieri and Lorenzoni (2017); Ravn and Sterk (2017); Kaplan, Moll, and Violante (2018); Den Haan, Rendahl, and Riegler (2018); Auclert, Rognlie, and Straub (2024); Bayer et al. (2019); among many others.
[7] See Angeletos, Lian, and Wolf (2024).
[8] Known violations of Ricardian Equivalence include: liquidity constraints (Heathcote, 2005); asset illiquidity (Kaplan, Moll, and Violante, 2018); finite lives (Angeletos, Lian, and Wolf, 2024); and present bias (Laibson, 1997).
[9] For other analyses of government spending in heterogeneous-agent models, see: Bayer, Born, and Luetticke (2023); Broer, Krusell, and Öberg (2023); Hagedorn, Manovskii, and Mitman (2019).

agent environments and focus on the rationalization of the forward guidance puzzle. The closest to this paper are Farhi and Werning (2019), which analyzes monetary policy and forward guidance in a one-asset HANK model with level-k thinking, and Pfäuti and Seyrich (2024), which considers a one-asset HANK model with cognitive discounting; my paper takes a complementary approach and studies the transmission of monetary and fiscal policies under mental accounting.[10]

The outline of the paper is as follows. Section 2 introduces the model environments. Section 3 discusses their consumption properties. Sections 4 – 7 discuss the results on the transmission of monetary and fiscal policies. Section 8 concludes.

2. Models

This section presents the general-equilibrium models that will be used for macroeconomic policy analysis in later sections. While alternative demand structures are considered, in order to allow for a cleaner comparison between them the supply and policy blocks stay the same throughout.

2.1 Households

This section considers three different environments. First, an incomplete markets setting with household heterogeneity and a utility function that nests mental accounting and standard preferences, as in Gimeno-Ribes (2025). Second, a representative household with access to complete markets. And third, a two-agent model.

2.1.1 Incomplete Markets and Mental Accounting

Households choose consumption to maximize:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[U\left(c_{h,t} \middle| r_{h,t}\right) \right]$$

subject to

$$c_{h,t} + a_{h,t+1} = (1 + R_t) a_{h,t} + e_{h,t} + T_t$$

and

[10] Angeletos and Huo (2021) have argued that these two types of features – information frictions / non-rational expectations on one hand, and non-smoothing consumption behavior / high MPCs on the other hand – are complementary rather than mutually exclusive.

$$a_{h,t+1} \geq 0,$$

where $c_{h,t}$ denotes consumption of household h at time t and T_t is a lump-sum transfer. Households can save in a liquid asset, $a_{h,t}$, with real interest rate R_t between periods $t-1$ and t, but they cannot borrow because of the borrowing constraint. The after-tax labor earnings of household h at time t are:

$$e_{h,t} = (1-\tau_t) w_t z_{h,t} l_{h,t},$$

where $z_{h,t}$ is the stochastic idiosyncratic labor productivity, which follows a Markov chain whose transition probabilities are $\Pr(z_{h,t+1}|z_{h,t})$. The transition matrix of the Markov chain is constant over time. The initial cross-sectional distribution is set equal to the ergodic distribution of the Markov chain, such that the distribution is constant over time. Households also supply labor $l_{h,t}$, which is uniform across all households and it is determined to meet market demand. The aggregate real wage, w_t, is determined in the market for labor. The productivity, labor supply, and wage jointly determine the household's pre-tax labor earnings, $w_t z_{h,t} l_{h,t}$, on which households pay a tax rate τ_t.

Utility. – Household utility U is defined as follows:

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

where $r_{h,t}$ denotes the reference point of household h in period t. Utility consists of the "intrinsic" consumption utility $u(c_{h,t})$, and gain-loss utility $u(r_{h,t}) - u(c_{h,t})$, where $u(\cdot)$ is an increasing and concave function with constant relative risk aversion (CRRA). Gain-loss utility is expressed in terms of $u(\cdot)$ because departures from the reference point are connected to the utility assigned to each level of consumption. When consumption is below or at the reference point ($c_{h,t} \leq r_{h,t}$), the household derives gain utility $u(r_{h,t}) - u(c_{h,t}) > 0$ with weight η. Conversely, when consumption is above the reference point ($c_{h,t} > r_{h,t}$), the household derives loss utility $u(r_{h,t}) - u(c_{h,t}) < 0$ with weight $\eta\lambda$, where $\lambda > 1$ is the loss-aversion parameter. Importantly, at $c_{h,t} = r_{h,t}$ the utility function has a non-differentiability point or kink. This specification nests the standard model as a special case when $\eta = 0$.

The reference point is $r = y_m$, where y_m denotes the resources that the household classifies in the 'income' mental account. As per the following classification rules:

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

$$a_m = (1+R)a + Tr^a, \qquad a_m \geq 0$$

the income mental account contains the after-tax labor earnings plus the lump-sum transfer, whereas the asset holdings and their returns belong in the 'assets' mental account.[11]

The relevant state variables of the problem are the balances of the mental accounts, $\Gamma_t(y_m, a_m)$ denotes the distribution of households, and further details on the recursive problem can be found in Online Appendix A.

2.1.2 Representative Agent

The representative household chooses consumption to maximize:

$$E_0 \sum_{t=0}^{\infty} \beta^t [U(C_t)]$$

subject to

$$C_t + A_{t+1} = (1+R_t)A_t + E_t + T_t,$$

where the variables denote the same as before, only that capital letters denote aggregates. There is a degenerate distribution of households where the representative agent has a probability mass of one, and its consumption, wealth, and labor supply are equal to its aggregate counterparts. Accordingly, there is only one level of labor productivity that the representative agent maintains invariably, therefore the agents does not receive any idiosyncratic shocks to income, only aggregate shocks. Households have access to a complete set of contingent securities to insure themselves against any state of the world; however, because they can only trade with themselves, they choose to save in a riskless asset of the characteristics explained above. The utility function is assumed to be of standard CRRA form, that is corresponding to the case where $\eta = 0$.

The first-order condition of the problem is:

$$U_c(C_t) = \beta(1+R)U_c(C_{t+1}).$$

Because households have access to complete markets and face no liquidity constraints or other

[11] Braeuer et al. (2022) present evidence that cash payments associated with dividends from directly held stocks are classified in the income account and generate a sufficiently high MPC, whereas capital gains from directly held stocks generate a substantially lower MPC – two facts that can be reconciled by a mental accounting model (Gimeno-Ribes, 2025). That being said, the data show that following a monetary policy shock the fluctuations in capital gains are at least one order of magnitude larger than fluctuations in dividends (Holm, Paul, and Tischbirek, 2021). Therefore, the model assumes that all profits capitalize and households receive them as an asset return.

frictions, their behavior is governed by the above Euler Equation, implying that they engage primarily in intertemporal substitution of consumption.

2.1.3 Two-Agent Model

This economy is populated by two types of households: a share χ of spenders and a share (1–χ) of savers. These shares and, thereby, the household distribution, are constant over time. Each type supplies the same amount of labor and receives the share of aggregate earnings plus transfers that corresponds to the household type.

The spenders have zero wealth holdings, they do not have access to financial markets, and their consumption is equal to their earnings:

$$C_t^{Sp} = \chi(E_t + T_t).$$

In turn, the savers hold the entire wealth in the economy and their consumption, C_t^{Sav}, is determined by solving the maximization of:

$$E_0 \sum_{t=0}^{\infty} \beta^t [U(C_t^{Sav})]$$

subject to

$$C_t^{Sav} + A_{t+1} = (1 + R_t)A_t + (1 - \chi)(E_t + T_t),$$

where the household has access to a complete set of contingent securities and faces the same specification as in the representative-agent case. This problem gives the following first-order condition:

$$U_c(C_t^{Sav}) = \beta(1 + R)U_c(C_{t+1}^{Sav}).$$

Finally, aggregate consumption is the sum of the two types:

$$C_t = C_t^{Sp} + C_t^{Sav}.$$

2.2 Firms

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

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

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 is the markup. Final goods producers solve a cost minimization problem, and the demand for intermediate good *j* is given by:

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

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

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

Intermediate Goods Producers. – The producers of intermediate goods are monopolistically competitive firms. These firms hire labor in order to produce the intermediate good:

$$y_{j,t} = f\left(n_{j,t}\right) = n_{j,t} - fc$$

where $n_{j,t}$ denotes the labor hired by firm *j* in period *t*. The fixed production cost *fc* allows to target the steady-state value of intermediate firm equity in the calibration.

These 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):

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

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

$$J_{t-1} = \max_{p_{j,t}, n_{j,t}} \frac{1}{(1+R_{t-1}^e)} E_{t-1}\left\{\frac{p_{j,t}}{P_t} y_{j,t} - w_t n_{j,t} - \Theta_{j,t} + J_t\right\}$$

subject to the final good producers' demand for intermediate goods

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

where J_t is the value of the firm at time *t* and w_t is the wage in period *t*. Imposing symmetry among all firms ($p_{j,t} = P_t$, $n_{j,t} = N_t$), the maximization problem yields the Phillips curve:

$$log(1+\pi_t) = \frac{\mu}{\theta(\mu-1)}\left(MC_t - \frac{1}{\mu}\right) + \frac{1}{1+R_t^e} E_t\left\{\frac{Y_{t+1}}{Y_t} log(1+\pi_{t+1})\right\}$$

where $\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$ is net inflation, the marginal cost is given by cost minimization

$$MC_t = w_t,$$

and aggregate output is

$$Y_t = F(N_t) = N_t - FC.$$

The per-period profits of the intermediate goods firms are:

$$X_t = Y_t - w_t N_t - \Theta_t,$$

where $\Theta_t = \frac{\theta}{2} log(1 + \pi_t)^2 Y_t$ are total price adjustment costs. The value of the firms, J_t, is the present discounted value of their stream of profits X_t.

2.3 Labor Market

Workers are compensated for their labor according to the following wage schedule (as in Alves et al., 2020):

$$w_t = w_{SS} \left(\frac{N_t}{N_{SS}} \right)^{\varepsilon_w}$$

where N_t is the aggregate labor demand, w_t is the real wage, N_{SS} and w_{SS} are steady-state values, and ε_w is the wage elasticity with respect to labor demand. With a low calibrated elasticity, this rule generates wages that are quite rigid to fluctuations in labor demand. This assumption is empirically plausible (e.g. Taylor, 2016) and, in combination with sticky prices, it avoids countercyclical monopoly profits, which can generate counterfactual variations in consumption (Werning, 2015; Farhi and Werning, 2019; Broer et al., 2020).

The amount of labor supplied is demand-determined given the wage, and allocated across workers according to an equal rationing rule. This setup has several advantages. First, it avoids implausible differences in endogenous labor supply that arise in incomplete markets models. And second, it prevents high-MPC households from having counterfactually large "marginal propensities to earn" (Auclert, Bardóczy, and Rognlie, 2023).

2.4 Monetary Authority

The monetary authority sets the nominal interest rate by responding to changes in inflation, following a Taylor rule:

$$i_t = R_{SS} + \phi \pi_t + \epsilon_t,$$

where R_{SS} is the steady state real interest rate, ϵ_t is the innovation term which is zero in steady state, and ϕ governs the responsiveness of the nominal interest rate to deviations of inflation from steady state. The nominal rate and inflation are related to the real interest rate through a standard Fisher equation:

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

2.5 Fiscal Authority

The government issues bonds, B_t, and levies taxes on households' labor earnings in order to finance public transfers, T_t, and expenditures, G_t, while respecting its budget constraint in each period:

$$B_t + \int \tau_t\left(w_t z_{h,t} l_{h,t}\right)\Gamma_t(y_m, a_m)\, dyda = (1 + R_{t-1}^e)B_{t-1} + G_t + T_t.$$

The government also operates the following fiscal rule:

$$\tau_t - \tau_{SS} = \varphi_B \frac{B_{t-1} - B_{SS}}{Y_{SS}},$$

where φ_B determines the speed of adjustment of the tax rate in response to deviations of debt from its steady-state level normalized to steady-state output (as in Auclert, Rognlie, and Straub, 2020). This rule captures a "passive" fiscal response to a shock: the government runs a deficit/surplus in the short term and then adjusts its debt and brings it back to the steady state level over time. Hence, this rule allows to study monetary policy with limited interference from the fiscal response.

2.6 Financial Intermediary

All households deposit their wealth with the financial intermediary, which in turn holds a portfolio of two assets: (i) government bonds, B_t; and (ii) equity shares of the intermediate goods producers, J_t. No arbitrage implies that the two assets offer ex-ante the same expected return R_t^e between periods *t* and *t+1*:

$$1 + R_t^e = E_t\left[\frac{1 + i_t}{1 + \pi_{t+1}}\right] = E_t\left[\frac{X_{t+1} + J_{t+1}}{J_t}\right],$$

where R_t^e is pinned down by the monetary authority.

The portfolio delivers a realized rate of return R_t between periods *t-1* and *t*, which is the weighted average of the realized return on all assets:

$$1 + R_t = \frac{B_{t-1}}{B_{t-1} + J_{t-1}}(1 + R^e_{t-1}) + \frac{J_{t-1}}{B_{t-1} + J_{t-1}}\frac{X_t + J_t}{J_{t-1}},$$

where the portfolio weights are the shares of wealth invested in each asset. Because the analysis includes perfect-foresight paths, the realized return on equities differs from the return on government bonds in the first period when the shock hits.

2.7 Equilibrium

The clearing condition for the asset market is:

$$A_t = B_t + J_t,$$

where household asset supply must equal the asset demand from firms and government.
The goods market clearing condition is:

$$C_t + G_t + \Theta_t = Y_t,$$

where aggregate private and public consumption of goods and services plus price adjustment costs must equal aggregate production by firms.
An equilibrium of this economy is defined by the policy function $\{c_t(a, z)\}_{t=0}^{\infty}$ that solves the household's problem, the household distribution $\{\Gamma_t(y_m, a_m)\}_{t=0}^{\infty}$ that evolves according to its law of motion, policy functions that solve the problems of intermediate goods and final goods producers $\{n_t, y_t, p_t\}_{t=0}^{\infty}$, and a sequence of prices, monetary and fiscal policies $\{i_t, w_t, \pi_t, R_t, \tau_t, T_t, B_t, G_t\}_{t=0}^{\infty}$, such that the asset market and the goods market all clear, and the government budget constraint holds. Household labor supply is pinned down by the labor demand of intermediate-goods firms, N_t, which together with the wage-setting rule determine the wage.

2.8 Calibration

The model period is one quarter, the coefficient of relative risk aversion is 2 and the real interest rate is 0.5% (2% annually). The calibration is summarized in Table 1.

Table 1. List of Calibrated Parameters

Parameter	Value				Target / Source
Model	*MA-HANK*	*HANK*	*TANK*	*RANK*	
Preferences					
γ (risk aversion)			2		Standard value
β (discount factor)	0.985	0.981	0.995	0.995	Assets / annual pre-tax income = 4.10[a]
η (gain-loss utility)	0.27	0	-	-	Aggregate MPC = 25.0%[b]
λ (loss aversion)	2.5	2.5	-	-	Literature[c]
χ (share of spenders)	-	-	25%	-	Aggregate MPC = 25.0%[b]
Production					
μ (markup)			1.10		Literature[d]
θ (price stickiness)			122		Slope of Phillips Curve = 0.09[e]
FC (fixed cost)			0.033		Asset Market Clearing
Labor Market					
ε_w (wage elasticity)			0.10		Literature[f]
Policy					
ϕ (Taylor rule coeff.)			1.25		Literature[g]
B (Bonds / annual GDP)			0.70		Literature[h]
τ (tax rate)			0.33		Literature[i]
φ_B (fiscal rule)			0.10		B_{ss} at medium term[f]

[a]Kaplan and Violante (2022).

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

[c]Gimeno-Ribes (2025).

[d]McKay and Reis (2016).

[e]Bayer et al. (2019).

[f]Alves, Kaplan, Moll, and Violante (2020).

[g]Kaplan, Moll, and Violante (2018).

[h]Straub (2019).

[i]DeLong and Summers (2012).

Household block in MA-HANK and HANK. – The idiosyncratic income process is modelled as an AR(1) process with an autoregressive coefficient of 0.9657 (Floden and Lindé, 2001), as in McKay, Nakamura, and Steinsson (2016) and in Farhi and Werning (2019); and an unconditional cross-sectional standard deviation of 0.92 (Song et al., 2019), as in Auclert et al. (2024). I calibrate the discount factor to match a ratio of aggregate wealth to annual pre-tax income of 4.10 (Kaplan and Violante, 2022). The calibration of the mental accounting friction follows Gimeno-Ribes (2025): the loss aversion parameter is set to 2.5, which is within the

range of plausible values in the literature, and the weight on the gain-loss utility is calibrated to match a 25% quarterly MPC, based on Kaplan and Violante's (2014) survey of empirical estimates. For the variant with standard CRRA utility $\eta = 0$.

Household block in RANK and TANK. – These models abstract from idiosyncratic income risk: the single productivity level is the average productivity from the incomplete markets economy, and (the shares of) individual income coincides with (the shares of) aggregate income. In the representative agent model the discount factor is equal to the inverse of the gross interest rate, and I assume for comparison that aggregate consumption is equal to the heterogeneous-agent counterpart (as in Debortoli and Galí, 2024). In turn, in the two-agent model the share of spenders is equal to 25% to match the quarterly MPC target, and the discount factor for the savers is equal to the inverse of the gross interest rate, and aggregate consumption is assumed to be equal to the heterogeneous-agent counterpart.

Production. – The production structure is calibrated as follows. The price markup is set to 1.10 (McKay and Reis, 2016), and the parameter on the Rotemberg price adjustment costs is chosen to match a 0.09 slope in the Phillips Curve (Bayer et al., 2019). The fixed cost of production is calibrated to set the steady-state value of firm equity over annual output (following a similar strategy to Auclert, Bardóczy, and Rognlie, 2023), which equals the overall aggregate wealth minus government bonds. The wage elasticity to labor demand is set to 0.10 (Alves et al., 2020).

Policy. – The parameters governing the monetary and fiscal policy are as follows. The steady-state ratio of government bonds to annual output is 0.70 (Straub, 2019). The Taylor rule coefficient on inflation takes a standard value of 1.25. The tax rate is 0.33 (DeLong and Summers, 2012), steady-state transfers are zero, and government spending is obtained as a residual from the 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.

2.9 Computation

The household problem is solved following the algorithm in Gimeno-Ribes (2025). In turn, the impulse response functions (IRF) are obtained as perfect-foresight transition paths of the economy in response to an MIT shock (Boppart, Krusell, and Mitman, 2018), following a strategy similar to McKay, Nakamura, and Steinsson (2016).

3. Consumption Behavior and the Household Distribution

This section presents the consumption properties of the models that have implications for policy transmission.

First, the effective Elasticity of Intertemporal Substitution (EIS) is obtained as the substitution effect on consumption due to a change in the interest rate:

$$EIS_h = \frac{\Delta log \frac{C_{t+1}(y_m, a_m)}{C_t(y_m, a_m)}}{\Delta R}.$$

The EIS is obtained for a negative 1bps change in the real rate. The results are reported in Table 2, as well as in Figures 1 and 2. Online Appendix B contains the graphic intuition for the EIS results in a two-period model.

Second, MPCs are obtained as the consumption response from a transfer T distributed uniformly across households. Note that the MPC results with mental accounting in an incomplete markets environment are borrowed from Gimeno-Ribes (2025) and are reproduced here merely for expositional purposes. The MPCs are computed as follows:

$$MPC_h^y = \frac{C(y_m + T, a_m) - C(y_m, a_m)}{T}.$$

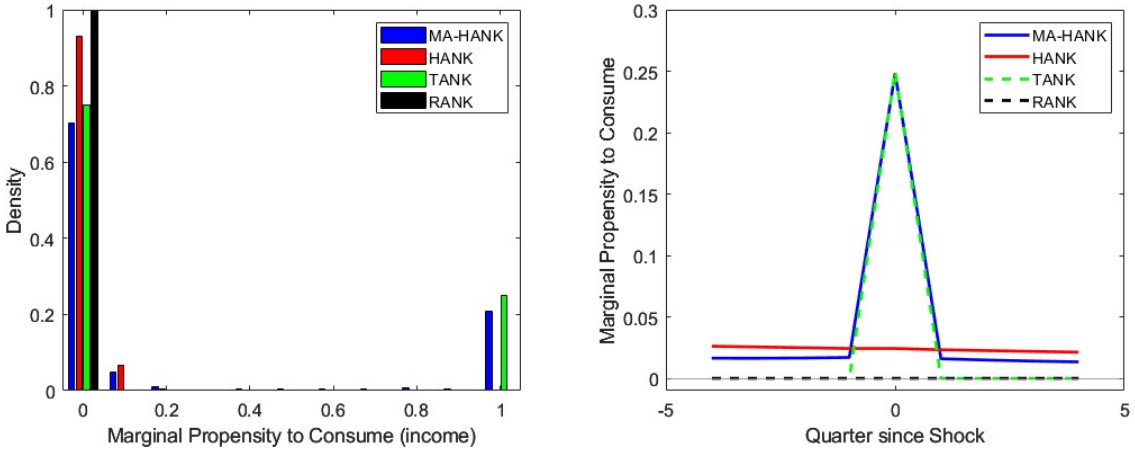
For the MPC the windfall transfer considered has a typical size of $500. The intertemporal MPC to an anticipated shock is obtained with 4 quarters of anticipation and 4 quarters of lag (as in Kaplan and Violante, 2022).

Several definitions of hand-to-mouth (HtM) households are considered in order to capture the specific features of each model: the poor HtM are those whose wealth is less than half their pay-period earnings, and the liquid households are the rest; the liquid HtM have assets over half of their pay-period earnings and their MPC is above the annuity value of the winfall. The average household captures the aggregate reaction of the economy.

Starting from the simplest environment, the RANK presents an aggregate MPC of 0% out of income and assets because the representative household is always on the Euler Equation and it engages in intertemporal substitution. As a result, the model's effective Elasticity of Intertemporal Substitution (EIS) is equal to the inverse of the CRRA coefficient, 50%. The representative agent holds all the wealth in the economy, therefore it is classified in the category of liquid households in Table 2. The agent is not classified as a HtM, since it does not have low liquidity nor a high MPC.

Table 2. Household Types, Shares, EIS, and MPC out of income and assets

Model		MA-HANK	HANK	TANK	RANK
Household Type	***Magnitude***				
Average	MPC^y (%)	25.0	2.8	25.0	0.0
	MPC^a (%)	2.0	2.8	0.0	0.0
	EIS (%)	38.2	48.3	37.3	49.8
Poor HtM	Share (%)	1.3	1.00	25.0	0
$(a \leq \frac{y}{2})$	MPC^y (%)	75.3	13.3	100	-
	MPC^a (%)	8.4	13.3	0.0	-
	EIS (%)	12.2	28.9	0.0	-
Liquid HHs	Share (%)	98.7	99.0	75.0	100
$(a > \frac{y}{2})$	MPC^y (%)	24.4	2.7	0.0	0.0
	MPC^a (%)	2.0	2.7	0.0	0.0
	EIS (%)	38.5	48.5	49.8	49.8

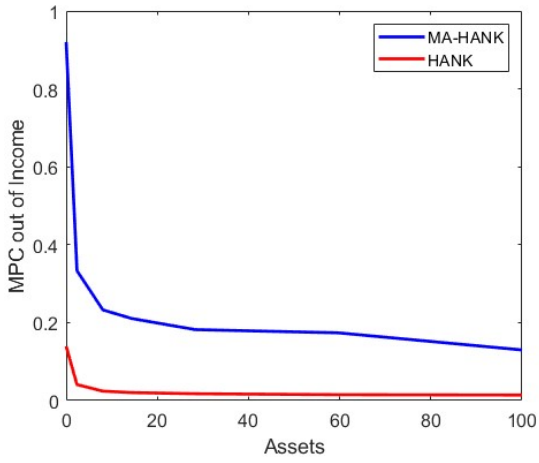


Panel A: MPC Histogram. Panel B: Intertemporal MPC.

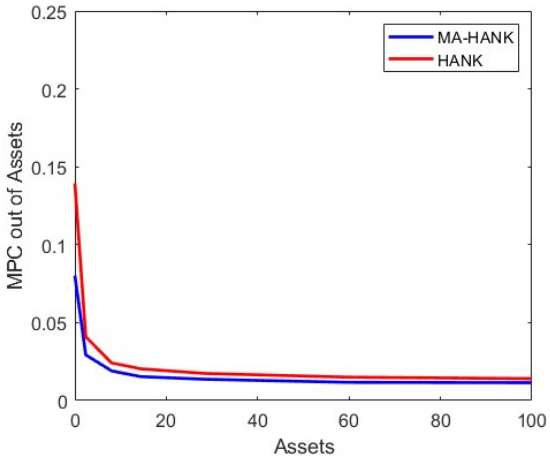
Figure 1. MPCs out of uniform transfer in all four models.

The TANK model has, by assumption, a 25% share of spenders with zero wealth, an MPC of 100% out of income and an MPC of 0% out of wealth. The presence of spenders, who do not engage in intertemporal substitution, reduces the effective EIS to 37.3%.[12] Therefore, these households fall into the category of poor HtM. The rest of the households, who are savers, are classified as liquid households because they own the entire stock of wealth, and have an MPC of 0% out of income and wealth. The spender-saver dichotomy is depicted in the MPC histogram in Figure 1. and it generates a non-Ricardian intertemporal MPC out of an expected shock with non-anticipation, no lagged effects, and excess sensitivity.

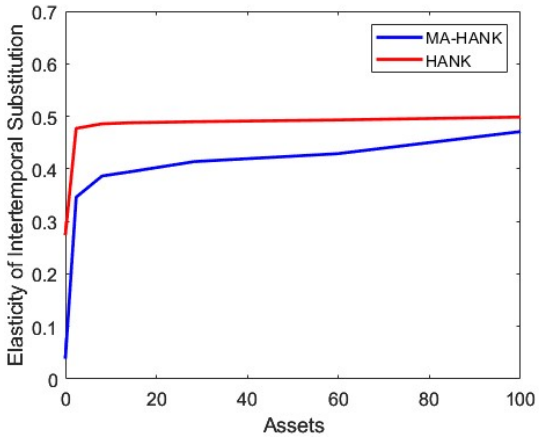
[12] Reassuringly, these results are consistent with the formula (Auclert, 2019): EIS = 1/CRRA*(1 – MPC).



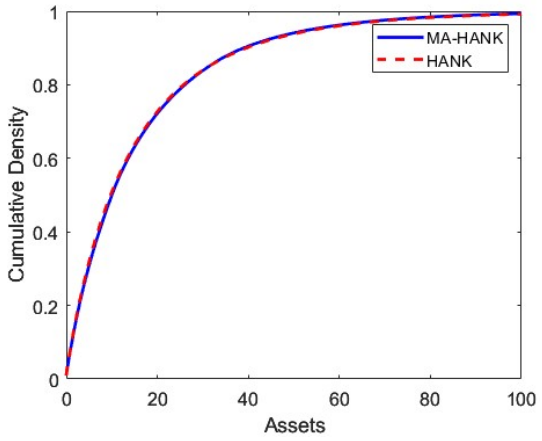
Panel A: MPC out of income.



Panel B: MPC out of assets.



Panel C: EIS.



Panel D: Assets CDF.

Figure 2. MPCs and EISs across the asset distributions in MA-HANK and in HANK.

Thus, TANK models have the advantage over RANK models that they can match the aggregate MPC (Kaplan and Violante, 2014), the intertemporal MPC (e.g. Kueng, 2018; Baugh et al., 2021; Boehm et al., 2025), the MPC bi-modality (Misra and Surico, 2014), and are closer to the aggregate EIS estimates (Hall, 1988; Yogo, 2004; Canzoneri et al., 2007; Havránek, 2015). However, both RANK and TANK models are by design unable to match consumption facts across the household distribution. In TANK, the entire MPC comes from a household with zero liquidity: this is at odds with the empirical literature, where households with enough liquid holdings have high MPCs (Olafsson and Pagel, 2018; Kueng, 2018; Baugh et al., 2021; Bräuer et al., 2022) and, as a result, they contribute substantially to the aggregate. Also, there is evidence of high MPCs both at low and high income levels (Misra and Surico, 2014), but the TANK model again by design cannot speak to that evidence. Finally, low EIS have been estimated not just for liquidity-constrained households (Vissing-Jorgensen, 2002), but homogeneously across the asset distribution (Best et al., 2020).

As for the MPCs out of asset shocks, both RANK and TANK predict MPCs of 0%. This is at odds with the empirical evidence that MPCs out of capital gains are in the single digits (Di Maggio et al., 2020; Baker et al., 2007; Chodorow-Reich et al., 2021). One could try to amend this difficulty by assuming that the spenders also consume returns to wealth, but then their MPC out of wealth would be the same as the MPC out of income, which would be even further apart from the data.

The incomplete markets economies are, by design, better equipped to make predictions across the household distribution. The HANK model generates a realistic MPC out of assets across the distribution and in the aggregate. However, because of the implicit assumption of fungibility between income and wealth, the MPC out of assets is equal to the MPC out of income (the red lines in Figure 2 Panel A and Figure 2 Panel B). But such equality is counterfactual, and that MPC out of income is too low, both across the distribution and also in the aggregate. The HANK model can only generate high MPCs for low liquidity households that are either at the constraint, and therefore incapable of reaching their optimal consumption, or close to the constraint, and therefore behave as if they had a shorter planning horizon (McKay, Nakamura, and Steinsson, 2016). Because the aggregate MPC out of income is too low, the intertemporal MPC does not feature enough sensitivity to the receipt of the shock.

The effective EIS can be thought of as the mirror image of the MPC. When households are on the Euler Equation, their effective EIS is given by the inverse of the CRRA; but when they have low or zero liquidity and are constrained, the EIS drops. Since the share of constrained households is very low, the aggregate EIS of the HANK model is very close to that of RANK.

Adding mental accounting to the incomplete markets environment does improve these properties. First, and by virtue of the non-fungibility assumption, the aggregate MPCs out of income and wealth are almost one order of magnitude apart and are consistent with the evidence. Second, it generates excess sensitivity to the receipt of the shock in the intertemporal MPC. Third, it produces high MPCs out of income across the distribution, including for high assets and high income households. Fourth, the spender-saver structure arises endogenously, with the respective shares being in line with available estimates. Fifth, the presence of hand-to-mouth households due to the mental accounting friction reduces the effective EIS both at the constraint and for liquid households.

4. Monetary Policy

This section analyzes the effects of shock to the nominal interest rate, in particular a -25bps

innovation to the Taylor rule in period $t = 0$ that reverts back to its steady state value following a quarterly AR(1) process $\epsilon_t = \rho_\epsilon \epsilon_{t-1} + \varepsilon_t^\epsilon$, with an autocorrelation of $\rho_\epsilon = 0.5$ (Galí, 2015).

4.1 Aggregate Effects

For the IRFs of aggregate magnitudes in all models, see Figure C.1 in the Online Appendix C.1. Note that the IRFs and, therefore, the model belongs to the "micro jump" literature, rather than to the "macro hump" literature, using the terminology in Auclert, Rognlie, and Straub (2020). That is, the model is able to match the response of consumption at the microeconomic level, but not the typical hump-shaped aggregate responses.

Consumption is more volatile than output because there is no investment in the model and government spending is kept fixed at its steady-state value. Nominal rigidities in prices and wages are clearly visible as they respond significantly less than output and labor, respectively. The increase in the value of stock prices is consistent with the evidence in Bernanke and Kuttner (2005). The monopolists' profits are practically acyclical due to the presence of sticky prices and wages, and because labor is the only factor of production. Hence, the reaction of stock prices is a pure revaluation effect generated by a lower discount rate.[13]

4.2 Direct and Indirect Effects in the Aggregate and Across the Distribution

This section decomposes the effects of the monetary policy shock on consumption into the different channels of prices and policies: it focuses on the effect of one price or policy at a time, while holding fixed all the other inputs of the household problem. The decomposition considers separately the real interest rate, the returns on equity, the labor income, and the fiscal adjustment, and it can be summarized as follows:

$$dC = \int_0^\infty \left(\frac{\partial C}{\partial R_t^e} dR_t^e dt + \frac{\partial C}{\partial R_t^J} dR_t^J dt + \frac{\partial C}{\partial w_t} dw_t + \frac{\partial C}{\partial \tau_t} d\tau_t \right) dt$$

where each term represents the effects of one of the prices and policies considered, computed for the entire duration of the shock.

Table 3 and Figure 3 show the total consumption response, as well as its decomposition into the different channels. Table 3 shows responses cumulated over the first year, whereas Figure 3 shows the IRFs for four years.

[13] While stock prices move in the right direction, the reaction is smaller than found in empirical studies, probably because the only model mechanism is a lower discount rate, whereas the evidence has also identified an additional channel via risk premia (see Kekre and Lenel, 2022).

Table 5.3. Decomposition of the Effect of Monetary Shock on Aggregate Consumption

Model Version	MA-HANK	HANK	TANK	RANK
Total Response	0.46%	0.43%	0.48%	0.46%
Response Decomposition				
R^e (substitution effect)	14.4%	18.3%	12.7%	18.2%
R^e (wealth effect)	-20.4%	-32.2%	0%	0%
R^e (total)	-8.4%	-14.2%	12.7%	18.2%
Labor	26.2%	5.9%	16.8%	0%
Equity (substitution effect)	54.5%	81.0%	57.3%	81.8%
Equity (wealth effect)	0.3%	0.4%	0%	0%
Equity (total)	54.8%	81.1%	57.3%	81.8%
Fiscal Rule	28.7%	28.4%	13.3%	0%

All reported values are cumulated effects over the first year. The 'total' effect on aggregate consumption is expressed as a fraction of its steady-state value. The components are expressed as a fraction of the effect on aggregate consumption.

4.2.1 Real Interest Rates

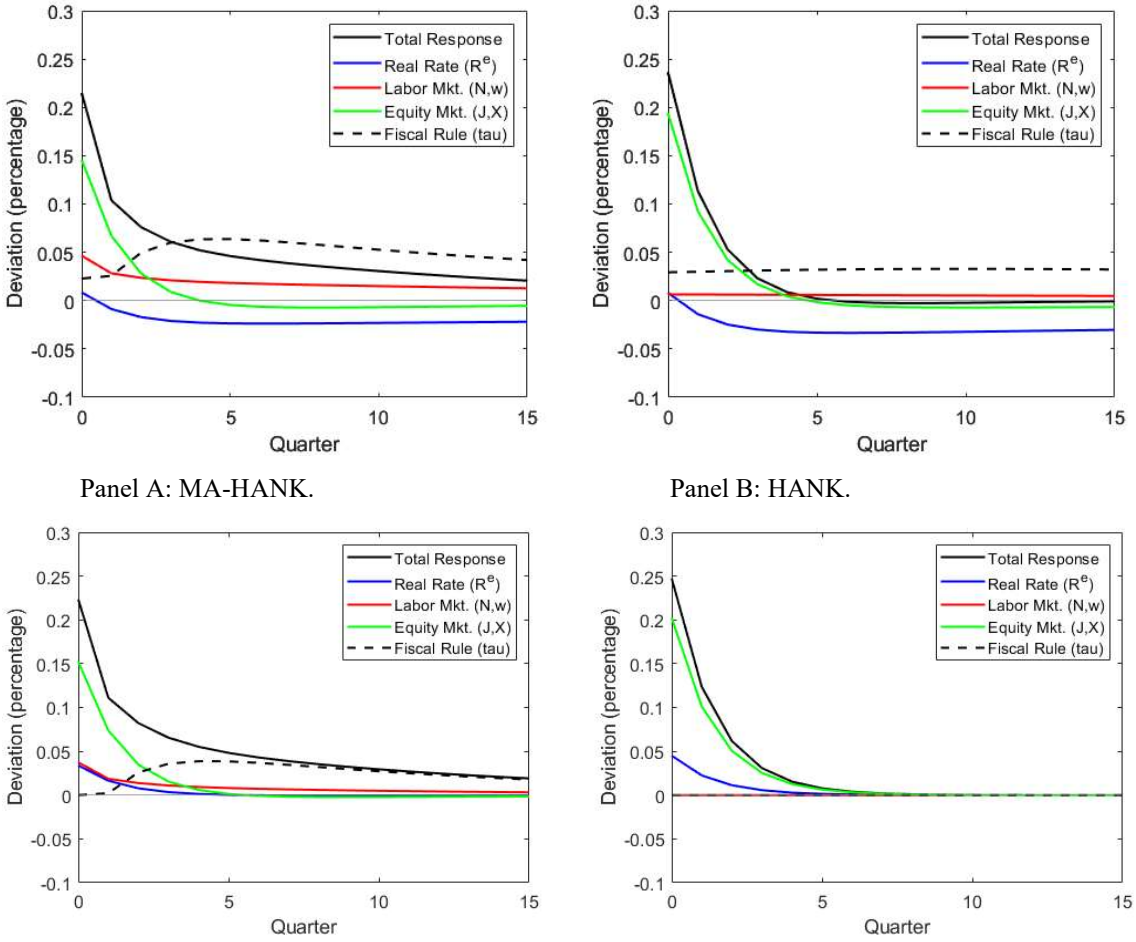
In Table 3, the effects of the real interest rate on consumption are further decomposed into substitution and wealth effect. These can be understood, respectively, through the model's effective EIS and MPC out of wealth documented in Section 3.

The RANK model only registers effects on consumption through a substitution effect that is equal to the relative weight of the bond holdings in the portfolio; in turn, the wealth effect is counterfactually zero, as argued in Section 3. The TANK model also has a zero wealth effect, and the substitution effect is smaller because of the presence of spenders.

The incomplete markets economies feature both substitution and wealth effects. The substitution effect in HANK is very similar to RANK, which is reassuring given that the effective EISs in both models are nearly identical. In turn, HANK also features a negative wealth effect, due to the drop in the real interest rate. Because the wealth effect is larger than the substitution effect in absolute value, the resulting total (net) effect of the real rate is negative.

The substitution effect in MA-HANK is in the same range as TANK, which makes sense because their effective EISs are very similar. However, MA-HANK also features a negative wealth effect, which is smaller in absolute value than in HANK because the MPC out of wealth is also smaller with mental accounting. The resulting total effect is also negative, yet smaller in absolute value than HANK.[14]

[14] The net negative direct effect (due to the interest rate on bonds) is consistent with the aggregate-wealth calibration of the 1-asset model in Kaplan, Moll, and Violante (2018).



Panel A: MA-HANK. Panel B: HANK.

Panel C: TANK. Panel D: RANK.

Figure 3. Monetary policy shock: decomposition of the consumption IRF in all four models.

To sum up, household heterogeneity is necessary to generate realistic wealth effects (Di Maggio et al., 2020; Chodorow-Reich et al., 2021), and both these and substitution effects are more realistic with mental accounting.

4.2.2 Labor Earnings

The above change in the real rate provides a stimulus to consumption that generates a general-equilibrium increase in labor demand (the increase in wages is much lower, as already mentioned) and, as a result, in labor earnings. This rise in earnings further stimulates consumption, which in turn increases labor earnings, following a Keynesian cross logic.

RANK features a zero effect of labor earnings on consumption (Table 3, Figure 3). TANK improves the predictions on this dimension due to the presence of spenders. However, the shock is transmitted only through zero-liquidity households, whereas the evidence has found that a sizable share of the indirect labor-earnings effects is transmitted through households with ample levels of liquidity (Holm et al., 2021). In HANK, as it features an unrealistically low MPC, the

labor effects are small and transmitted only through low-liquidity households. MA-HANK, with the higher MPC, can generate a substantial labor effect that is 20pp higher and that is transmitted through households with sufficient liquidity, consistent with the mentioned evidence. Although the MPC in MA-HANK and TANK is the same, the size of the effects in Table 3 differs because MA-HANK features a negative effect of the real rate, which implicitly scales up all the positive effects such that the sum of different components is around 100%.

4.2.3 Fiscal Adjustment

The lower real rate on government bonds reduces the cost of financing for the government; in addition, the rise in labor earnings increases tax revenues. Higher revenues and lower costs require the government to issue less debt, freeing up fiscal space. Over the subsequent periods, by the fiscal rule the government reduces taxes to drive the debt back to its steady-state level.

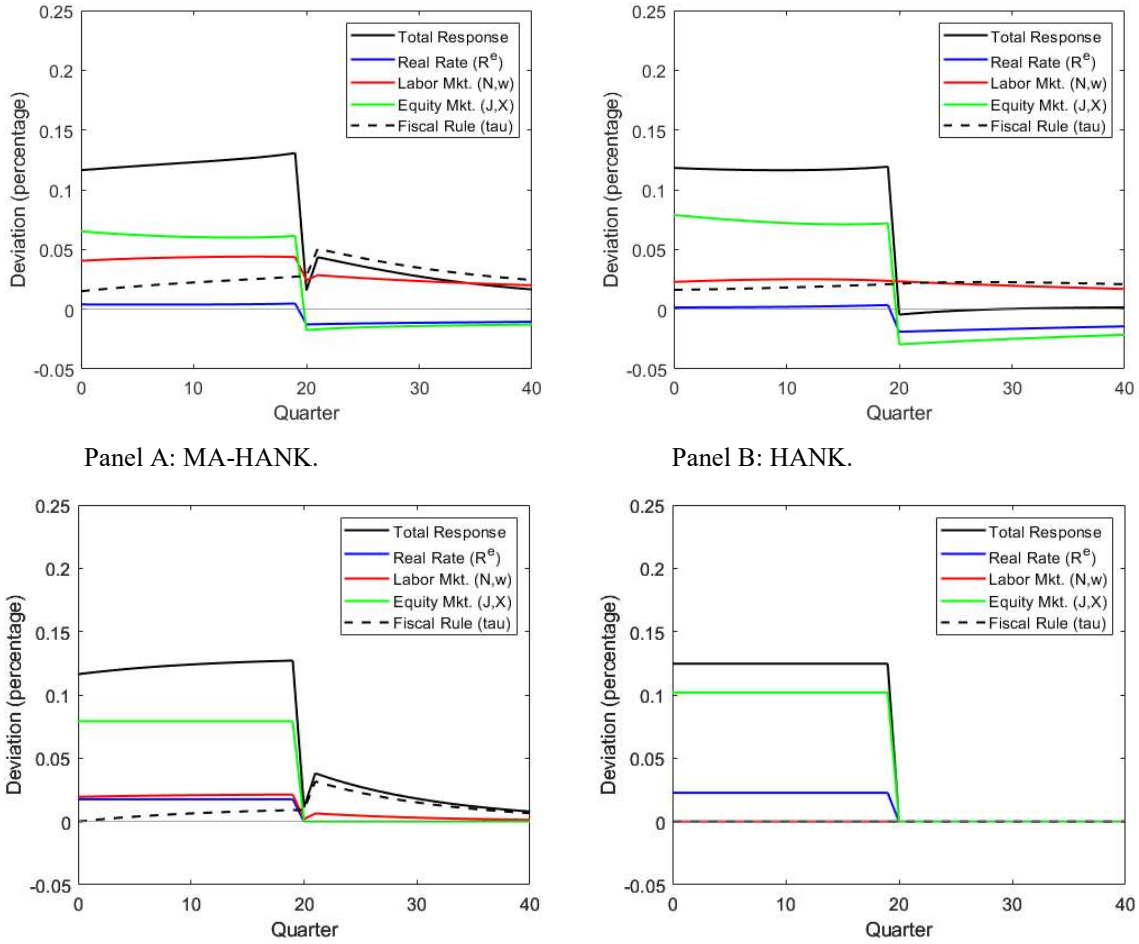
The resulting increase in after-tax income also has different effects across models. Similar to the case of labor earnings, the effects of the lower taxes in RANK are zero (Table 3, Figure 3). TANK features a strong response that is also correlated with the tax changes, indicating that consumption tracks income closely. In HANK, the effects are again positive, but the nearly flat line in Figure 3 indicates that most households smooth consumption, which is consistent with its low MPC. Finally, in MA-HANK the somewhat hump-shaped response indicates a strong reaction to income changes, but again the effects are sizable across the asset distribution and not just for low-liquidity households, consistent with the evidence (Holm et al., 2021).[15]

4.2.4 Returns on Equity

The revaluation of firm equity generates a surprise, positive return at impact, followed by negative returns because of the arbitrage condition. However, the equity returns affect the household more significantly, as equity is approximately 81.2% of the portfolio.

In the RANK model, consumption responds via intertemporal substitution, with a weight that mimics the share of equity in the portfolio. The positive return on impact has no wealth effect in the RANK model, which is counterfactual. In the TANK model the wealth effect is still zero, but the return on equity otherwise has a smaller effect because only the savers respond to it via intertemporal substitution.

[15] In Holm et al. (2021) 'nonfinancial income' includes both transfers and labor earnings. The latter display a strong response when the general-equilibrium effects kick in.



Panel A: MA-HANK. Panel B: HANK.

Panel C: TANK. Panel D: RANK.

Figure 4. Forward guidance shock: decomposition of the consumption IRF in all four models.

In turn, the HANK model does feature a response in both substitution and wealth effects. In this case, the return at impact is positive and large, hence both effects have the same sign when cumulated over the first year (Table 3, Figure 3). However, the substitution effect dominates and is of a similar size as in RANK, because both models have a similar effective EIS. The difference in the total effects between both models is due to the wealth effect, given the small but positive MPC out of wealth in HANK.

Mental accounting substantially reduces the substitution effects (in MA-HANK, the hand-to-mouth have an effective EIS of zero). In addition, the MA-HANK has a small wealth effect in the same order of magnitude than HANK based on the small MPC out of wealth.

5. Forward Guidance

This section considers an announcement of a future monetary policy shock in a similar fashion as in McKay, Nakamura, and Steinsson (2016). For this section, the central bank operates a different monetary policy rule: $R_t = R_t^n + \epsilon_{t,t-j}$, ensuring that in all periods the

interest rate is equal to the natural rate, which is also the steady-state value at all times. The error term accommodates the shock that occurs at time t and is announced j periods ahead. I consider a –25bps shock 20 quarters ahead, i.e. with $j = 20$.

The aggregate effects across variables can be found in Figure C.2 in the Online Appendix C.2. In turn, Figure 4 shows the total consumption response, as well as its decomposition into the effects of different prices and policies, analogously to Section 4.

In RANK, the announcement of a future monetary policy shock has counterfactually the same effects as a contemporaneous shock, which is known as the 'forward guidance puzzle' (Del Negro et al., 2023). In terms of decomposition, consumption only responds via intertemporal substitution, and the relative importance of the real rate and the return on equity is proportional to their shares in the household portfolio. The responses to labor income and the fiscal adjustment are nonexistent.

In the TANK model, the higher aggregate MPC induces a positive consumption response to the increase in labor earnings and to the fiscal adjustment; whereas the lower effective EIS generates a smaller response to the real rate and, most visibly, to the return on equity. These effects aggregate such that the effect of the announcement in the present is about 9% smaller than the effect of the shock when it occurs. The interest rate channels stay constant throughout the announcement horizon until the shock occurs, for the same reason as in RANK, namely because agents are on the Euler Equation. Conversely, the income channels feature some reduction as the horizon of the shock becomes more distant. Such effect is most visible in the case of the fiscal adjustment, where the expansion generates enough fiscal space to increasingly reduce taxes, thereby generating an upward sloping effect. After the interest cut occurs, the resulting drop in debt triggers a larger tax reduction, which drives the response afterwards.

The HANK model features a response to the real rate that is virtually zero before the shock occurs, as the substitution effect approximately cancels out with the expectation of the negative wealth effect; after the shock, the negative wealth effect dominates. The return on equity now acts through a substitution effect, as well as through a positive wealth effect that is most visible when the announcement is made; in turn, after the shock the negative wealth effect dominates. As for the labor income and the fiscal adjustment channels, they have rather smooth profiles, owing to the overwhelming majority of savers in the household distribution. As a result, the aggregate response is similar to RANK before the shock occurs, and therefore the forward guidance puzzle persists in this economy. However, after the shock the picture is quite different: the responses go below zero because of the negative wealth effect of the rate cut, something that does not appear in RANK or TANK because of the absence of wealth effects.

Table 4. Government Spending Multipliers

Model	MA-HANK		HANK		TANK		RANK	
Monetary Policy	Active	Passive	Active	Passive	Active	Passive	Active	Passive
Fiscal Adjustment								
Deficit, tax rule	1.17	1.24	0.95	1.04	1.14	1.21	0.92	1.00
Balanced budget, tax	0.92	1.01	0.92	1.00	0.92	1.00	0.92	1.00

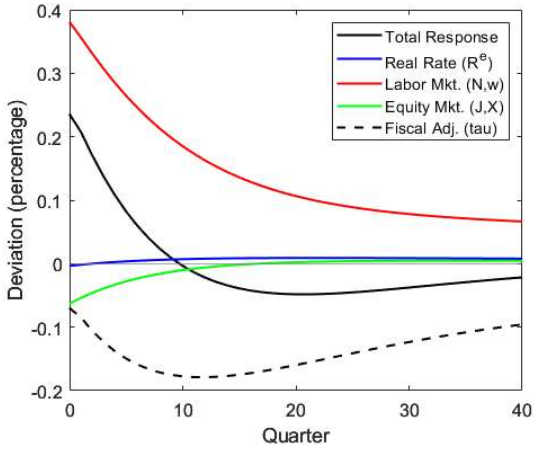
In the mental accounting model, the announcement effect is an 11% weaker than the contemporaneous shock, which is in the direction of resolving the forward guidance puzzle. Similar to HANK, the response to the real rate is nearly zero because the negative wealth effect counteracts the substitution effect. The effect of the equity returns is the smallest in absolute value, because of the lower effective EIS and small MPC out of wealth. The effects of labor income and fiscal adjustment are now stronger and reflect the property that consumption tracks income more closely. The intuition for the spike right after the shock is the same as in TANK, namely the effect of the fiscal adjustment.

6. Government Spending

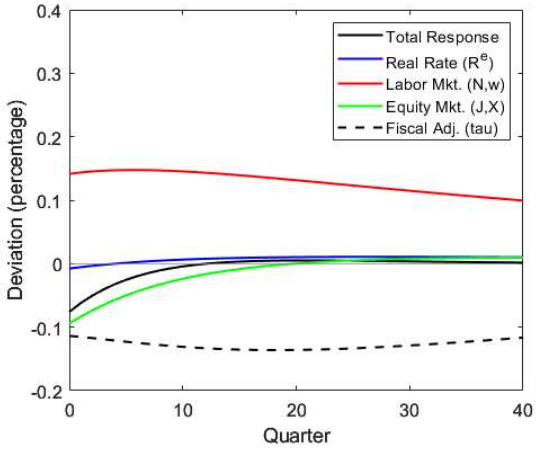
This section discusses a shock that increases government purchases by 1% of steady-state output in period $t = 0$, and then reverts back to its steady state value following an AR(1) process with a quarterly autocorrelation of $\rho_G = 0.9$ (Auclert et al., 2023).

The effects of the shock on consumption and output are analyzed under alternative settings. Monetary policy can either be "active" with a Taylor rule or "passive" in the sense that the monetary authority that does not respond to inflation and targets the steady-state real interest rate, such that $R_t^e = R_{ss}^e$. In turn, fiscal policy can follow different financing schemes for the shock: (i) deficits, based on the fiscal rule in Section 2.5, and (ii) balanced budget, where the labor income tax is adjusted to keep government debt constant at its steady-state level. Table 4 contains the impact multipliers on output, $\frac{dY_0}{dG_0}$, under the different cases, in all four models.

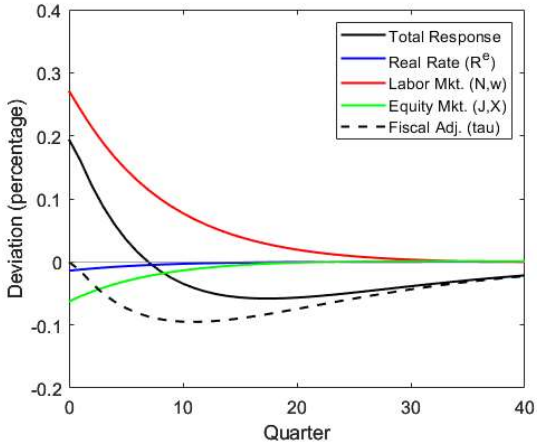
The expansion in government spending generates an increase in output and, thereby, in labor demand; at the same time, it triggers an immediate or delayed fiscal adjustment in the form of higher taxes. The rise in output generates inflation, to which under active monetary policy the central bank responds by raising the nominal interest rate; as a result, households face a higher real rate on bonds and equity, as well as a negative equity revaluation at impact. The responses of aggregate variables are plotted in Appendix C.3 for all cases. Figure 5 and 6 plot the decomposition of consumption under active monetary policy.



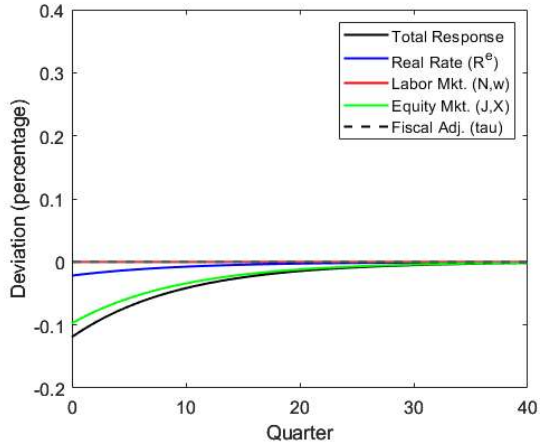
Panel A: MA-HANK.



Panel B: HANK.



Panel C: TANK.

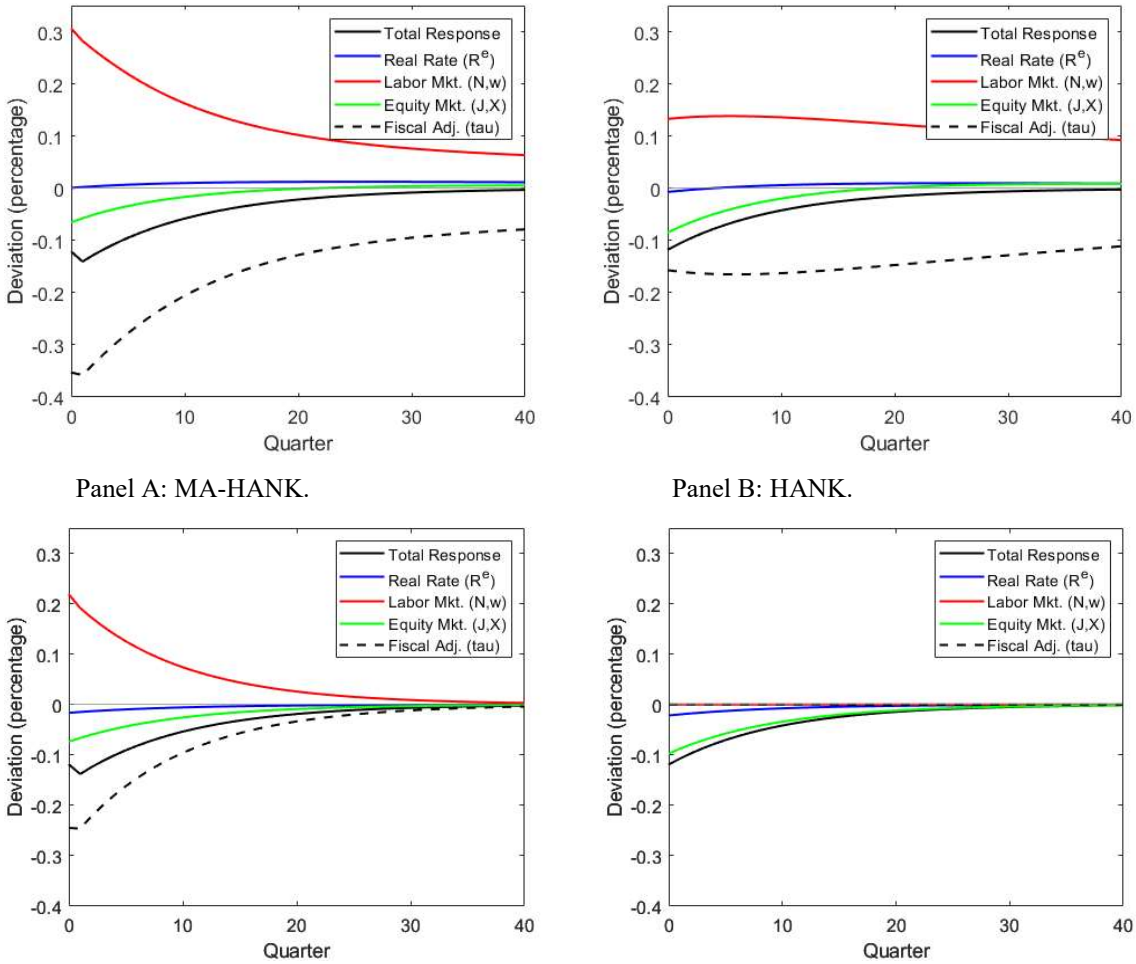


Panel D: RANK.

Figure 5. Deficit-financed government spending: decomposition of the consumption IRF under active monetary policy, in all four models.

In RANK, the shock only affects consumption when monetary policy is active through the higher real rate on bonds and equity, which via intertemporal substitution reduces consumption (Figure 5 Panel D). The negative revaluation of equity in period 0 does not have any impact, and neither does the increase in labor demand or the fiscal adjustment. Hence, the multiplier is smaller than one. With passive monetary policy, the interest rate does not change, consumption remains at its steady-state value and the multiplier is equal to one. Because the fiscal adjustment does not have any impact, the timing of it is irrelevant (Figures 5 and 6, Panels D): Ricardian Equivalence holds, and the corresponding multipliers coincide across monetary regimes.

In TANK the substitution effects of interest rates on bond and equity are smaller, while the wealth effects are zero. The labor income and fiscal adjustment do affect aggregate consumption. Hence, the timing of the fiscal adjustment matters, the multiplier is larger under deficits than under a balanced budget (Figure 5 and 6 Panel C), and Ricardian Equivalence fails. With passive monetary policy, the interest rate effects vanish and both multipliers are higher.



Panel A: MA-HANK. Panel B: HANK.

Panel C: TANK. Panel D: RANK.

Figure 6. Balanced-budget government spending: decomposition of the consumption IRF under active monetary policy, in all four models.

There is a slight drop in consumption in the first period under a balanced-budget scheme, before converging back to the steady state. In that period, consumption responds to the higher taxes needed to close the larger fiscal imbalance, due to a higher interest paid on debt and lower tax base, in turn due to a smaller amount of hours worked.

The HANK environment displays a similar response to interest rate channels as the RANK model, both channels being now closer to zero because the negative substitution effects are counteracted with positive wealth effects, including the first-period surprise wealth effect on equity (Figures 5 and 6 Panel B). The labor income and fiscal adjustment channels are now larger and smoother.

The responses in HANK are quite similar with deficit-financing and with a balanced budget, the latter being weaker because the fiscal adjustment is more front-loaded. However, the positive MPC out of income, due to the presence of some liquidity constrained households, explains this violation of Ricardian Equivalence, albeit quantitatively small. This difference is

similar under both monetary regimes.

The MA-HANK model shows, on one hand, less of a response to interest rate changes than HANK due to the presence of hand-to-mouth households with zero EIS and zero MPC out of wealth (Figures 5 and 6 Panel A). On the other hand, the effects of the labor earnings and fiscal adjustment channels are larger due to the higher MPC out of income. The small blip in the first period after the shock in the balanced-budget expansion arises for the same reasons as in TANK.

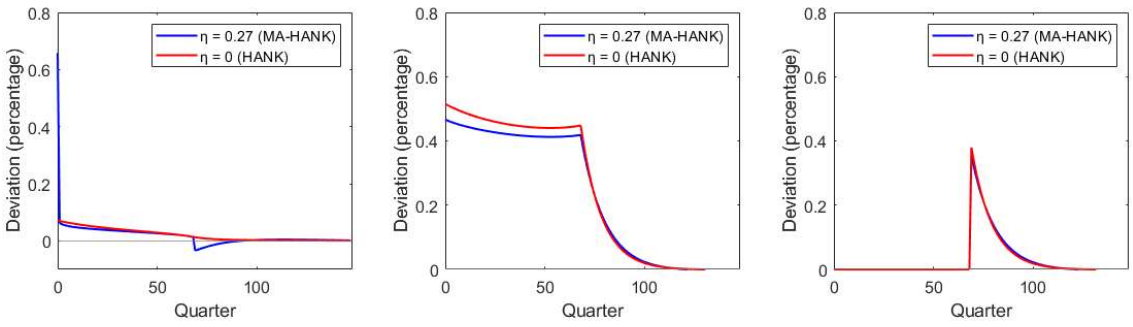
The mental accounting model generates the largest difference between the multiplier of the deficit-financed expansion and that of the balanced-budget expansion, showing that Ricardian Equivalence does not hold across monetary regimes. The intertemporal MPC indicates that households do not respond in anticipation to future income changes, hence consumption does not respond to the anticipated future tax hike in the deficit-financed case, but it does respond to the current tax hike in the balanced-budget case.

7. Can Deficits Finance Themselves? The Case of Fiscal Stimulus Transfers

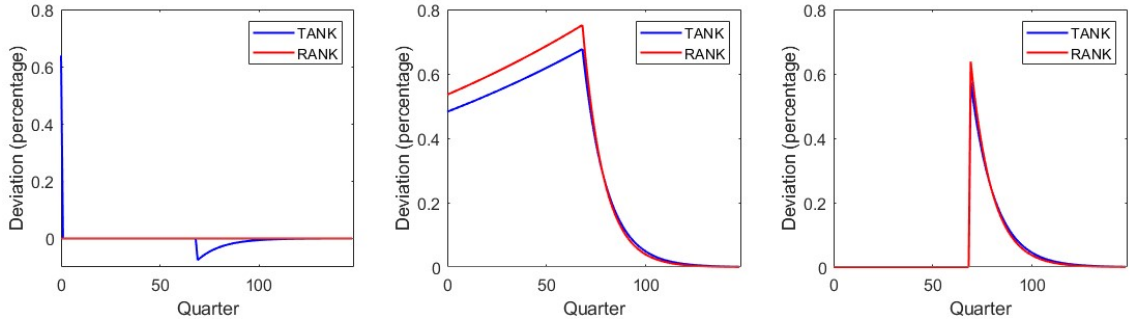
This section considers a deficit-financed $500 transfer distributed uniformly to households and evaluates whether the transfer-induced boom in aggregate demand generates a sufficient increase in the tax base (i.e. labor income) such that, without any further fiscal adjustment (i.e. keeping the tax rate constant), the resulting tax revenues are enough to pay back the initial increase in government debt.

For the exercise, the fiscal adjustment, i.e. the activation of the fiscal rule, is delayed for 70 quarters, as in Angeletos, Lian, and Wolf (2024). This way, if the economy has not been able to repay the debt by then, fiscal policy measures can reduce the debt to its steady state level and therefore keep it from exploding. For this exercise, the central bank keeps the real interest rate at its neutral, steady-state level, such that monetary policy does not dampen the expansionary effects of the transfer. Figure 7 plots the resulting dynamics of the relevant aggregate variables.

In RANK, the receipt of the transfer has no effect on consumption, and therefore, no effect on output, on labor demand, on the tax base and on tax revenues, neither contemporaneously nor in the periods after the shock. The only effect in the model is a fiscal imbalance that is registered in the first period by the rise in government debt. Because nothing else changes, the government debt rises monotonically due to the interest expenses on an increasing stock of debt, until the fiscal adjustment kicks in many periods later. When the taxes start adjusting, there is no effect on consumption or output either, only on the government budget constraint.



Panel A: Consumption. Panel B: Government debt. Panel C: tau.



Panel D: Consumption. Panel E: Government debt. Panel F: tau.

Figure 7. Deficit-financed transfer: IRFs of consumption, government debt, and tax rate: top row for MA-HANK and HANK; bottom row for TANK and RANK.

In TANK, the receipt of the transfer generates a contemporaneous effect on consumption proportional to its MPC out of income; however, it does not generate any lagged effects on consumption, consistent with the intertemporal MPC (Figure 1 Panel B). As a result, the only rise in output, labor demand, tax base, and tax revenues occurs in the first period; and the associated rise in government debt in the first period is smaller than in RANK. After the first period, the government debt rises monotonically on an upward path, until the tax rate starts adjusting many periods later.

The HANK model generates a small reaction to the transfer, because its MPC out of income is small; but it does generate lagged effects on consumption because of its intertemporal MPC properties. Hence, after the jump in government debt in the first period, the lagged effects on aggregate demand are large enough that the tax base, and as a result the tax revenues, keep rising and the government debt falls until period 50, approximately. After that period, however, the consumption lagged effects have a smaller impact on the tax base than the interest payments on government debt, which starts to rise from that point onwards. When the fiscal rule is activated, the fiscal adjustment is necessary to bring the debt back to its steady state level. However, the level of government debt in period 50 and even in period 70 is smaller than when the deficit-financed transfer was first distributed.

The MA-HANK displays a large consumption response at the receipt of the transfer, which generates a smaller jump in government debt than in HANK. After the shock, there are small lagged effects on consumption that increase the tax base and tax revenues until period 50, approximately. At this point, approximately 10% of the initial increase in government debt has been repaid. After that, the tax revenues are outpaced by the interest payments on government debt, which starts to rise until the fiscal adjustment kicks in. In this model, only around 20% of the deficit can finance itself.

8. Conclusion

This paper studies the implications of mental accounting friction for the transmission of different monetary and fiscal policies to consumption.

Relative to a standard incomplete markets environment where the irrelevance result (Werning, 2015) holds approximately, mental accounting constitutes a departure from that benchmark that generates hand-to-mouth behavior. In particular, it reduces the importance of intertemporal substitution channels triggered by interest rate changes, and it increases the relative weight of income channels – effects that become especially evident after a government spending shock. While these aggregate effects are broadly consistent with the effect of illiquid assets (Kaplan, Moll, and Violante, 2018), mental accounting can deliver them while retaining model parsimony. In addition, mental accounting can explain facts concerning the impact of macroeconomic policies across the household distribution. Finally, mental accounting implies that fiscal deficits can, for the most part, not finance themselves.

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Monetary and Fiscal Policy in a Mental Accounting HANK

Online Appendix

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Contents

A **Recursive Problem of the Household with Incomplete Markets**……..…….2

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A Recursive Problem of the Household with Incomplete Markets

This section presents the recursive formulation of the household problem in the 1-asset and 2-asset environments, respectively.

A.1 Recursive Problem of Incomplete Markets Model

The recursive problem is:

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

subject to

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

and

$$b' \geq 0\ ,$$

where $V(a, y_m)$ denotes the value function for the household in the current period; y', b', y'_m, and b'_m are next-period variables; after-tax income and mental account balances are computed following the classification rules in Section 2; and the rest of the notation is as in the main text. The expectations operator E is taken over the different possible realizations of the stochastic earnings process, using the conditional probabilities $\Pr(z'|z)$.

The First-Order Condition (FOC) and Envelope Condition (EC) are:

$$\frac{\partial}{\partial c}U(c|r) = \mu + \beta E\left[\frac{\partial}{\partial b}V(y'_m, b'_m)\right] \qquad \forall\, c \neq y_m\ , \quad \nexists \frac{\partial}{\partial c}U(y_m|r)$$

$$\frac{\partial}{\partial b}V(y_m, b_m) = (1 + R^b)\frac{\partial}{\partial c}U(c|r) \qquad \forall\, c \neq y_m\ , \quad \nexists \frac{\partial}{\partial c}U(y_m|r),$$

where the marginal utility does not exist at the non-differentiability point ($c = y_m$).

The law of motion for the distribution is:

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

and aggregate consumption and wealth are computed as:

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

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

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

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

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

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 the interest rate is 0% and that the income is the same in both periods $e_1 = e_2$, and that 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 $\frac{(1-\eta\lambda)}{(1-\eta)} < 1$.

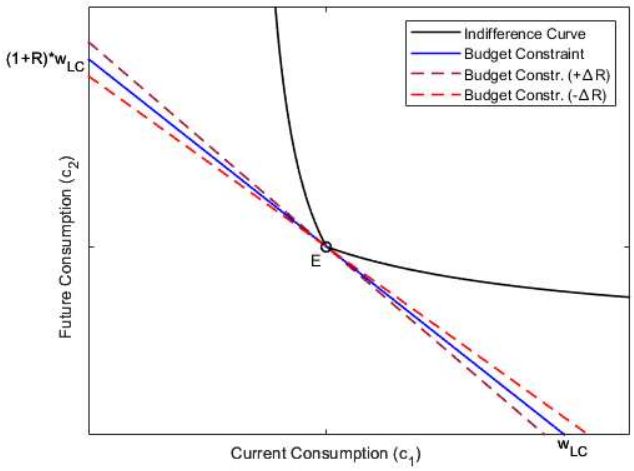


Figure B.1. Two-period model: optimal choice and sensitivity to the real interest rate of a hand-to-mouth consumer.

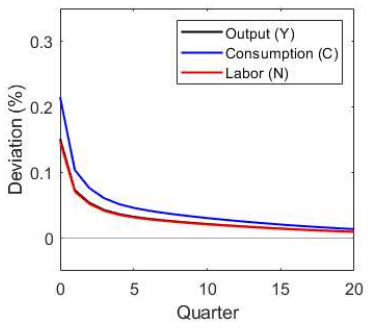
Intuitively, point E is the optimal choice when the slope of the budget constraint is between the two marginal rates of substitution. On one hand, the marginal utility of increasing c_1 above e_1 at the cost of reducing c_2 below e_2 is lower than the cost of the extra borrowing (1+R). On the other hand, 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.

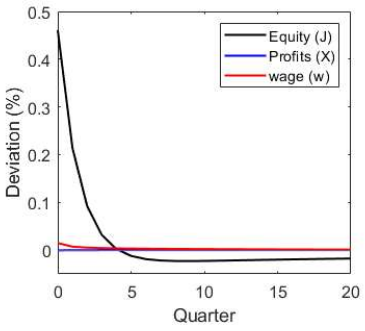
Finally, note that when the mental accounting friction vanishes ($\eta = 0$), the two MRSs collapse into one and the household faces the same trade-offs as in the standard model.

C Additional Figures

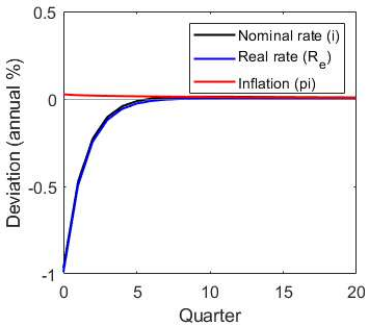
C.1 Monetary Policy Shock: Aggregate Impulse Response Functions



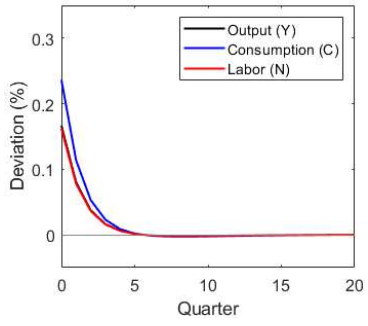
Panel A: Y, C, N.



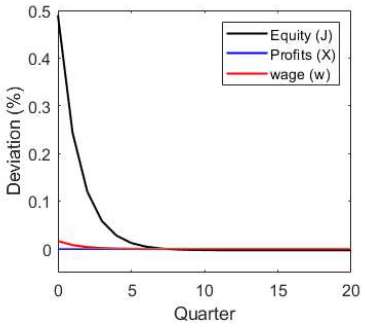
Panel B: J, X, wage.



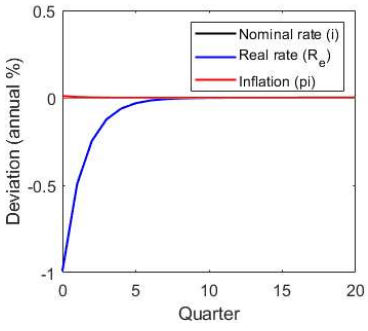
Panel C: i, R^e, pi.



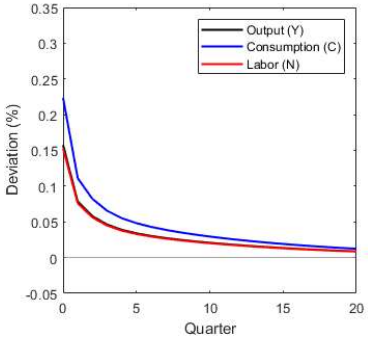
Panel D: Y, C, N.



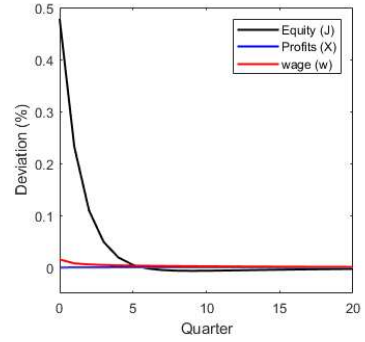
Panel E: J, X, wage.



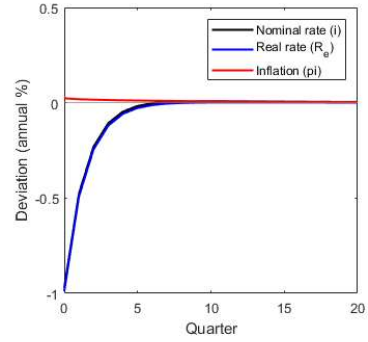
Panel F: i, R^e, pi.



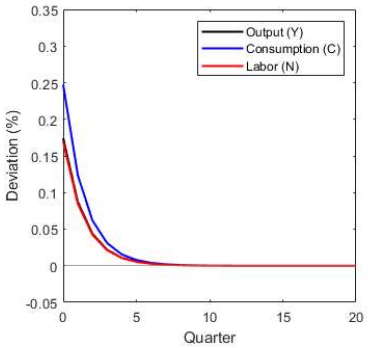
Panel G: Y, C, N.



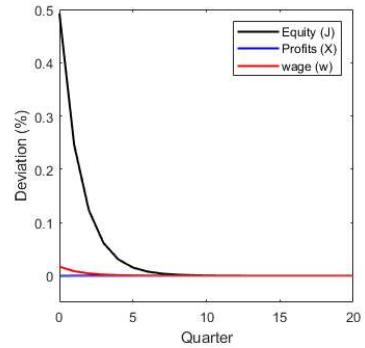
Panel H: J, X, wage.



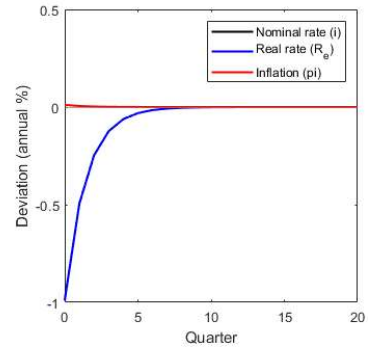
Panel I: i, R^e, pi.



Panel J: Y, C, N.



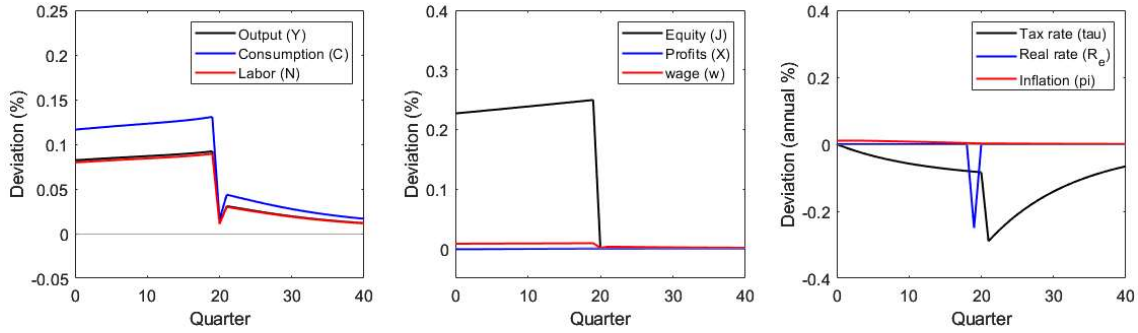
Panel K: J, X, wage.



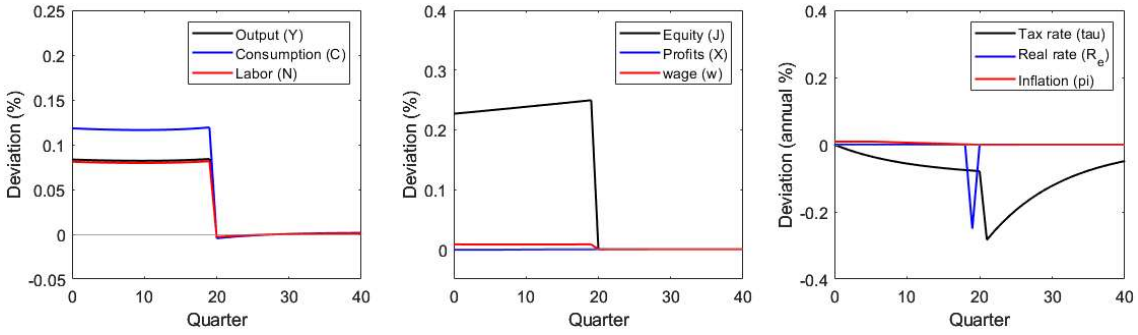
Panel L: i, R^e, pi.

Figure C.1. Monetary IRFs in MA-HANK (Panels A-C), HANK (D-F), TANK (G-I), RANK (J-L).

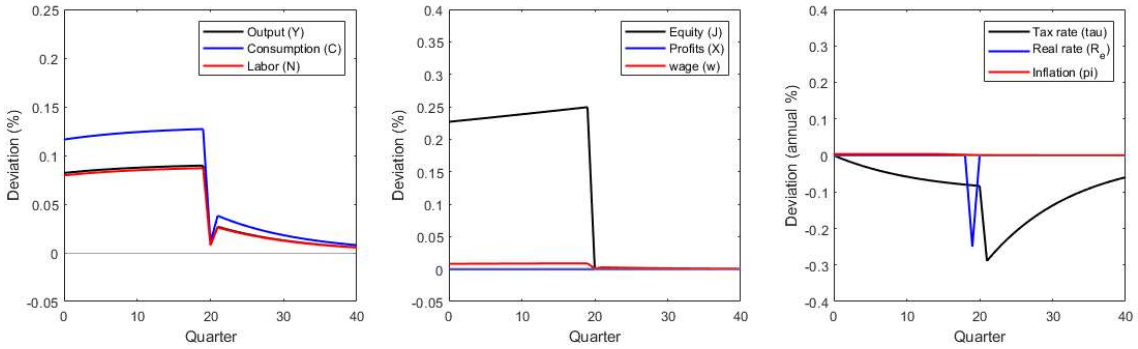
C.2 Forward Guidance Shock: Aggregate Impulse Response Functions



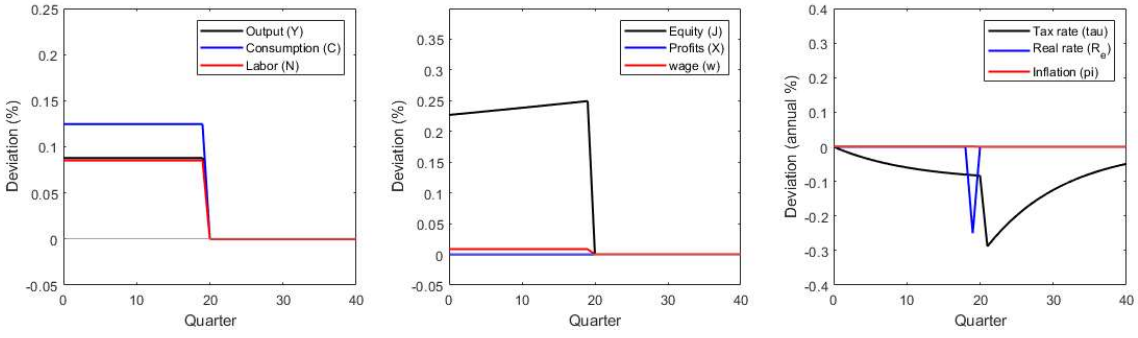
Panel A: Y, C, N. Panel B: J, X, wage. Panel C: tau, R^e, pi.



Panel D: Y, C, N. Panel E: J, X, wage. Panel F: tau, R^e, pi.



Panel G: Y, C, N. Panel H: J, X, wage. Panel I: tau, R^e, pi.

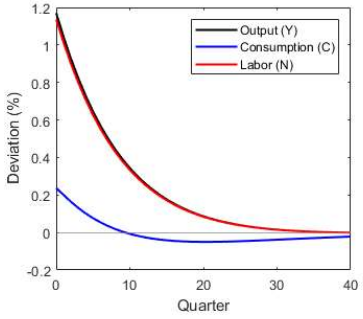


Panel J: Y, C, N. Panel K: J, X, wage. Panel L: tau, R^e, pi.

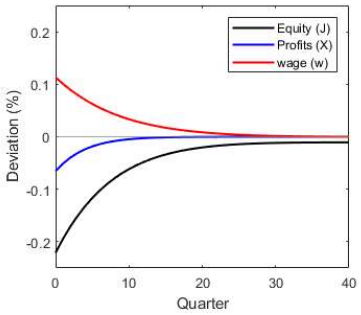
Figure C.2. Forward Guidance IRFs in MA-HANK (Panels A-C), HANK (D-F), TANK (G-I), and RANK (J-L).

C.3 Government Spending Shock: Aggregate Impulse Response Functions

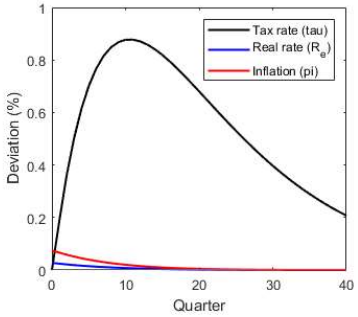
C.3.1 Deficit-Financed Expansion, Tax Rule, Active Monetary Policy



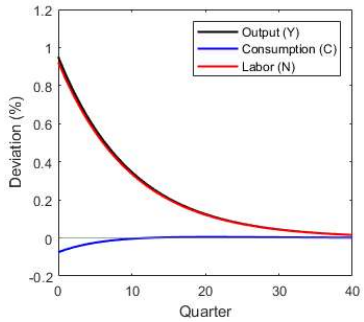
Panel A: Y, C, N.



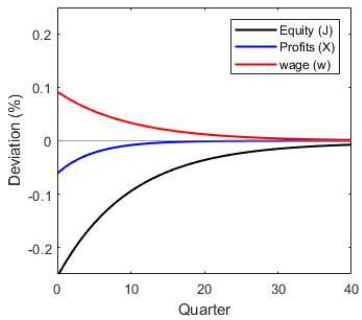
Panel B: J, X, wage.



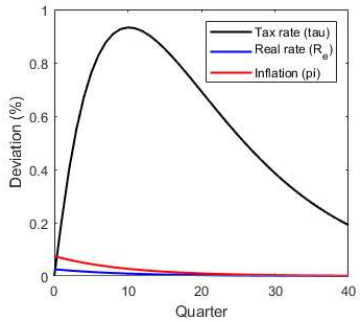
Panel C: tau, R^e, pi.



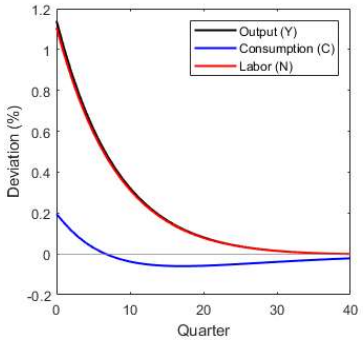
Panel D: Y, C, N.



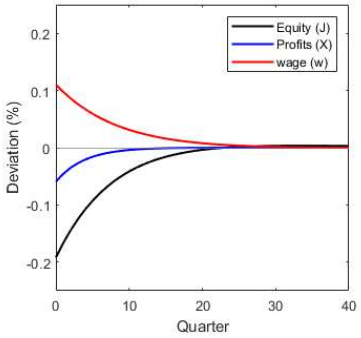
Panel E: J, X, wage.



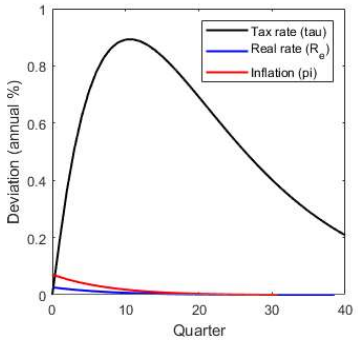
Panel F: tau, R^e, pi.



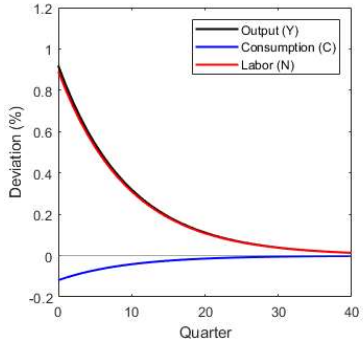
Panel G: Y, C, N.



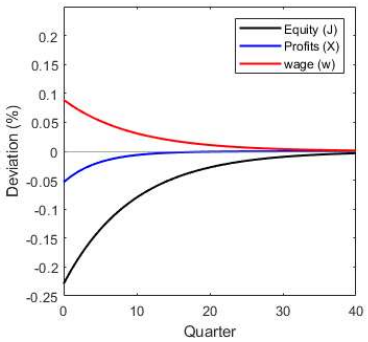
Panel H: J, X, wage.



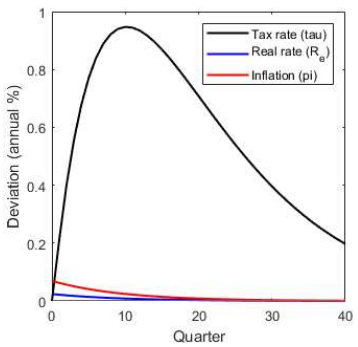
Panel I: tau, R^e, pi.



Panel J: Y, C, N.



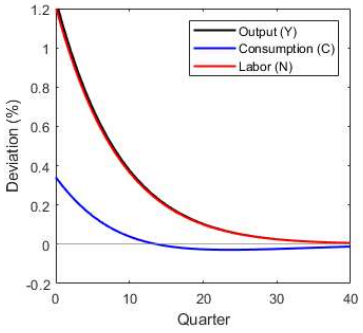
Panel K: J, X, wage.



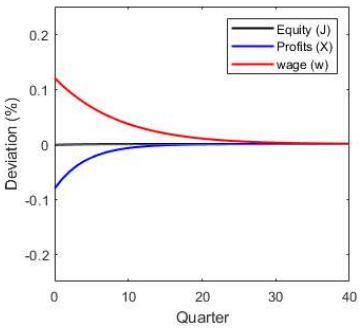
Panel L: tau, R^e, pi.

Figure C.3.1. Fiscal IRFs in MA-HANK (Panels A-C), HANK (D-F), TANK (G-I), and RANK (J-L).

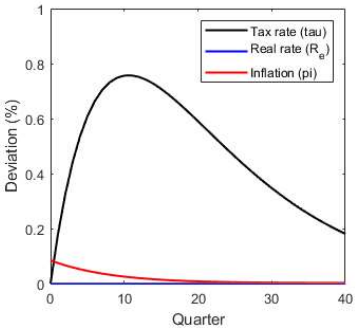
C.3.2 Deficit-Financed Expansion, Tax Rule, Passive Monetary Policy



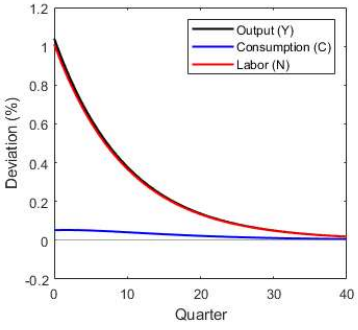
Panel A: Y, C, N.



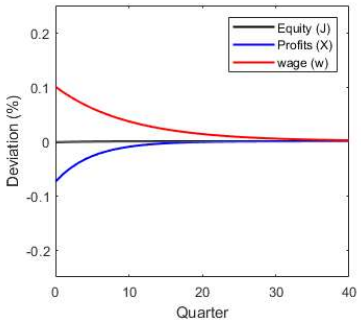
Panel B: J, X, wage.



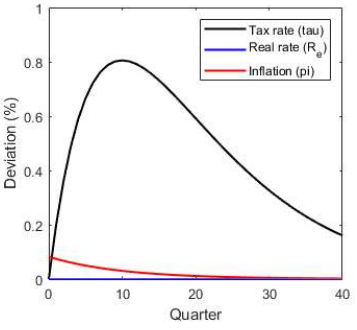
Panel C: tau, R^e, pi.



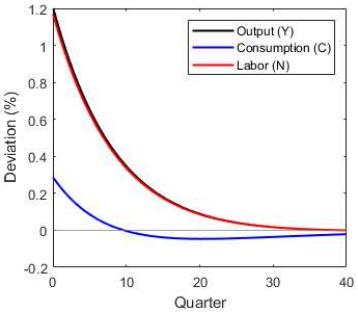
Panel D: Y, C, N.



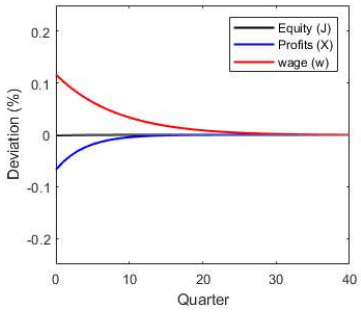
Panel E: J, X, wage.



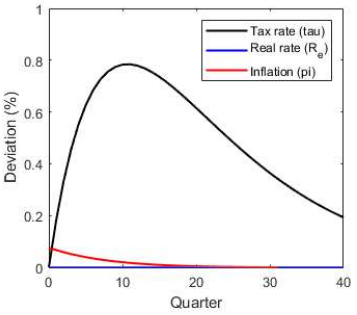
Panel F: tau, R^e, pi.



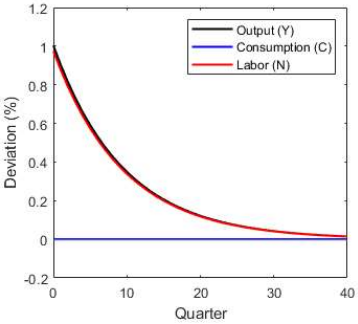
Panel G: Y, C, N.



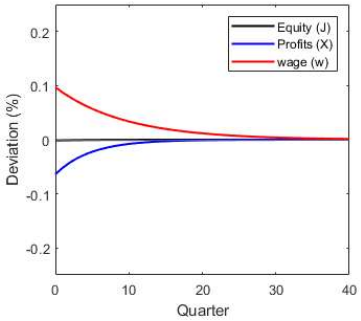
Panel H: J, X, wage.



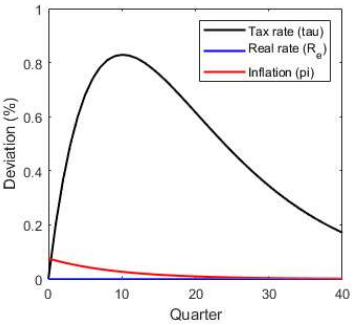
Panel I: tau, R^e, pi.



Panel J: Y, C, N.



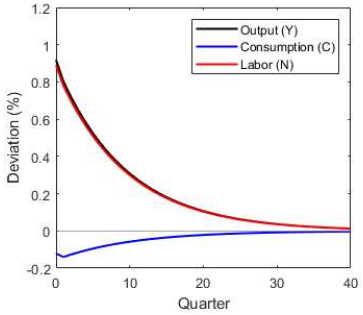
Panel K: J, X, wage.



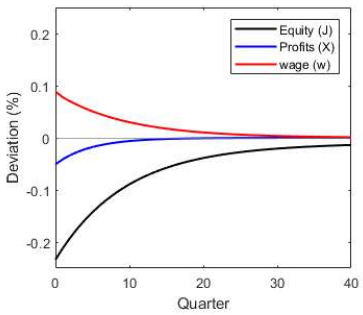
Panel L: tau, R^e, pi.

Figure C.3.2. Fiscal IRFs in MA-HANK (Panels A-C), HANK (D-F), TANK (G-I), and RANK (J-L).

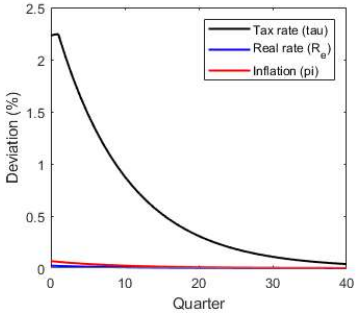
C.3.3 Balanced-Budget Expansion, Active Monetary Policy



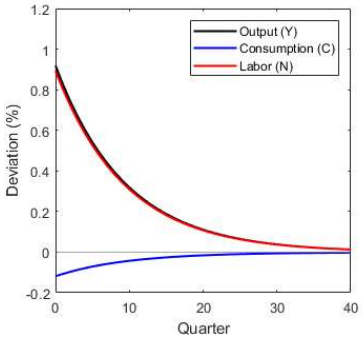
Panel A: Y, C, N.



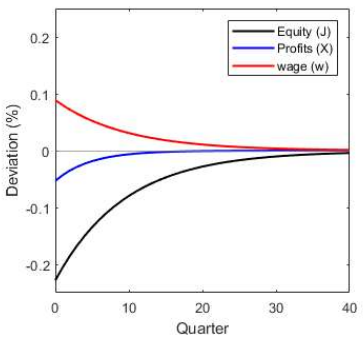
Panel B: J, X, wage.



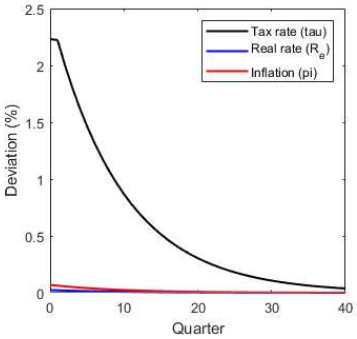
Panel C: tau, R^e, pi.



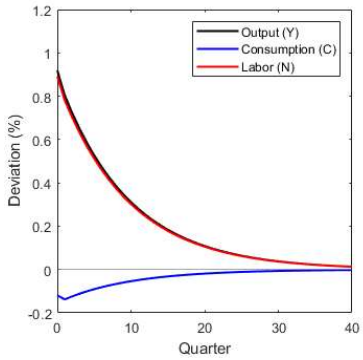
Panel D: Y, C, N.



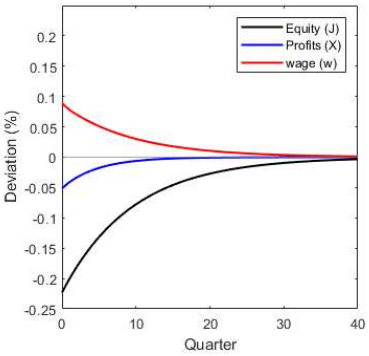
Panel E: J, X, wage.



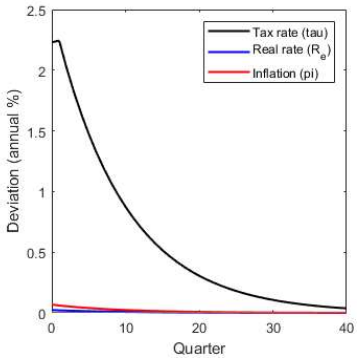
Panel F: tau, R^e, pi.



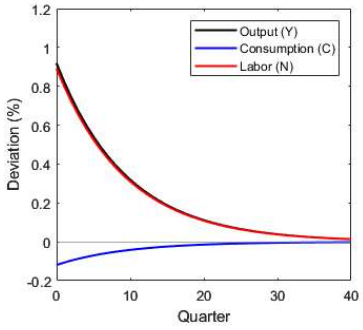
Panel G: Y, C, N.



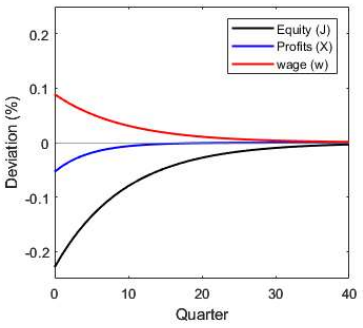
Panel H: J, X, wage.



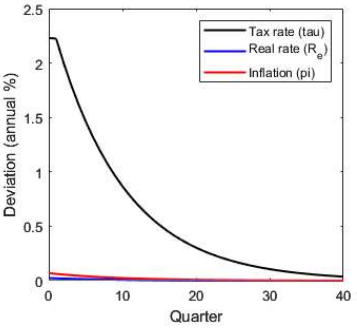
Panel I: tau, R^e, pi.



Panel J: Y, C, N.



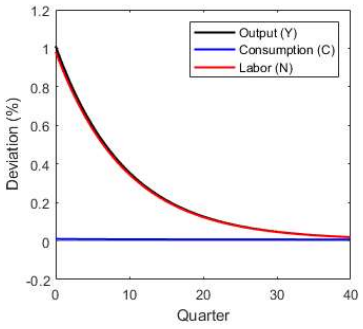
Panel K: J, X, wage.



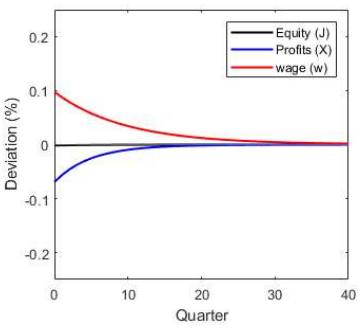
Panel L: tau, R^e, pi.

Figure C.3.3. Fiscal IRFs in MA-HANK (Panels A-C), HANK (D-F), TANK (G-I), and RANK (J-L).

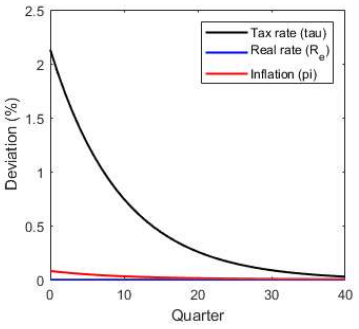
C.3.4 Balanced-Budget Expansion, Passive Monetary Policy



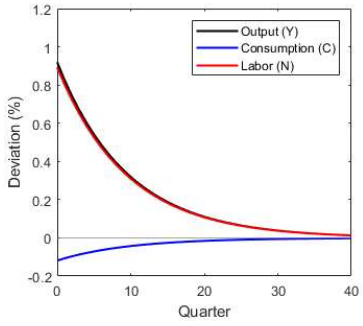
Panel A: Y, C, N.



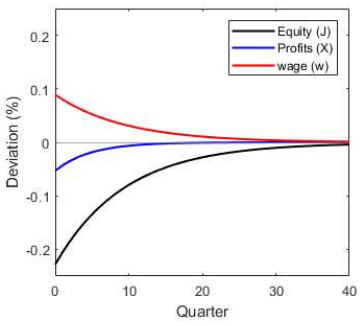
Panel B: J, X, wage.



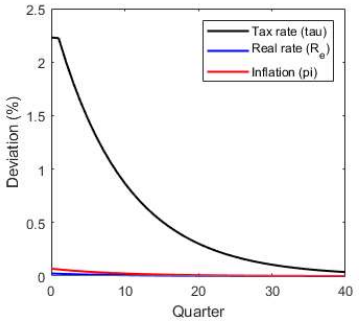
Panel C: tau, R^e, pi.



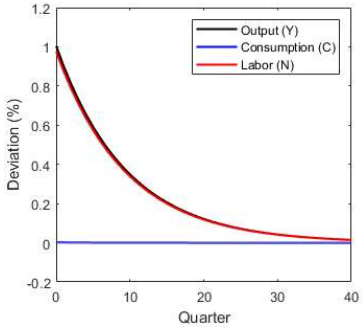
Panel D: Y, C, N.



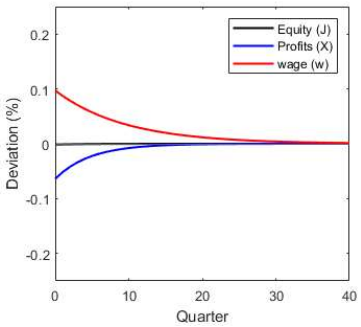
Panel E: J, X, wage.



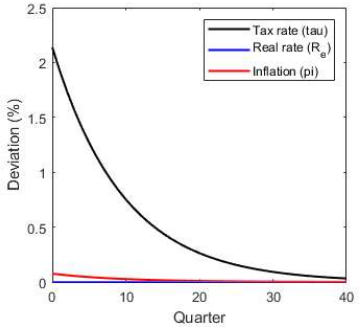
Panel F: tau, R^e, pi.



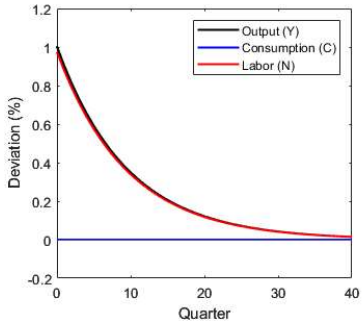
Panel G: Y, C, N.



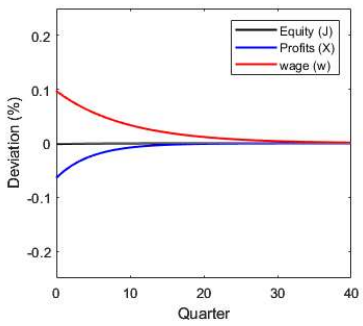
Panel H: J, X, wage.



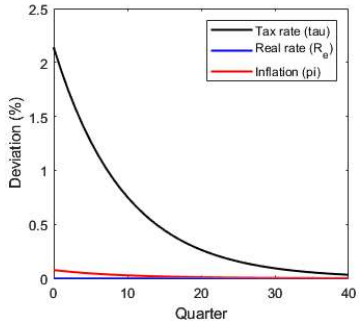
Panel I: tau, R^e, pi.



Panel J: Y, C, N.



Panel K: J, X, wage.



Panel L: tau, R^e, pi.

Figure C.3.4. Fiscal IRFs in MA-HANK (Panels A-C), HANK (D-F), TANK (G-I), and RANK (J-L).