Consumer Durables in T(H)ANK Economies

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Abstract

Introducing consumer durables into an analytically tractable New Keynesian model with limited asset market participation overturns key properties of this class of frameworks. By acting as a store of value, durables enable hand-to-mouth households to self-insure, bringing aggregate responses to monetary and fiscal shocks close to those in a two-sector representative-agent model. This mechanism has several implications: (i) it relaxes the conditions under which the *inverted* Taylor principle binds, even under major financial exclusion; (ii) it reduces the aggregate impact of profit redistribution on monetary transmission; and (iii) it dampens precautionary behavior in settings with idiosyncratic uncertainty.

Keywords: Durable goods, heterogeneous agents, monetary policy, fiscal spending, profit redistribution.

JEL codes: E21, E31, E40, E44, E52.

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1 Introduction

Incorporating household heterogeneity in income and wealth has become central to both positive and normative analysis in modern macroeconomics. Models combining idiosyncratic income risk, incomplete markets, and nominal rigidities are now standard. However, the complexity of these Heterogeneous-Agent New Keynesian (HANK) frameworks often makes it difficult to disentangle the two-way feedback between household heterogeneity and aggregate dynamics. To address this, recent research has revived interest in Two-Agent (TA) models—where Ricardian households coexist with Hand-to-Mouth (HtM) agents lacking access to liquid assets (see, e.g., Campbell and Mankiw, 1989; Mankiw and Zeldes, 1991; Galí et al., 2007; Bilbiie, 2008). These Tractable HANK (THANK) models introduce stylized idiosyncratic risk while preserving analytical tractability, serving as conceptual bridges between simple TANK and fully-fledged computational HANK frameworks.[1]

Yet, THANK models overlook a central channel through which heterogeneity interacts with macroeconomic shocks—durable consumption. In fact, a substantial share of the volatility in household and aggregate expenditures arises from durable spending (Attanasio, 1999; Stock and Watson, 1999). Durables are far more sensitive to interest rate fluctuations (Mankiw, 1985), and fiscal stimulus often transmits via durable spending (see, e.g., Orchard et al., 2025). While some quantitative HANK models incorporate durables (e.g., McKay and Wieland, 2021, 2022), this dimension remains unexplored in the THANK literature.

We show that incorporating consumer durables fundamentally alters the core properties of standard one-sector THANK frameworks. Durables act as a tradable store of value, allowing financially constrained households to self-insure against idiosyncratic risk.[2] This weakens the tight link between consumption and current income that characterizes the HtM channel, enabling some degree of consumption smoothing. Consequently, the inclusion of durables significantly attenuates the amplification typically driven by asset market incompleteness and narrows the gap in aggregate responses between THANK and RANK models following both monetary and fiscal shocks. These results challenge the prevailing view that household heterogeneity inherently amplifies macroeconomic fluctuations, and highlight the importance for macroeconomic analysis of accounting for durable expenditure.

We provide analytical support to our numerical analysis using a tractable model with perpetual durables. In this limit case, durables exhibit infinite intertemporal elasticity of substitution, and their shadow value remains quasi-constant in response to temporary shocks

[1] A (non-exhaustive) list of related papers includes Bilbiie (2020); Acharya and Dogra (2020); Challe (2020); Bilbiie (2024); Ravn and Sterk (2021); Bilbiie et al. (2023); Broer et al. (2023); Debortoli and Galí (2024).

[2] Durables are goods that can be stored and traded in second-hand markets. Under this assumption, even agents without access to financial assets may transfer resources across periods—albeit to a limited extent.

(Barsky et al., 2007). As a result, the shadow value of income for any household deriving utility from durables closely tracks the relative price of durables to nondurables. This generates an endogenous *risk-sharing* condition between HtM households and savers: their nondurable consumption expenditures move jointly, leading to aggregate dynamics in two-sector TANK models that are nearly indistinguishable from those in RANK economies.

Our analysis yields several important implications. When durables are present, real interest rates retain their disciplining role over intertemporal demand—even in the presence of liquidity-constrained households. This challenges a standard result from TANK models with limited asset market participation (LAMP), where restricted access to liquid assets can generate an "inverted" IS curve, undermining equilibrium determinacy under standard Taylor rules (Bilbiie, 2008). With durables, instead, determinacy holds across a much broader set of policy parameters, and the conventional Taylor principle remains sufficient even at high "financial exclusion".

Moreover, when durables are introduced, profit redistribution becomes largely neutral with respect to aggregate outcomes. Constrained households can partially self-insure by saving through durables, which insulates their nondurable consumption from income fluctuations. Consequently, redistribution affects the allocation of spending across households but has little impact on its aggregate level. This stands in sharp contrast to standard findings in one-sector TANK models, where shifting firm profits from savers to HtM households dampens the effects of monetary shocks by mitigating the externalities created by liquidity constraints through the HtM channel (Bilbiie, 2020).

We extend our analysis along several dimensions. First, we show that our main insight—durables attenuate TANK amplification relative to RANK—holds not only under deterministic segmentation but also in a two-state THANK model, where households stochastically transition between constrained and unconstrained financial states. Even with precautionary motives, durables allow liquidity-constrained agents to smooth consumption across states. As a result, compounding (discounting) in the aggregate Euler equation (Bilbiie, 2020) has limited influence on the amplification (dampening) of anticipated monetary shocks.

Finally, we develop a richer three-state model in which some households face illiquidity in adjusting both financial and durable assets. In this setting, profit redistribution from savers to HtM households with illiquid durables is no longer neutral: it *amplifies* the output response to monetary shocks—opposite to the dampening effect found in one-sector models focused solely on nondurables (Bilbiie, 2020). Introducing nominal wage rigidity makes sectoral profits procyclical, which can dampen the amplification effect associated with profit redistribution.

These findings have important implications for the broader HANK literature. Much of what we know about amplification and policy transmission in T(H)ANK frameworks hinges on the implicit assumption that all consumption is nondurable. This paper shows that introducing a durable goods sector—where constrained households can self-insure by accumulating durables—can significantly weaken or even reverse many of the core mechanisms emphasized in saver–spender models. As a result, key conclusions about the role of household heterogeneity in shaping macroeconomic dynamics may not hold in more realistic two-sector environments. Capturing the full impact of heterogeneity in such settings likely requires richer HANK structures that incorporate deeper forms of idiosyncratic risk, frictions in asset markets, and micro-level adjustment constraints, as explored in McKay and Wieland (2021, 2022) and Holst Partsch et al. (2025).

Related literature This work relates to a broad literature employing saver-spender models to investigate the transmission of monetary policy (see Campbell and Mankiw, 1989; Mankiw and Zeldes, 1991) and fiscal policy (see Galí et al., 2007). Inspired by this tradition, Bilbiie (2008) devises a one-sector TANK model where profits and their redistribution through fiscal policy take center stage. While building up on this, our settings represent non-trivial two-sector extensions, where the propagation of monetary and fiscal policy may change profoundly. In this respect, we relate to Barsky et al. (2007) and other contributions that employ RANK models with durables to study the transmission of monetary policy (e.g., Erceg and Levin, 2006; Monacelli, 2009; Tsai, 2016; Petrella et al., 2019), by documenting how profit redistribution and other structural features of consumer spending can interact in non-trivial ways to affect shock transmission in RA economies.

On the THANK front, Bilbiie (2020, 2024) emphasizes the role of cyclical inequality, while others study cyclical income risk (see, e.g., Werning, 2015; Acharya and Dogra, 2020; Challe, 2020; Ravn and Sterk, 2021). However, both strands of the literature abstract from consumer durables. We highlight that durables attenuate amplification by enabling partial risk sharing—thereby weakening the aggregate role of HtM behavior. This is consistent with Bilbiie et al. (2023), who in their one-sector model show that business cycle fluctuations become markedly less pronounced when heterogeneity is removed by equating the marginal utilities of HtM and saver households, as under complete markets. On the computational HANK front, our work connects with McKay and Wieland (2022), who highlight how durables mitigate the forward guidance puzzle. Finally, in a companion paper we develop a quantitative two-sector HANK model combining financial frictions and idiosyncratic income risk (Holst Partsch et al., 2025) and show that durables significantly amplify the direct interest-rate transmission channel relative to one-sector frameworks. Adding further micro-level frictions affects—but does not eliminate—the risk-sharing channel arising from the use of durables as a store of value for agents with limited financial access.

Finally, we relate to a body of work examining how households adjust the durable/ non-durable consumption mix in response to transitory income shocks. In this respect, Parker (1999) suggests that constrained households cut back more on goods with high intertemporal substitutability, as the utility cost of fluctuations in these goods is lower than for those less substitutable over time. Browning and Crossley (2000) formally show that this "accelerator" effect is equivalent to the luxury-good adjustment in Hamermesh (1982).[3] Fernández-Villaverde and Krueger (2011) report that consumer durables represent a considerable share of wealth among young US households and argue that durables are bought not only for their service flow but also for self-insurance against idiosyncratic income shocks in life-cycle settings. While our main focus is on aggregate policy transmission, our model highlights a similar mechanism: durables function as an "inefficient" saving device that absorbs adjustment, due to their quasi-constant shadow value and near-infinite intertemporal substitutability. Also Cerletti and Pijoan-Mas (2012) and Asdrubali et al. (2020) stress durable purchases as a means of (dis-)saving, while Attanasio et al. (2022) provide evidence on car expenditure during the Great Recession.[4]

Structure The remainder of the paper is organized as follows. Section 2 outlines the baseline structure of our modular economies. Section 3 compares one- and two-sector TANK and RANK models, showing how the introduction of durables attenuates differences between HtM and Ricardian agents. Section 4 discusses broader implications of this result. Section 5 extends the TANK framework in two directions: first, by developing a two-state THANK model with stochastic transition between liquidity-constrained and unconstrained states; second, by introducing a three-state THANK model where we examine the implications of durables' illiquidity on a subset of households. Section 6 concludes.

2 Durables in a TANK economy

The baseline TANK model is a standard cashless dynamic general equilibrium economy augmented with LAMP. In line with Galí et al. (2007) and Bilbiie (2008, 2020, 2024), we assume that a fraction of the households are excluded from asset markets, while others trade in complete markets for state-contingent securities (including a market for shares in firms).

[3] Browning and Crossley (2009) complement this accelerator effect with irreversibility in durable purchases.

[4] Attanasio et al. (2022) emphasize the importance of the extensive margin—a channel absent from our setup (see also McKay and Wieland, 2021, on this point)—and how it complements the intensive margin in driving demand fluctuations during downturns.

The main point of departure from conventional LAMP economies lies in differentiating consumption goods into nondurables and durables.

There is a continuum of households and two sectors of production, each of them populated by a single perfectly competitive final-good producer, and a continuum of monopolistically competitive intermediate-goods producers setting prices on a staggered basis.[5] There is also a government, who pursues an endogenous redistributive policy through dividend taxation, buys an exogenous amount of nondurable goods by taxing both types of households, and conducts monetary policy by implementing a Taylor-type rule. A continuum of households is envisaged over the support $[0, 1]$, all with the same functional form for consumer utility. At each point in time, λ_S denotes the share of households who can trade in all markets for state-contingent securities. We will interchangeably refer to these as assetholders or savers. Conversely, $\lambda_H = 1 - \lambda_S$ denotes the share of HtM—or, equivalently, liquidity-constrained—households.

2.1 Households

Each saver chooses consumption, asset holdings, and leisure, solving a standard intertemporal problem featuring an additively separable CRRA time utility:

$$\max_{C_{S,t},B_{S,t},X_{S,t},N_{S,t}} E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left(\frac{C_{S,t}^{1-\sigma}}{1-\sigma} + \eta \frac{X_{S,t}^{1-\chi}}{1-\chi} - \varpi \frac{N_{S,t}^{1+\phi}}{1+\phi} \right) \right\}$$

s.t.

$$B_{S,t} + \Omega_{S,t} V_t \leqslant (1 + r_{t-1}) B_{S,t-1} + \Omega_{S,t-1} (V_t + P_{C,t} D_t) + W_t N_{S,t} - P_{C,t} C_{S,t} - P_{X,t} I_{S,t}^X - \Upsilon_{S,t},$$

where $\beta \in (0, 1)$ is the discount factor, $\eta > 0$ and $\varpi > 0$ indicate how durable consumption and leisure are valued relative to nondurable consumption, $\phi > 0$ is the inverse of the labor supply elasticity, while $\sigma \geq 1$ and $\chi \geq 1$ index the curvature of the utility in nondurables and durables, respectively. $C_{S,t}$, $X_{S,t}$, $N_{S,t}$ are nondurable consumption, the stock of durables and hours worked (the time endowment is normalized to unity), while $I_{S,t}^X = X_{S,t} - (1 - \delta) X_{S,t-1}$ accounts for durables' accumulation. $P_{C,t}$ (taken as the numeraire) and $P_{X,t}$ are the nominal prices of nondurable and durable goods, respectively. There are two financial assets: a riskless bond paying a nominal return r_t (> 0), denoted by $B_{S,t}$, and shares in monopolistically competitive firms, denoted by $\Omega_{S,t}$. V_t is the average market value at time t of the shares in the intermediate-goods firms, while $D_t = D_{C,t} + D_{X,t}^C$ are total dividend payoffs aggregated

[5] We assume perfect labor mobility and abstract from the implications of labor reallocation across sectors.

over the two sectors in terms of nondurable prices, with $D_{C,t}$ denoting profits from the non-durable goods sector and $D^{C}_{X,t}$ indicating profits from the durable goods sector (deflated by $P_{C,t}$). Finally, $\Upsilon_{S,t}$ denotes lump-sum taxes.

Maximizing utility subject to this constraint gives the bond, the stock, and durables' Euler equations, as well as savers' labor supply schedule, respectively:

$$1 = \beta E_t \left\{ \frac{C^{-\sigma}_{S,t+1}}{C^{-\sigma}_{S,t}} \frac{1 + r_t}{1 + \pi_{C,t+1}} \right\}, \tag{1}$$

$$\frac{V_t}{P_{C,t}} = \beta E_t \left\{ \frac{C^{-\sigma}_{S,t+1}}{C^{-\sigma}_{S,t}} \left(\frac{V_{t+1}}{P_{C,t+1}} + D_{t+1} \right) \right\}, \tag{2}$$

$$Q_t C^{-\sigma}_{S,t} = \eta X^{-\chi}_{S,t} + \beta(1-\delta) E_t \left\{ Q_{t+1} C^{-\sigma}_{S,t+1} \right\}, \tag{3}$$

$$\varpi N^{\phi}_{S,t} = C^{-\sigma}_{S,t} \frac{W_t}{P_{C,t}}, \tag{4}$$

where $Q_t \equiv P_{X,t}/P_{C,t}$, and $1 + \pi_{C,t+1} \equiv \frac{P_{C,t+1}}{P_{C,t}}$.

The remaining households hold no financial assets and solve

$$\max_{C_{H,t}, X_{H,t}, N_{H,t}} E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left(\frac{C^{1-\sigma}_{H,t}}{1-\sigma} + \eta \frac{X^{1-\chi}_{H,t}}{1-\chi} - \varpi \frac{N^{1+\phi}_{H,t}}{1+\phi} \right) \right\}$$

s.t.

$$C_{H,t} + Q_t I^{X}_{H,t} = \frac{W_t}{P_{C,t}} N_{H,t} + T_{H,t} - \Upsilon_{H,t},$$

where $I^{X}_{H,t} = X_{H,t} - (1-\delta) X_{H,t-1}$, while $T_{H,t}$ and $\Upsilon_{H,t}$ respectively denote fiscal transfers and lump-sum taxes. The first-order conditions are

$$Q_t C^{-\sigma}_{H,t} = \eta X^{-\chi}_{H,t} + \beta(1-\delta) E_t \left\{ Q_{t+1} C^{-\sigma}_{H,t+1} \right\}, \tag{5}$$

$$\varpi N^{\phi}_{H,t} = C^{-\sigma}_{H,t} \frac{W_t}{P_{C,t}}. \tag{6}$$

2.2 Firms

In each sector $j = \{C, X\}$, the final good is produced by a representative firm using a CES production function (with elasticity of substitution ε^{j}) to aggregate a continuum of intermediate goods indexed by i : $Y_{j,t} = \left(\int_0^1 Y_{j,t}(i)^{(\varepsilon_j - 1)/\varepsilon_j} di \right)^{\varepsilon_j/(\varepsilon_j - 1)}$. The final-good producer behaves as a price taker, maximizing profits $P_{j,t}Y_{j,t} - \int_0^1 P_{j,t}(i)Y_{j,t}(i)di$ each period: for the j^{th} sector, $P_{j,t}$ is the overall price index of the final good and $P_{j,t}(i)$ is the price of intermediate good i. For $j = \{C, X\}$, the demand for each intermediate input is $Y_{j,t}(i) = (P_{j,t}(i)/P_{j,t})^{-\varepsilon_j} Y_{j,t}$ and the price index is $P_{j,t}^{1-\varepsilon_j} = \int_0^1 P_{j,t}(i)^{1-\varepsilon_j} di$. Each intermediate good is produced by a monopolistically competitive firm indexed by i, using a linear technology, $Y_{j,t}(i) = N_{j,t}(i)$, while bearing a nominal marginal cost that is common across sectors, W_t. The profit function in real terms is thus given by: $D_{j,t}(i) = \left(1 + \tau_j^S\right) [P_{j,t}(i)/P_{j,t}] Y_{j,t}(i) - (W_t/P_{j,t}) N_{j,t}(i) - T_{j,t}^F$, where $1 + \tau_j^S$ is a production subsidy, while $T_{j,t}^F$ stands for a lump-sum profit tax. We assume the subsidy is set to eliminate the markup distortion in the steady state: the pricing condition under flexible prices, $P_{j,t}^*(i)/P_{j,t} = 1 = \varepsilon_j \left(W_{j,t}^*/P_{j,t}\right) \left[\left(1 + \tau_j^S\right)(\varepsilon_j - 1)\right]^{-1}$, allows us to pin down this value at $\tau_j^S = (\varepsilon_j - 1)^{-1}$. Financing the total cost of this subsidy by the profit tax ($T_{j,t}^F = \tau_j^S Y_{j,t}$) leads to aggregate sectoral profits $D_{j,t} = Y_{j,t} - (W_t/P_{j,t}) N_{j,t}$, which are zero in the steady state, thus allowing for full insurance in both nondurable and durable consumption—i.e. $C_S = C_H = C$ and $X_S = X_H = X$—and implying $Q = 1$. Our core analysis will be conducted in economies that are log-linearized around this undistorted steady state. Log-linear variables will generally be denoted by the lower-case counterparts of level variables. As for dividends, we define $d_{j,t} \equiv \ln(D_{j,t}/Y_j)$, which implies $d_{j,t} = -(w_t - p_{j,t})$.[6] Moreover, in the remainder of the analysis ω_t will denote the real wage expressed in units of nondurables, i.e. $\omega_t \equiv w_t - p_{C,t}$.

Next, we allow for price setting in the vein of Calvo (1983) and Yun (1996). Intermediate-good firms in each sector $j = \{C, X\}$ adjust their prices infrequently, with θ_j being both the history-independent probability of keeping the price constant and the fraction of firms that keep their prices unchanged. Assetholders (who, in equilibrium, will hold all the shares) maximize the value of the firm, i.e. the discounted sum of future nominal profits, choosing the price $P_{j,t}(i)$ and using $\Lambda_{t,t+i}$, the relevant stochastic discount factor (pricing kernel) for nominal payoffs: $\max E_t \sum_{s=0}^{\infty} \left(\theta^s \Lambda_{t,t+s} \left[\left(1 + \tau_j^S\right) P_{j,t}(i) Y_{j,t,t+s}(i) - MC_{t+i} \;\; Y_{j,t,t+s}(i) - T_{j,t+s}^F\right]\right.$, subject to the demand equation, and where $\Lambda_{t,t+1}$ is S's the marginal rate of intertemporal substitution between time t and $t+1$. In equilibrium, each producer that chooses a new price $P_{j,t}(i)$ in period t will choose the same price and the same level output, so that the sectoral price index is $P_{j,t}^{1-\varepsilon_j} = (1 - \theta_j)\left(P_{j,t}^*\right)^{1-\varepsilon_j} + \theta_j P_{j,t-1}^{1-\varepsilon_j}$. Finally, we assume unit steady-state inflation in both sectors.

[6]Notice that, due to the subsidy leading to an undistorted steady state, $d_{X,t} = d_{X,t}^C$.

2.3 Government

The government conducts fiscal and monetary policy. Along with the tax and the subsidy applied to sectoral production, the former consists of a redistribution scheme that taxes S's dividends at τ_H^D and rebates the proceedings to H, so that $T_{H,t} = \frac{\tau_H^D}{\lambda_H} D_t$. Furthermore, we assume the government spends an exogenous wasteful amount G_t of nondurable goods every period,[7] financed by lump-sum taxes, Υ_t. H pays a share of total lump-sum taxes $\lambda_H \Upsilon_{H,t} = \kappa \Upsilon_t$, while savers pay $\lambda_S \Upsilon_{S,t} = (1-\kappa)\Upsilon_t$. Steady-state values are normalized to zero, so that $\upsilon_{z,t} \approx \Upsilon_{H,t}/Y_C$ and $g_t \approx G_t/Y_C$. Moreover, we assume fiscal spending to be a fraction γ of nondurable consumption in the steady state. Finally, $g_t = \rho_g g_{t-1} + \varepsilon_t^g$, with $\varepsilon_t^g \sim iid(0, \sigma_g^2)$.

Monetary policy is conducted by means of a standard interest-rate rule that adjusts the nominal rate of interest in reaction to aggregate inflation, $\pi_t = \alpha \pi_{C,t} + (1-\alpha)\, \pi_{X,t}$—with $\alpha \in [0,1]$ assumed to be equal to the steady-state size of the nondurable goods sector.[8] Specifically,

$$\frac{R_t}{R} = (1+\pi_t)^{\phi_\pi} \exp(\nu_t), \tag{7}$$

where R is the steady-state (gross) nominal interest rate, ϕ_π denotes the degree to which the nominal interest rate responds to aggregate inflation, and $\nu_t = \rho_\nu \nu_{t-1} + \varepsilon_t^\nu$, with $\varepsilon_t^\nu \sim iid(0, \sigma_\nu^2)$, captures the non-systematic component of monetary-policy making.

2.4 Equilibrium and market clearing

A rational expectations equilibrium (REE) is a sequence of processes for all prices and quantities introduced above, such that the optimality conditions hold for all agents and all markets clear at any given time t. Specifically, labor market clearing requires that labor demand and total labor supply to be equal, $N_t = \lambda_H N_{H,t} + \lambda_S N_{S,t} = \sum_{j=\{C,X\}} N_{j,t}$. With uniform steady-state hours, this implies the log-linear relationship $n_t = \lambda_H n_{H,t} + \lambda_S n_{S,t}$.

State-contingent assets are in zero net supply (markets are complete and agents trading in them are identical), whereas equity market clearing implies that shareholdings of each assetholder are $\Omega_{S,t+1} = \Omega_{S,t} = \Omega = 1/\lambda_S$. Finally, by Walras's Law, the goods markets also clear, implying that $C_t \equiv \lambda_H C_{H,t} + \lambda_S C_{S,t}$ and $X_t \equiv \lambda_H X_{H,t} + \lambda_S X_{S,t}$: once log-linearized around the symmetric steady state, these respectively translate into $c_t = \lambda_H c_{H,t} + \lambda_S c_{S,t}$ and $x_t = \lambda_H x_{H,t} + \lambda_S x_{S,t}$.

[7] We assume fiscal spending is directed toward nondurables only, to enhance comparability between the one-sector and two-sector models.

[8] Steady-state aggregate inflation has been implicitly set to zero, as in the case of the sectoral inflation rates.

2.5 Aggregate TANK economy

The complete log-linearized model is presented in Appendix A. From this, one can directly obtain the aggregate TANK representation by household aggregation, as detailed in Appendix A.1. The resulting system mirrors that of a RANK framework, with the sole exception of the aggregate Euler equation:[9]

$$\frac{1}{1-\lambda_H}(c_t - \lambda_H c_{H,t}) = \frac{1}{1-\lambda_H}(E_t c_{t+1} - \lambda_H E_t c_{H,t+1}) - \frac{1}{\sigma}(r_t - E_t \pi_{C,t+1}). \tag{8}$$

This expression differs from the canonical Euler equation in a RANK setting, as aggregate consumption dynamics now incorporate both the forward-looking behavior of Ricardian agents and the intratemporal constraint of HtM households, whose consumption is tightly linked to their income. Intuitively, the HtM share λ_H acts as a wedge, dampening the overall responsiveness of aggregate consumption to intertemporal incentives. As a result, any divergence in aggregate outcomes between the TANK and RANK economies stems from this modified Euler equation, which governs the interplay between household heterogeneity and aggregate intertemporal allocation.

3 Aggregate amplification: TANK vs. RANK

This section examines the extent to which the dynamics of TANK models resemble those of their RANK counterparts, in both one-sector and two-sector settings. To this end, we adopt a standard calibration, assuming that each model period corresponds to one quarter. Specifically: i) we set $\beta = 0.9938$, to obtain a steady-state annual real risk-free rate of 2.5%; ii) broadly consistent with existing estimates, the curvature parameters of household utility over nondurable consumption and durable services are set to $\sigma = \chi = 2$, as is the inverse Frisch elasticity of labor supply, ϕ (this value lies comfortably within the range of available microeconomic and macroeconomic estimates; cf. Chetty et al., 2011); iii) we set the steady-state ratio of nondurables to total consumption to 87.5%, as computed by Laibson et al. (2022) based on NIPA data; iv) durables' depreciation, δ, is set to 10% annually, in line with the estimates from the Fixed Assets Accounts Tables from the BEA (see, e.g., Erceg and Levin, 2006); v) $\lambda_S = 70\%$, in line with the evidence of Kaplan et al. (2014), where about 30% of the households are liquidity constrained; vi) the reaction parameter in the Taylor rule, ϕ_π, is set to 1.25;[10] vii) the autoregressive parameters in the shock processes, ρ_ν and ρ_g, are both set to 0.5, in line with

[9] Note this is generally true also in a model without durable spending (see, e.g., Bilbiie, 2008).

[10] Adopting a more responsive policy rule does not alter our main results. In fact, a more "hawkish" policy stance tends to reduce the quantitative importance of household heterogeneity (see Debortoli and Galí, 2024).

Debortoli and Galí (2024); viii) the share of fiscal spending in nondurable production, γ, is set to 30%;[11] ix) to elicit the distinctive role of durability, we take an economy with symmetric sectoral price stickiness as the most straightforward extension of the one-sector framework,[12] imposing both Calvo parameters at 0.75; x) finally, we set $\tau_H^D = 0$, unless a specific exercise delves into the role of endogenous profit redistribution. It is worth emphasizing that none of the qualitative results we report depends on the specific calibration of the model.

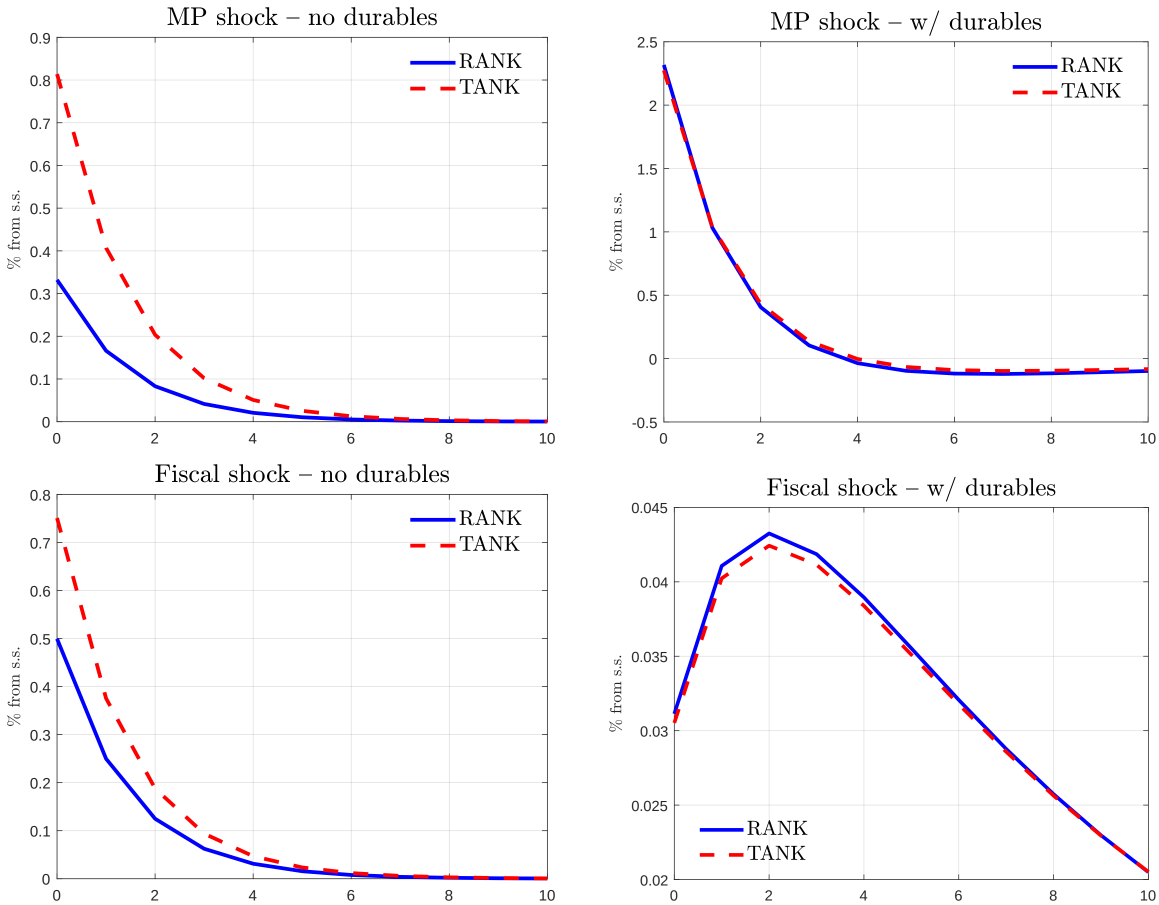
Figure 1 compares the responses to monetary and fiscal shocks in RANK and TANK economies, both in the one-sector (left panels) and the two-sector scenario (right panels).In the one-sector economy, the transmission of both shocks is sizably amplified in the presence of HtM households. In the economies with durables, it is worth highlighting that responses to monetary shocks are substantially more pronounced, while responses to fiscal shocks are an order of magnitude smaller compared to the one-sector benchmarks. Most importantly, regardless of the specific shock being considered, the TANK model produces shock responses much closer to its RANK counterpart, when durables are incorporated. In fact, the RANK and TANK responses in the two-sector scenario can hardly be told apart.

From this preliminary evidence it appears as the introduction of durables into an otherwise standard TANK model weakens the role of household heterogeneity, making the two-sector TANK closely aligned with the corresponding RANK framework. This conjecture is broadly supported by Figure 2, where we compare the response of savers' and HtM households' nondurable spending in the one-sector and the two-sector TANK models. In the model with durables, household-level consumption responses are markedly more muted—regardless of household type—and this attenuation is especially pronounced following fiscal spending shocks, where cross-household heterogeneity is substantially reduced compared to the one-sector TANK. Importantly, the two-sector TANK model fails to resolve the crowding-out of aggregate consumption observed in response to expansionary fiscal shocks, despite the presence of HtM households. This contrasts with the one-sector model, where the positive consumption response of constrained households overcomes the decline among savers, resulting into a crowding-in of aggregate consumption.

[11] This is computed as the ratio of government consumption and transfers directed to nondurable goods and services (from BEA NIPA and federal budget data) to the total value added in nondurables and services (from BEA industry accounts and headline GDP).

[12] This choice is also consistent with evidence showing a limited response of the relative price of durables (e.g., Cantelmo and Melina, 2018). In this respect, it is relevant to emphasize that our two-sector TANK model generates positive sectoral comovement in response to monetary shocks—a robust empirical feature of durable and nondurable expenditures—even under intermediate degrees of asymmetry in sectoral price stickiness. This specific point is examined in Section 4.3.

Figure 1: Response of aggregate production – RANK vs. TANK

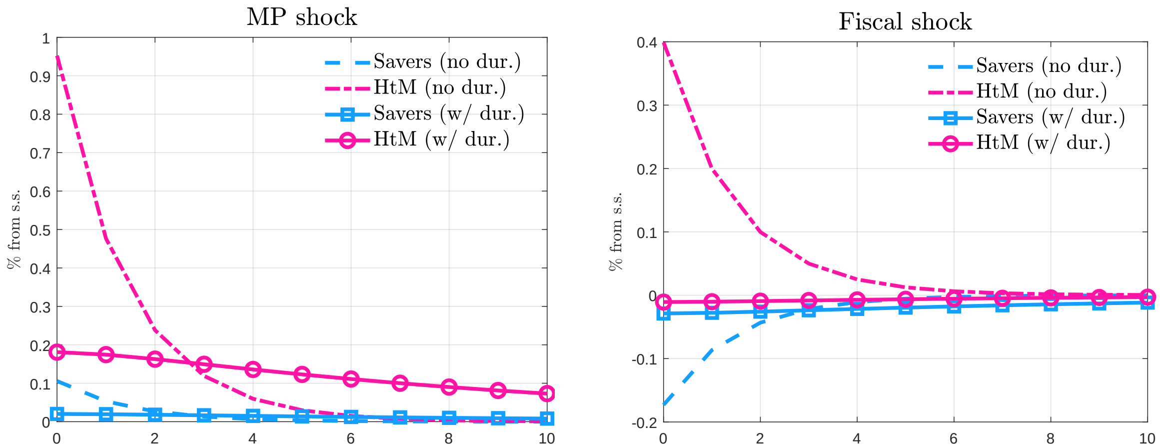


Notes: Each panel compares the responses of aggregate production in RANK and TANK frameworks with identical sectoral structures. The left panels refer to one-sector economies producing only nondurables, while the right panels correspond to two-sector models that include both nondurables and durables. The top row shows the responses to an expansionary 25 basis point (annualized) cut in the nominal interest rate, while the bottom row reports the response to a fiscal shock implying a 1% (annualized) increase in government spending (in both cases, τ_H^D is set to zero).

3.1 On the role of durables

In this section, we provide intuition for why introducing durable goods into a model with LAMP yields outcomes that resemble those observed in a RA framework. To clarify the mechanisms at play and highlight their implications, it is useful to consider an *analytically tractable limit case* with perpetual durables, i.e., where $\delta \to 0$. The goal of this approach is not to approximate the behavior of an economy with long-lived durables in response to temporary aggregate shocks. Rather, it aims to complement the numerical analysis with analytical insights into how durables function in HA settings.

Figure 2: Response of nondurable spending – savers vs. HtM households



Notes: In each panel we compare the responses of household-specific nondurable spending in the one-sector and two-sector TANK frameworks. The left panel shows the responses to an expansionary 25 basis point (annualized) cut in the nominal interest rate, while the right panel reports the response to a fiscal shock implying a 1% (annualized) increase in government spending (in both cases, τ_H^D is set to zero).

Consider household's $z = \{S, H\}$ log-linear Euler equation for durables. This may be solved forward to yield an expression for the households-specific shadow value of durables, as a percentage deviation from the steady state:

$$q_t - \sigma c_{z,t} = -\left[1 - \beta(1-\delta)\right] \chi E_t \left\{ \sum_{i=0}^{\infty} \beta^i (1-\delta)^i x_{z,t+i} \right\} \equiv \lambda_{z,t}. \tag{9}$$

The following proposition can be enunciated:

Proposition 1 *As the depreciation rate $\delta \to 0$, the stock of durables for household $z = \{S, H\}$ becomes approximately constant over time, i.e., $x_{z,t} \approx x_{z,t-1}$. If $x_{z,0} = 0$, the unique stationary path is $x_{z,t} \approx 0$ for all t. Under this approximation, the shadow value of durables $\lambda_{z,t} \approx 0$ and equation (9) implies that $q_t - \sigma c_{z,t} \approx 0$.*
Proof. *See Appendix A.2.*

As noted by Barsky et al. (2007), short-term movements in the stock of durables—such as those triggered by temporary fiscal or monetary shocks—have limited impact on the shadow value of durables when these are long-lived. With low depreciation, this shadow value is primarily determined by the marginal utility of service flows far in the future, which are barely affected by transitory shocks. As a result, its present value remains near steady state, and the demand for durables displays an almost infinite elasticity of intertemporal substitution: even small relative price changes can significantly shift the timing of purchases. The same mechanism applies in our TANK framework: in the limit case of perpetual durables, the shadow value remains pinned to its steady-state level.[13]

Corollary 1 *If $q_t \approx \sigma c_{z,t}$ holds for both S and H, then marginal utilities are approximately equalized across household types. The presence of durables enables agents to self-insure, endogenously giving rise to the following risk-sharing condition:*

$$c_{S,t} \approx c_{H,t}. \tag{10}$$

This relationship, which we will assume to hold with equality throughout the analytical derivations based on the limit case with perpetual durables, implies tight comovement between the consumption of nondurables of the two households.[14] This is broadly consistent with the evidence in Figure 2 on the transmission of monetary and fiscal shocks to household-level spending, where the responses of both H and S are very similar. In fact, Proposition 1 implies that the nondurable consumption responses of both agents closely follow the dynamics of relative prices. Since symmetry in sectoral price stickiness prevents any deviation of the relative price from its steady-state level, household-level nondurable spending remains nearly unchanged in a model with durables—explaining why these responses are close to zero.

Corollary 1 implies that, in the limit case, HtM agents behave like Ricardian agents and smooth consumption over time. As a result, the aggregate Euler equation becomes

$$c_t = E_t c_{t+1} - \frac{1}{\sigma}\left(r_t - E_t \pi_{C,t+1}\right), \tag{11}$$

which is equivalent to the log-linearized Euler equation in a RANK economy.[15]

Corollary 2 *In the limit case of perpetual durables (i.e., $\delta \to 0$), the aggregate dynamics of the TANK economy are equivalent to those of the corresponding RANK economy.*

This result holds regardless of the degree of sectoral price rigidity and, therefore, of the extent

[13]Assuming linear utility from durables would lead to the same result, without relying on the approximation. Furthermore, Barsky et al. (2007) also discuss how allowing for *non-separability* between durables and nondurables in households' utility would not fundamentally alter the quasi-constancy property, given that the stock-flow ratio is high for durables that depreciate slowly, so that little or no deviation from steady state should be observed, in the face of temporary shocks.

[14]In fact, under preference heterogeneity—i.e., assuming $\sigma_S \neq \sigma_H$—the extent of this comovement would hinge on the relative curvature of households' nondurable utility, and $\sigma_S c_{S,t} \approx \sigma_H c_{H,t}$.

[15]This follows from equation (8): when $c_{H,t} \approx c_{S,t} \approx c_t$, it holds that $\frac{1}{1-\lambda_H}(c_t - \lambda_H c_{H,t}) \approx c_t$, implying that the bond Euler equation—and thus the entire aggregate system—in a TANK setting becomes identical to its RANK counterpart.

to which q_t influences the path of household- and aggregate-level nondurable consumption. In effect, the slope of the nondurable demand schedule no longer depends on the HtM share, in contrast to standard one-sector TANK models. Instead, it aligns with the elasticity of intertemporal substitution in the RANK benchmark.[16] Accordingly, the aggregate responses to monetary and fiscal shocks in the two-sector RANK model are equivalent to those in the TANK model—though the latter still permits heterogeneous household-level responses in durable spending.

The key insight is that even financially constrained households can engage in a form of saving through durable holdings. Durables serve a dual role: they provide utility through consumption services and act as a store of value. Even in the absence of direct utility, investing in durables today creates value because households can liquidate the (depreciated) stock in secondary markets in the future.

When relative prices remain roughly constant, durables act as an inefficient storage technology, offering negative expected returns due to depreciation. For this reason, Ricardian households always prefer to save through bonds. In contrast, households with limited access to financial markets are constrained to use durables for self-insurance—despite their inherent inefficiency as a saving device. In the extreme case of perpetual durables, the costs associated with this form of saving are minimal, especially in a realistic environment with a low risk-free rate. As a result, the behavior of constrained and unconstrained households eventually converges. Such convergence weakens the tight link between income and consumption for HtM households. Consequently, the role of household heterogeneity is significantly diminished, and the two-sector TANK model becomes closely aligned with its RANK counterpart.

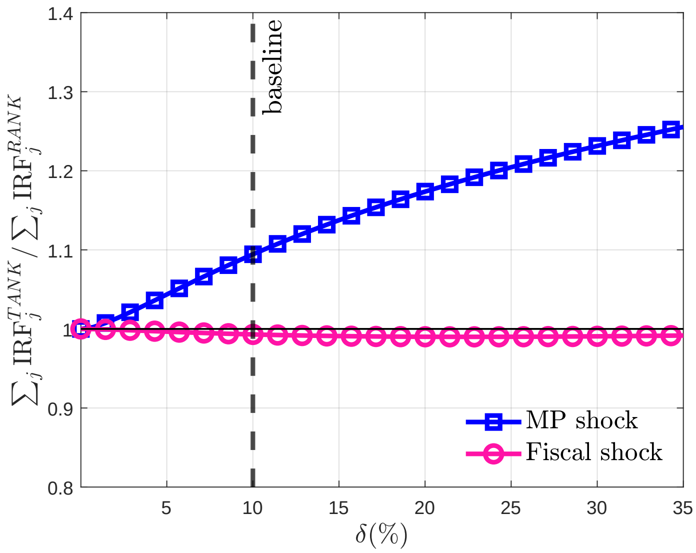
Incidentally, to isolate the contribution of household heterogeneity to aggregate fluctuations in their estimated THANK model with cyclical inequality, Bilbiie et al. (2023) impose a condition analogous to equation (10). In a counterfactual exercise, they show that business cycle fluctuations become substantially less pronounced—mirroring our result, where the presence of durables endogenously dampens the effects of heterogeneity.

Durability is therefore central to enabling implicit risk sharing across heterogeneous households. To assess the quantitative relevance of this mechanism, we compare the cumulative output response in the two-sector TANK model to that in the corresponding RANK model following both monetary and fiscal shocks, across different values of the durable depreciation rate, δ.[17] Figure 3 shows that, even under unrealistically high depreciation rates, the two

[16] Under preference heterogeneity, the slope becomes $\frac{1-\lambda_H(1-\iota)}{\sigma_S}$, where $\iota \equiv \sigma_S/\sigma_H$. In this case, the IS slope reflects both the curvature of nondurable utility and the HtM share. Relaxing the assumption of preference homogeneity has no bearing on our subsequent analysis.

[17] Since durability induces limited persistence, results are qualitatively similar if one focuses solely on impact responses.

Figure 3: The role of durability



Notes: The figure reports the ratio between the cumulated responses of total output (over a period of 20 quarters) to monetary and fiscal shocks in the two-sector TANK model and the corresponding RANK model, as a function of the (annualized) depreciation rate of durables. The vertical line denotes the depreciation rate used in the baseline calibration.

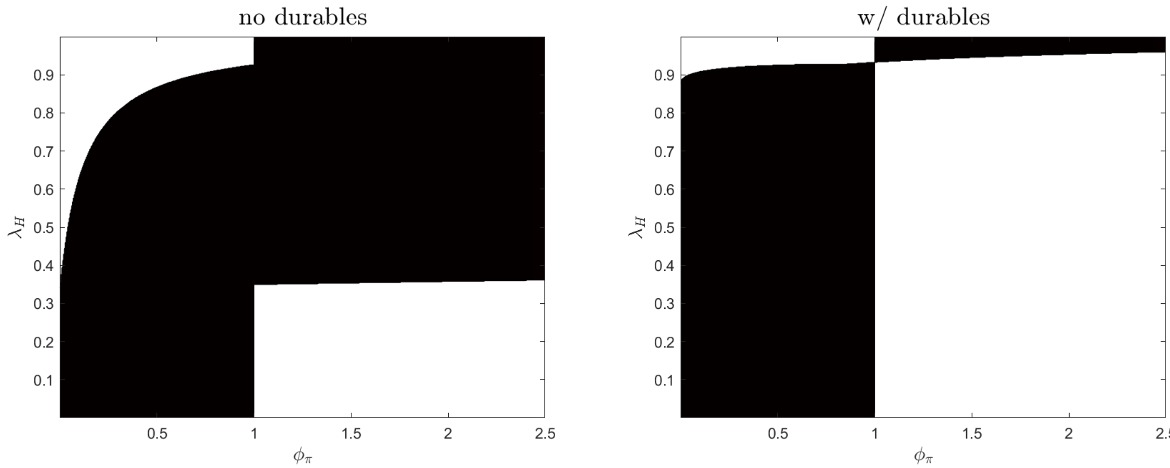
models exhibit nearly identical responses to fiscal shocks and very similar responses to monetary shocks. For comparison, the one-sector TANK model displays cumulative responses that are roughly twice as large for monetary shocks and 30% larger for fiscal shocks than those in the RANK model (see Figure 1).

While our baseline model assumes costless adjustment of durables, Barsky et al. (2007) show that adding convex adjustment costs further restricts durable responses, preserving the quasi-constancy of their shadow value. Yet, while convex costs at the aggregate level are consistent with fixed or non-convex frictions at the micro level (see King and Thomas, 2006), an open question is the extent to which the aggregate implications of endogenous adjustment remain unchanged in the presence of illiquidity. We explore such frictions in Section 5.2, where some households face impaired durable adjustment alongside limited access to liquid financial assets.

4 Implications

We now turn to the key implications of introducing durables into an otherwise standard TANK framework. Last, we examine sectoral comovement in connection with varying degrees of asymmetric sectoral price stickiness.

Figure 4: REE determinacy



Notes: White area: REE determinacy. Black area: indeterminacy.

4.1 Durables and the inverted nondurable demand logic

A key implication of TANK models is that, when the share of HtM households is sufficiently large, the IS curve may become upward-sloping: variations in profit income offset the direct effect of interest rates on savers' demand (Bilbiie, 2008). This reversal has important implications for monetary policy design, especially for REE determinacy, as it may require a modified Taylor principle in environments with constrained financial access.

LAMP alters the connection between aggregate demand and the real interest rate: changes in the latter affect real wages—the main income source for HtM agents—amplifying aggregate demand in both directions. As a result, an active policy rule ($\phi_\pi > 1$) may lead to self-fulfilling sunspot equilibria when λ_H exceeds a certain threshold: a rise in expected inflation raises real rates and demand, validating the initial expectation. In contrast, determinacy under inflation targeting may only be achieved through a passive rule ($\phi_\pi < 1$), which lowers real rates in response to non-fundamental inflation expectations, reducing demand and generating deflation. In line with these theoretical considerations, Bilbiie and Straub (2013) shows that LAMP helps explain the behavior of U.S. macroeconomic outcomes and monetary policy determinacy before and after the 1980s.

Figure 4 displays the conditions for REE determinacy across different values of the inflation response coefficient in the Taylor rule and the share of HtM households, comparing one-sector and two-sector TANK models. In line with Bilbiie (2008), in the economy with only nondurables, determinacy may fail to obtain at rather conventional levels of financial exclusion—unless the central bank adopts a passive stance. For instance, when $\lambda_H \gtrapprox 0.35$, determinacy can only be achieved if the inflation response is extremely weak.

In the two-sector TANK model, REE uniqueness is generally achieved under a standard Taylor principle ($\phi_\pi > 1$) across a broad range of λ_H values—even under relatively extreme LAMP calibrations. A passive inflation-targeting regime becomes necessary to ensure determinacy only under very severe financial exclusion.

To build analytical intuition for this result, it is useful to examine the determinacy conditions in the TANK framework with perpetual durables. Recalling the aggregate Euler equation in this setting (equation 11), it becomes clear that an inversion of its slope—governing aggregate demand for nondurables—cannot occur. More formally, we state the following proposition:

Proposition 2 *In the two-sector TANK model with perpetual durables (i.e., as $\delta \to 0$) and symmetric sectoral price stickiness, $\phi_\pi > 1$ is a sufficient condition for REE determinacy.*
Proof. *See Appendix A.3.*

In the limit case with perpetual durables, the conventional Taylor principle alone ensures determinacy, regardless of the degree of LAMP. Again, this is because agents with limited access to financial markets can partially self-insure through durables. This result is consistent with our quantitative findings, which show that the *inverted* Taylor principle only emerges at implausibly high shares of HtM households.

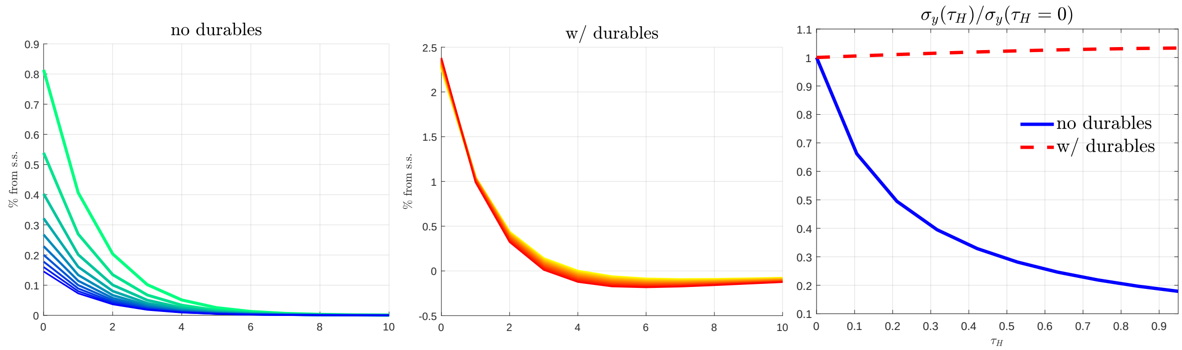
4.2 Neutrality of profit redistribution

A key feature of TANK models is that fiscal policy—particularly through redistribution between savers and HtM households—can significantly shape transmission and amplify/ mitigate the effects of monetary policy shocks. To investigate this mechanism, Figure 5 displays the gross output response to a monetary shock in an economy producing only nondurables, as we vary the extent of profit redistribution via τ_H^D.

The left panel confirms that, in a one-sector economy with nondurables only, redistributing monopoly profits toward HtM households dampens the effects of monetary shocks (Bilbiie, 2020). The middle panel replicates the exercise in a setting with durables. In this case, redistribution has little effect on private spending, indicating near-neutrality.

The last panel summarizes this evidence, reporting the conditional volatility of gross output across different values of τ_H^D, normalized by its level in the absence of redistribution. While in the one-sector model increasing τ_H^D leads to a pronounced decline in volatility, the two-sector economy exhibits a slight increase—pointing to a substantial neutrality of profit redistribution in the transmission of monetary policy, when durables are incorporated.

Figure 5: Profit redistribution and amplification



Notes: The first two panels show the responses of aggregate production in the one-sector and two-sector TANK frameworks, respectively, to an expansionary 25-basis-point monetary policy shock, for different values of τ_H^D (ranging from $\tau_H^D = 0$, indicated by a light-colored thick line, to $\tau_H^D = 0.95$, indicated by a dark-colored thin line). The last panel maps the conditional standard deviation of aggregate production with respect to τ_H^D, scaled by the corresponding measure in the case of no endogenous profit redistribution (blue-continuous line: economy with nondurables only; red-dashed line: economy with both durables and nondurables).

To understand these differences, it is useful to revisit the mechanism behind the attenuation of monetary policy transmission in a one-sector economy. In this setting, a monetary expansion increases aggregate demand, which raises the income of HtM households through higher real wages—provided the labor supply elasticity is positive ($\phi > 0$). Their consumption rises proportionally with income, reinforcing demand. This feedback loop increases labor demand, further raising wages and amplifying the cycle (Bilbiie, 2020). Equilibrium is achieved as savers face declining profits, leading them to work more hours to accommodate the additional demand. Effectively, savers 'finance' the expansion in aggregate demand. Introducing profit redistribution (i.e., $\tau_H^D > 0$) shifts part of this burden onto the HtM, who then internalize the decline in firm profits. Therefore, profit redistribution reduces the overall response—highlighting that endogenous redistribution is *non-neutral* and dampens the HtM amplification channel.

As shown in the previous section, the introduction of durables enables HtM households to self-insure, weakening the tight link between their consumption and income. This, in turn, softens the grip of profit redistribution on aggregate outcomes. In the limit case with perpetual durables, household-specific durable spending adjusts to satisfy the implicit risk-sharing condition, such that both nondurable consumption and labor supply move *in tandem* across types. In this environment, transfers have no effect on aggregate demand, and changes in τ_H^D are purely redistributive.

To see this, combine the approximation $\sigma c_{z,t} \approx q_t = 0$ with the household budget constraints, the aggregate labor supply schedule, and market clearing in the nondurable goods sector, abstracting from fiscal spending ($\gamma = 0$). This yields a relationship connecting household-specific spending to the aggregate production of durables:

$$e_{z,t} = \left(1 + \phi \frac{\mathscr{I}_z(\tau_H^D - \lambda_H)}{\lambda_z}\right) y_{X,t}, \quad z \in \{S, H\}, \tag{12}$$

where $\mathscr{I}_z = 1$ if $z = S$ and -1 otherwise. Thus, changes in τ_H^D simply reallocate demand between savers and HtM households, as durables insulate HtM agents from income fluctuations during aggregate expansions. In fact, in this limit case with perpetual durables, $y_t = -\frac{1-\beta\rho_\nu}{\phi\psi(\phi_\pi - \rho_\nu)}\nu_t$ (see Appendices A.3-A.4 for derivations), implying no effect whatsoever of profit redistribution in the aggregate.

4.3 Sectoral comovement

A well-documented feature of household spending is the strong comovement between durable and nondurable expenditures in response to monetary policy shocks (see, e.g., Erceg and Levin, 2006; Monacelli, 2009). However, standard two-sector RANK models struggle to replicate this pattern under asymmetric sectoral price stickiness. In such cases, relative price changes typically induce expenditure switching, giving rise to the so-called "comovement puzzle" (Barsky et al., 2007).[18]

Figure 6 reports the correlation between nondurable and durable output, conditional on monetary policy shocks, in two-sector RANK and TANK models, as the degree of price stickiness for durables and nondurables is varied. Asymmetric price rigidity generates relative price movements that can lead to sizable reallocation of spending across sectors—especially when one good has flexible prices—often resulting in negative comovement.[19] When both sectors exhibit sufficient stickiness, by contrast, relative price effects are dampened.

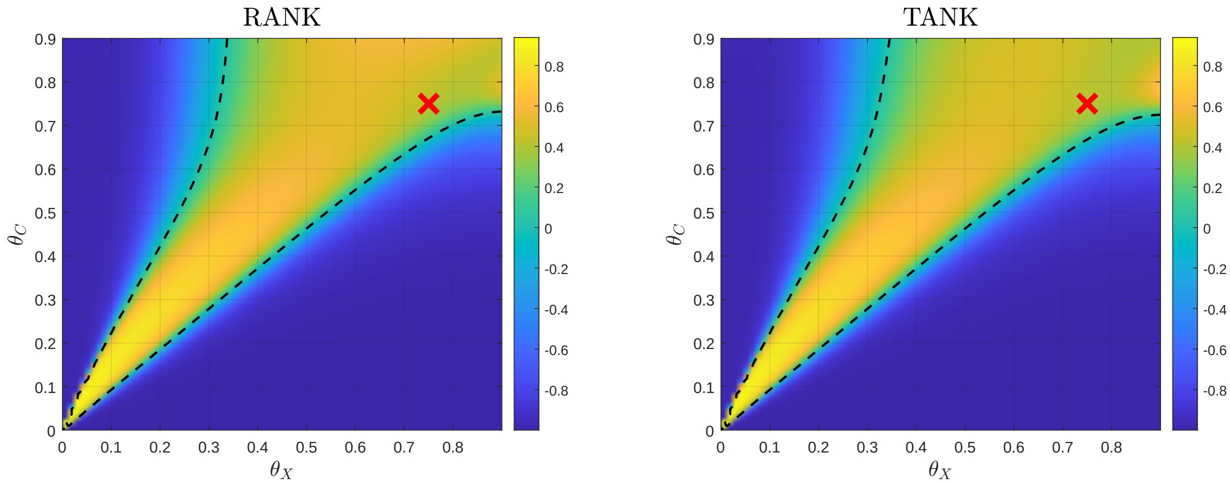
In the RANK model, near-symmetric sectoral price stickiness allows intertemporal substitution to dominate intratemporal substitution, given that relative price changes are modest. However, with asymmetric sectoral price rigidity, the strength of the relative price effect increases, leading to negative sectoral comovement.

Introducing HtM households, as in our TANK model, opens the door to an income channel in monetary transmission (see Kaplan et al., 2018), potentially amplifying demand and

[18]See Monacelli (2009) for a TANK model with collateralized borrowing that explores sectoral comovement, and Sterk (2010) for a discussion of the challenges to overcome the puzzle in this type of setting, due to tensions between liquidity constraints and equilibrium in the bond market.

[19]Appendix A.6 illustrates this point by showing how negative comovement emerges in the limit case of perpetual goods, under polar scenarios of asymmetric price stickiness—where one sector has fully flexible prices and the other has sticky prices.

Figure 6: Sectoral comovement conditional on monetary policy shocks



Notes: Each plot reports the correlation between durable and nondurable production, conditional on monetary policy shocks, for different levels of price stickiness in each sector. The dashed-black line indicates zero correlation, while the red cross marks the baseline calibration with $\theta_C = \theta_X = 0.75$. The left panel refers to a RANK setting; the right panel to a TANK setting.

strengthening comovement. Yet, this effect is limited in our setting, as durables serve as a self-insurance device from the perspective of HtM households, so their demand for either type of good responds only weakly to income changes. Consequently, the correlation patterns are virtually unchanged relative to the RANK benchmark, and the basic TANK framework fails to resolve the comovement puzzle.[20]

5 Extensions

We now extend the TANK model in various directions. First, we allow agents to switch financial status, thereby introducing a precautionary motive driven by idiosyncratic uncertainty. Second, we extend this two-state THANK economy to a three-state one, where we limit the ability of some agents to smooth consumption intertemporally through durable adjustment. Finally, we twist profit cyclicality through the introduction of nominal wage stickiness.

[20] More robust and empirically relevant comovement may emerge in richer environments with greater household heterogeneity and incomplete markets. When agents face both liquidity constraints and limited insurance against idiosyncratic shocks, monetary policy transmits through both direct and indirect channels—reinforcing sectoral comovement even under asymmetric price stickiness (Holst Partsch et al., 2025).

5.1 A two-state THANK economy

TANK economies miss an important channel in that unconstrained agents do not face the possibility of becoming constrained in the future, and *vice versa*. To overcome this limitation, we now introduce idiosyncratic risk in the vein of Bilbiie (2020, 2024).

We consider an environment with a unit mass of households that infrequently participate in financial markets. When participating (state S), households can frictionlessly adjust their portfolios and receive dividend payments from firms in both sectors. When not participating (state H), they only receive the return on their bond holdings from the previous period. The exogenous evolution of household types follows a Markov chain: the probability of remaining in state S is ϱ_{SS}, while the probability of remaining in state H is ϱ_{HH}. The corresponding transition probabilities are ϱ_{SH} and ϱ_{HS}, respectively. We focus on stationary equilibria in which the mass of households in state H is given by $\lambda_H = \frac{\varrho_{SH}}{\varrho_{SH}+\varrho_{HS}}$. We assume $\varrho_{SS} \geq \varrho_{SH}$, implying that the probability of remaining a saver exceeds the probability of becoming one.

We follow Bilbiie (2024) in adopting simplifying assumptions that allow for analytical tractability. Households are members of a family whose intertemporal utility is maximized by a representative head, subject to limits in risk sharing. Specifically, households reside on two *islands*, depending on their financial-market participation status—one for savers, and one for HtM households. The family head can transfer resources, including durables, freely within each island, while only a subset of resources can be transferred between islands. There is full insurance within each type in response to idiosyncratic risk, but only limited insurance across types. At the beginning of each period, the family head pools resources within each island. After the aggregate shock is realized, the head of family allocates consumption and savings decisions separately for each island. Then, the idiosyncratic shock occurs: households learn their next-period participation status and relocate accordingly. Financial assets differ in liquidity. Only one of the two financial assets—bonds—is liquid and can be used for self-insurance before idiosyncratic uncertainty is revealed; these can be moved across islands. In contrast, stocks are illiquid and cannot be used to self-insure across states. The detailed formulation of the family head's optimization problem is presented in Appendix B.

It is useful to start our discussion from the one-sector version of this two-state THANK framework, which features the following log-linear aggregate Euler equation (see Bilbiie, 2020, p. 101):

$$c_t = \mu E_t c_{t+1} - \frac{1-\lambda_H}{\sigma(1-\chi^B \lambda_H)} \left(r_t - E_t \pi_{t+1} \right), \tag{13}$$

where the parameter $\mu \equiv 1 + \frac{\varrho_{SH}(\chi^B - 1)}{1-\chi^B \lambda_H}$ may be greater or less than one, depending on the strength of the HtM channel, captured by $\chi^B \equiv 1+\phi\left(1-\tau_H^D/\lambda_H\right)$. The key insight is that self-insurance against household-specific uncertainty interacts with the standard HtM mechanism arising from aggregate uncertainty. This interaction either amplifies or attenuates the effects of future shocks, depending on whether χ^B is greater or less than one. This has important implications for the effectiveness of forward guidance in monetary policy.

To assess this, we examine the extent to which anticipated monetary policy shocks influence aggregate demand. Specifically, we introduce *anticipated monetary policy shocks* by assuming that the linearized monetary policy rule takes the following form:

$$r_t = \phi_\pi \pi_t + \nu_t + \sum_{j=1}^{J} \upsilon_{t-j}, \tag{14}$$

where υ_{t-j} denotes i.i.d. monetary policy "news"—that is, announcements made at time $t-j$ regarding future deviations from a baseline policy rule.

We calibrate the transition probabilities by setting a relatively high persistence in saver status, $\varrho_{SS} = 0.955$. The remaining transition probabilities are then chosen to target a stationary share of HtM households, $\lambda_H = \varrho_{SH}/(\varrho_{SH}+\varrho_{HS}) = 0.3$, consistent with the baseline TANK model. All other parameters are set as described in Section 3.

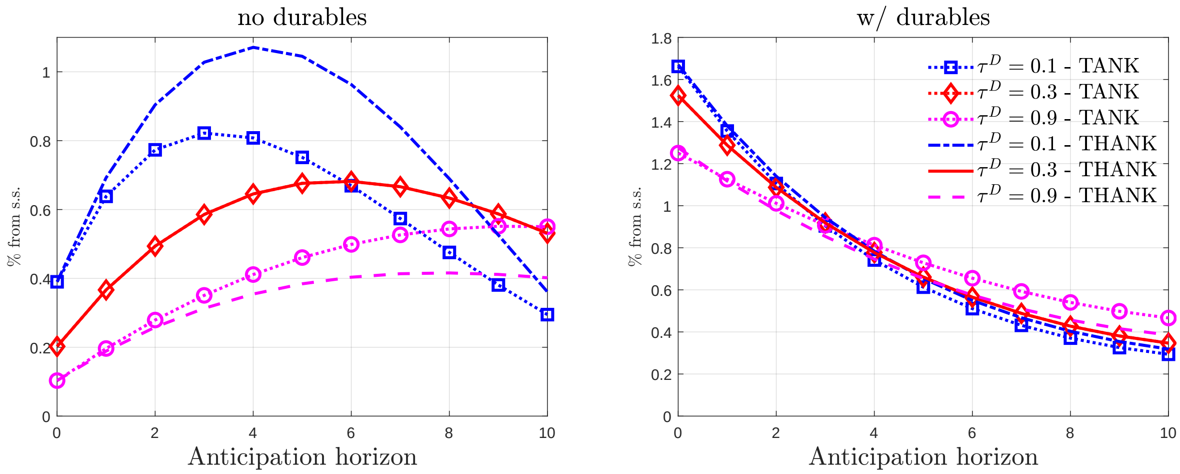
The left panel of Figure 7 illustrates the cumulative response of aggregate output in one-sector TANK and THANK economies to a j-periods-ahead anticipated shock to the nominal interest rate, for different values of τ_H^D. When redistribution is weak ($\tau_H^D = 0.1$), the compounding of future news reinforces the HtM channel, leading to an amplified output response in the THANK model relative to the TANK. In contrast, when redistribution is strong ($\tau_H^D = 0.9$), the parameter $\chi^B < 1$, in equation (13), and forward-guidance shocks are increasingly discounted, attenuating the output response in the THANK. When $\tau_H^D = \lambda_H$, the two models yield identical results.

The right panel of Figure 7 presents the same analysis for the two-sector versions of the THANK and TANK models. In this case, no clear monotonic pattern of compounding or discounting emerges over the anticipation horizon. Moreover, we emphasize that the output responses to future shocks become substantially more similar across models, once durables are introduced.

To rationalize these findings, it is useful to consider the limit case in which durables are perpetual. In this setting, the following proposition establishes an equivalence in equilibrium dynamics.

Proposition 3 *Equilibrium dynamics in the two-sector THANK model with perpetual durables (i.e., $\delta \to 0$) and symmetric sectoral price stickiness are equivalent to those in the corresponding TANK*

Figure 7: Anticipated monetary policy shocks – compounding and discounting



Notes: For different values of τ_H^D, we compute the cumulative response of aggregate output (over 20 quarters) to a J-periods-ahead anticipated monetary policy easing shock to the nominal interest rate, both in one-sector TANK and THANK economies (left panel) and in their respective two-sector counterparts (right panel).

model and, by extension, the RANK economy, as established in Proposition 1.
Proof. *See Appendix B.1.*

As shown in Proposition 1, in the TANK economy with perpetual durables, the bond Euler equation retains the same elasticity to the real interest rate as in the RANK model, and remains independent of the share of liquidity-constrained households. In the limit case of the THANK model ($\delta \rightarrow 0$), we further show that the Euler equation exhibits neither discounting nor compounding of news about future nondurable consumption, implying that the coefficient in front of $E_t c_{t+1}$ converges to one. Therefore, we retrieve an Euler equation equivalent to equation (11).

In this environment, the presence of durables attenuates precautionary saving in the face of idiosyncratic risk. Although a self-insurance channel may still be present—since households anticipate the possibility of facing financial constraints in the future—they can nevertheless use durables as a store of value. As a consequence, both nondurable and durable consumption behave in the same way as in the TANK model with perpetual durables. Furthermore, all analytical properties established in that context continue to hold in this THANK setting.

5.2 Illiquidity in durable adjustment

The THANK model with durables weakens the transmission mechanism that typically arises from the interaction between idiosyncratic risk and HtM behavior—an important driver of aggregate *nondurable* consumption. This dampening effect stems from the role of durables as a store of value, which enables self-insurance. To explore the implications of this channel under more restrictive conditions, we extend the framework to a three-state THANK model that allows for temporary illiquidity in the durable goods market. Within this setting, we examine how illiquidity affects the transmission of monetary policy shocks and, conditionally, the effects of profit redistribution.

In this extended setting, household members may transition across three islands: the usual saver (S) and HtM (H) states, and a third state, K, where agents—like those in H—have no access to financial assets, and in addition face illiquidity in their durable holdings. Specifically, when in state K, households cannot adjust their durable stock, which remains fixed at the level inherited from the previous period.[21] Transition across the three states follows a Markov chain. The probability of remaining in a given state $f \in \{K, S, H\}$ is ϱ_{ff}, and the probability of moving from state f to a different state $l \neq f$ is denoted ϱ_{fl}. Agents' demand for durables—when in state H or S—reflects the forward-looking consideration that, with positive probability, they may be unable to adjust their stock of durables in the next period. In this way, the model captures one of the central implications of infrequent adjustment in durable investment, as emphasized by Orchard et al. (2025).[22]

We focus on stationary equilibria and maintain the assumption that Ricardian agents are highly persistent in their financial status, setting $\varrho_{SS} = 0.955$, as in the two-state framework. To calibrate the steady-state distribution of the three household types, we assume that roughly 30% of the population has impaired access to financial markets, and that one-third of them—at any point in time—are unable to liquidate or alter their durable stock. We further impose restrictions on household mobility across states. Specifically, savers must first adjust their durable holdings before transitioning to the illiquid state K, implying $\varrho_{SK} = 0$. Likewise, households in K cannot directly transition to the saver state, so $\varrho_{KS} = 0$. Finally, HtM agents in state H are assumed to have equal probability of transitioning to either S or K, i.e., $\varrho_{HS} = \varrho_{HK}$. Assuming an ergodic Markov chain, these restrictions uniquely pin down the

[21] We also impose a fixed cost Ξ_K on households in state K. This ensures that the steady-state condition of consumption risk sharing continues to hold. As shown in Appendix C, under the constraint $X_{K,t} = (1 - \delta)\widetilde{X}_{K,t-1}$, K's stock of durables would prevent perfect consumption equalization across islands, unless a ticket $\Xi_K = \delta X$ is introduced.

[22] The model does not, however, account for the fact that the likelihood of becoming liquidity-constrained is time-varying—an essential feature of fully state-dependent models (see, e.g., Caballero, 1993). This dimension of durable adjustment, and its macroeconomic implications, is explored in detail by McKay and Wieland (2021).

mapping between transition probabilities and the targeted steady-state population shares.[23] All other model parameters are set to the values described in Section 3. The household head's optimization problem and the full log-linearized model are presented in Appendix C.

The left panel of Figure 8 compares the response of output to an expansionary monetary policy shock in the three-state THANK model with illiquid durables, against the two-state THANK benchmark with liquid durables (we assume no profit redistribution). The introduction of illiquidity clearly *dampens* the expansionary effect of monetary easing. To understand the rationale behind this result, consider the limit case of perpetual durables. With $\delta \to 0$, aggregate output can be expressed as a function of the real wage (see Appendix C.3 for derivations):

$$y_t = \left(\frac{(\lambda_S + \lambda_H)(1+\phi) - \phi}{\phi} + \frac{\widetilde{\lambda}_K (1+\phi)}{\phi} \right) \omega_t + \frac{\sigma Y}{\phi Y_C + \sigma Y} \tau_K^D \omega_t, \tag{15}$$

where $\widetilde{\lambda}_K \equiv \frac{\phi Y_C}{\phi Y_C + \sigma Y} \lambda_K$, which is strictly lower than λ_K. By contrast in the two-state THANK model with liquid durables, output equals $\frac{1}{\phi}\omega_t$. In turn, we need to recall that the real wage response to a monetary shock is identical across the RANK, TANK, and both the two-state and three-state THANK models (i.e., $\omega_t = -\frac{1-\beta\rho_\nu}{\psi(\phi_\pi - \rho_\nu)}$). Therefore, the following proposition can be enunciated:

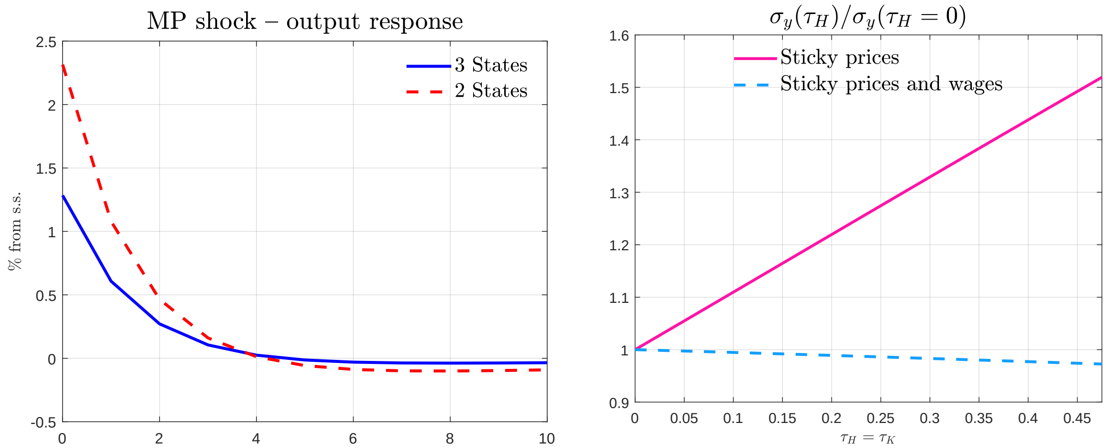
Proposition 4 *In the absence of profit redistribution (i.e., $\tau_K^D = 0$), the response of aggregate output, y_t, to a monetary policy shock in the three-state THANK model with perpetual durables (i.e., $\delta \to 0$) and symmetric sectoral stickiness is strictly smaller than in the corresponding two-state model.*
Proof. *See Appendix C.4.*

Introducing illiquidity shifts the entire burden of durable adjustment onto the households in states S and H, since those in the most constrained state, K, can only adjust their nondurable consumption. As a result, unlike the two-state THANK model—where nondurable production remains at its steady state when depreciation tends to zero—nondurables in the three-state model exhibit a non-zero response to monetary shocks through households in K. Nonetheless, aggregate demand continues to be driven primarily by durable consumption, which is far more sensitive to interest rate movements. This channel is weakened, however, because a share of the population—those in the illiquid K state—cannot adjust their durable holdings in response to monetary policy shocks.

We now revisit the role of fiscal transfers—implemented through profit redistribution—in shaping the transmission of monetary shocks within the three-state THANK framework. The

[23] Specifically, this implies $\varrho_{HH} = 1 - 2\lambda_S(1-\varrho_{SS})/\lambda_H$ and $\varrho_{KK} = 1 - \lambda_S(1-\varrho_{SS})/\lambda_K$.

Figure 8: 3-state THANK



Notes: Left panel: The figure compares the response of aggregate production in the two-state and the three-state THANK model with durables to an expansionary 25-basis-point monetary policy shock (τ_H^D and τ_K^D are set to zero). Right panel: we map the standard deviation of aggregate production in the three-state model with respect to $\tau_H^D = \tau_K^D$, scaled by the corresponding measure in the case of no endogenous profit redistribution (blue-continuous line: economy with sticky prices; red-dashed line: economy with nominal wage stickiness).

right panel of Figure 8 displays the conditional volatility of y_t in response to monetary shocks as a function of τ_K^D, the subsidy rate applied to households in state K (assumed, without loss of generality, to be equal to the rate applied to state H, i.e., τ_H^D). In contrast to the two-state setting, fiscal transfers are no longer quasi-neutral: aggregate volatility increases monotonically with τ_K^D. This stands in stark opposition to the one-sector TANK economy with nondurables only, where higher redistribution dampens volatility (see the last panel of Figure 5).

To understand this result, it is again helpful to consider the limit case with perpetual durables. In this environment, ω_t is independent of τ_K^D. Hence, the impact of profit redistribution on the transmission of monetary policy can be assessed by examining the second term on the right-hand side of equation (15), which encompasses all effects of fiscal transfers. It is straightforward to observe that, in this case, the passthrough from the real wage to aggregate output increases linearly with the level of profit redistribution. This relationship is formalized in the following proposition:

Proposition 5 *In the three-state THANK model with perpetual durables (i.e., $\delta \to 0$) and symmetric sectoral price stickiness, the response of aggregate output, y_t, to a monetary policy shock increases with τ_K^D.*

Proof. *See Appendix C.5.*

The interaction between durables and adjustment frictions—affecting only a subset of households—is central to the amplification mechanism. To provide economic intuition, consider an unanticipated monetary expansion that raises the real wage, and examine the resulting equilibrium outputs in each sector:

$$y_{C,t} = \widetilde{\lambda}_K \frac{Y}{Y_C} \left(\frac{1+\phi}{\phi} - \frac{\tau_K^D}{\lambda_K} \right) \omega_t, \tag{16}$$

$$y_{X,t} = \frac{Y}{Y_X} \left(\frac{(\lambda_S + \lambda_H)(1+\phi) - \phi}{\phi} + \tau_K^D \right) \omega_t. \tag{17}$$

Start with nondurable output. Since households in state K are the only ones adjusting nondurable consumption relative to steady state in this limit case with symmetric price stickiness, their behavior drives the sector's dynamics. These households internalize the decline in firm profits (and thus dividends) through fiscal transfers. Such mechanism is analogous to the one described in Bilbiie (2020), where HtM agents absorb the negative income effect of falling firm profits during monetary expansions. As a result, the real wage passthrough to nondurable production declines with higher τ_K^D.

Turning to $y_{X,t}$, the durable sector is fully driven by households in states S and H, as only they can adjust durable holdings. Increasing fiscal transfers to K shifts the burden of declining profits away from savers, effectively freeing up more resources for durable consumption. This amplifies the real-wage passthrough to durable demand. However, the offsetting effect on nondurables is incomplete due to imperfect risk sharing. Consequently, the expansionary effect through durables dominates.

In summary, while profit redistribution dampens the response to monetary policy in a one-sector economy, it amplifies it when durables are introduced—even if the durable sector is small.

5.2.1 Profit redistribution with wage stickiness

The aggregate effects of profit redistribution in the three-state THANK economy ultimately hinge on the cyclical behavior of dividends and, thus, the real wage. In this respect, introducing nominal wage rigidity has the potential to reshape the cyclicality of sectoral profits (for a THANK example, see Broer et al., 2019), and the way profit redistribution affects the conditional volatility of sectoral and total production. Introducing nominal wage stickiness into the model gives rise to the following log-linear wage Phillips curve:[24]

$$\pi_{W,t} = \beta E_t \pi_{W,t+1} - \frac{(1-\theta_W)(1-\beta\theta_W)}{\theta_W}\mu_{W,t}, \tag{18}$$

where $\pi_{W,t}$ denotes wage inflation and $\mu_{W,t} = \omega_t - \phi n_t - \sigma c_t$ and θ_W is the probability of not being able to adjust wages in a given period. As for the real wage, this now behaves according to $\omega_t = \omega_{t-1} + \pi_{W,t} - \pi_{C,t}$.

The right panel of Figure 8 shows that,[25] albeit to a limited extent, introducing nominal wage rigidity alters the behavior of output volatility in relation to τ_K^D, placing it on a declining path. This is due to dividends becoming procyclical. This result appears to re-establish, at least qualitatively, the key insight of Bilbiie (2020) about profit redistribution at the economy-wide level (and not just for nondurable production). However, it is worth recalling that wage stickiness would flip the behavior of conditional (nondurable) output volatility in the one-sector model too. Therefore, even in this case we conclude that, accounting for durable expenditure—no matter how large a share of the economy this represents, or whether wages are flexible or not—profoundly changes the core equilibrium properties of standard *one-sector* economies T(H)ANK economics.[26]

6 Discussion and concluding remarks

One of the main motivations for moving beyond the RA framework lies in its inability to match empirically observed marginal propensities to consume (MPC). In Ricardian models, agents smooth consumption fully, leading to unrealistically low MPCs. A large empirical literature has instead documented much higher MPCs across income and wealth groups. For instance, a common estimate is that the MPC of nondurable consumption is signicant and around 0.25 over the three months following a transitory income shock (see, e.g., Commault, 2022).[27]

[24]In line with Erceg et al. (2000), we assume each household provides some (perfectly competitive) labor packers with differentiated labor services, so as to be transformed into aggregate effective labor. A union sells labor services at the nominal wage (equalized across production sectors) to the labor recruiter, who minimizes costs given the aggregate demand for labor. In doing so, the union sets the nominal wage for one effective labor unit subject to adjustment frictions à la Calvo (1983). See Colciago (2011) for a full derivation of the log-linear wage Phillips curve in a TANK framework.

[25]We set $\theta_W = 0.857$, so that wages are re-optimized, on average, every 7 quarters—compared to 4 quarters for prices. Ensuring that wages are stickier than prices is a necessary condition for obtaining procyclical dividends.

[26]Analogous considerations apply to economies with a different asset structure (e.g., Ravn and Sterk, 2021).

[27]Estimates broadly consistent with these values are provided by Parker et al. (2013), Misra and Surico (2014), and Orchard et al. (2025), based on consumption responses to tax rebates, as well as by Fagereng et al. (2021), who study the consumption response to lottery winnings. More recent work exploits alternative sources of transitory income variation, reporting even slighly higher MPCs (see, e.g., Kan et al., 2017; Gelman et al., 2020).

Tractable HANK models address this by introducing a share of HtM households, who consume all of their income and are excluded from financial markets. This simple TA structure allows these models to reproduce key empirical features, most notably the limited consumption smoothing capacity reflected in elevated MPCs.

This paper challenges a foundational element of this approach by introducing durable goods into a tractable HANK framework. When HtM households are allowed to accumulate durables—despite lacking access to liquid financial assets—they gain access to an imperfect but effective store of value. Even if durables are illiquid and depreciate over time, they provide a channel for self-insurance. This weakens the tight link between current income and consumption for constrained agents. As a result, their behavior becomes more Ricardian, and the model's aggregate dynamics converge toward those of a representative agent economy. Crucially, this undermines the key transmission and amplification mechanisms that make household heterogeneity relevant for macroeconomic shocks.

These findings raise important concerns about the empirical relevance of tractable models in the HANK tradition. Their success depends on assuming that some agents face a complete absence of saving options. But once a basic storage technology—such as durable goods—is introduced, much of the distinct behavior of HtM households vanishes. Redistribution becomes less powerful, MPCs fall, and the aggregate effects of shocks diminish.

That said, our findings do not invalidate the usefulness of heterogeneity. In richer HANK environments, the self-insurance role of durables is limited by deeper microeconomic frictions—such as borrowing constraints, adjustment costs, or irreversibility in durable spending (see, e.g., McKay and Wieland, 2021; Holst Partsch et al., 2025). These frictions reduce the liquidity of durables and preserve meaningful differences in behavior across households. They also help match other features of the data, such as the finding that the marginal propensity to spend on durables is higher than that on nondurables, as documented for instance by Laibson et al. (2022) and Orchard et al. (2025). In this sense, while the introduction of durables poses a challenge to tractable HANK frameworks, it reinforces the case for richer models that better capture household behavior and the multiple channels through which policy shocks are transmitted.

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A TANK economy

This appendix summarizes the log-linear TANK economy and reports various derivations and proofs in the limit case of perpetual durables.

Savers:

$c_{S,t} = E_t c_{S,t+1} - \frac{1}{\sigma}\left(r_t - E_t \pi_{t+1}\right)$

$q_t - \sigma c_{S,t} = -\left[1 - \beta(1-\delta)\right]\chi x_{S,t} + \beta(1-\delta)\left(E_t q_{t+1} - \sigma E_t c_{S,t+1}\right)$

$\phi n_{S,t} = \omega_t - \sigma c_{S,t}$

$c_{S,t} + (1+\gamma)\frac{Y_X}{Y_C} e_{S,t} = (1+\gamma)\left[\frac{Y}{Y_C}\left(\omega_t + n_{S,t}\right) + \frac{1-\tau_H^D}{\lambda_S} d_{C,t} + \frac{1-\tau^D}{\lambda_S}\frac{Y_X}{Y_C} d_{X,t}\right] - \gamma\frac{1-\kappa}{\lambda_S}\upsilon_t$

$e_{S,t} = q_t + \frac{1}{\delta} x_{S,t} - \frac{1-\delta}{\delta} x_{S,t-1}$

HtM households:

$q_t - \sigma c_{H,t} = -\left[1 - \beta(1-\delta)\right]\chi x_{H,t} + \beta(1-\delta)\left(E_t q_{t+1} - \sigma E_t c_{H,t+1}\right)$

$\phi n_{H,t} = \omega_t - \sigma c_{H,t}$

$c_{H,t} + (1+\gamma)\frac{Y_X}{Y_C} e_{H,t} = (1+\gamma)\left[\frac{Y}{Y_C}\left(\omega_t + n_{H,t}\right) + \frac{\tau^D}{\lambda_H} d_{C,t} + \frac{\tau^D}{\lambda_H}\frac{Y_X}{Y_C} d_{X,t}\right] - \gamma\frac{\kappa}{\lambda_H}\upsilon_t$

$e_{H,t} = q_t + \frac{1}{\delta} x_{H,t} - \frac{1-\delta}{\delta} x_{H,t-1}$

Production and pricing:

$y_{j,t} = n_{j,t},\ j = \{C, X\}$

$d_{j,t} = -\left(w_t - p_{j,t}\right),\ j = \{C, X\}$

$\pi_{j,t} = \beta E_t \pi_{j,t+1} + \psi_j rmc_{j,t},\quad \psi_j \equiv (1-\theta_j)(1-\beta\theta_j)/\theta_j,\ j = \{C, X\}$

$rmc_{j,t} = w_t - p_{j,t},\quad j = \{C, X\}$

$q_t = q_{t-1} + \pi_{X,t} - \pi_{C,t}$

Market clearing:

$n_t = \frac{Y_X}{Y} n_{X,t} + \frac{Y_C}{Y} n_{C,t} = \lambda_H n_{H,t} + \lambda_S n_{S,t}$

$y_{C,t} = \frac{1}{1+\gamma} c_t + \frac{\gamma}{1+\gamma} g_t$

$c_t = \lambda_H c_{H,t} + \lambda_S c_{S,t}$

$y_{X,t} = \frac{1}{\delta} x_t - \frac{1-\delta}{\delta} x_{t-1}$

$x_t = \lambda_H x_{H,t} + \lambda_S x_{S,t}$

Monetary Policy:

$r_t = \phi_\pi \pi_t + \nu_t$

$\pi_t = \alpha \pi_{C,t} + (1-\alpha)\pi_{X,t}$

$\nu_t = \rho_\nu \nu_{t-1} + \varepsilon_t^\nu,$ with $\varepsilon_t^\nu \sim \text{iid}(0, \sigma_\nu^2)$

Fiscal Policy:

$g_t = \rho_g g_{t-1} + \varepsilon_t^g,$ with $\varepsilon_t^g \sim \text{iid}(0, \sigma_g^2)$

$g_t = \upsilon_t$

where ω_t denotes the real wage expressed in units of nondurables, in percentage deviation from its steady state, i.e. $\omega_t \equiv w_t - p_{C,t}$.

A.1 Aggregate TANK economy

We now aggregate the household-level blocks of the TANK economy. Taking the defintion of aggregate consumption, $c_t = \lambda_H c_{H,t} + \lambda_S c_{S,t}$ and savers's bond Euler equation, we obtain

Bond Euler:

$$\frac{1}{1-\lambda_H}(c_t - \lambda_H c_{H,t}) = \frac{1}{1-\lambda_H}(E_t c_{t+1} - \lambda_H E_t c_{H,t+1}) - \frac{1}{\sigma}(r_t - E_t \pi_{C,t+1})$$

The aggregate demand for durables, labor supply, resource constraint, and the equation defining the accumulation of the aggregate stock of durables can all be derived by simply averaging their household-specific counterparts, using λ_H and λ_S as the weights for savers and HtM households, respectively:

Durable Euler:

$$q_t - \sigma c_t = -\left[1 - \beta(1-\delta)\right]\chi x_t + \beta(1-\delta)\left(E_t q_{t+1} - \sigma E_t c_{t+1}\right)$$

Labor supply:

$$\phi n_t = \omega_t - \sigma c_t$$

Resource constraint:

$$c_t + (1+\gamma)\frac{Y_X}{Y_C}e_t = (1+\gamma)\left[\frac{Y}{Y_C}(\omega_t + n_t) + d_{C,t} + \frac{Y_X}{Y_C}d_{X,t}\right] - \gamma v_t$$

Durable dynamics:

$$x_t = (1-\delta)x_{t-1} + \delta(e_t - q_t)$$

The remaining blocks of the economy remain unchanged and are identical to those in the corresponding RANK economy. In fact, when focusing on aggregate dynamics, the two frameworks differ only in the bond Euler equation.

A.2 Proof of Proposition 1

We start from the log-linearized law of motion for durables:

$$x_{z,t} = \delta i^X_{z,t} + (1-\delta)x_{z,t-1}.$$

Taking the limit as $\delta \to 0$:

$$\lim_{\delta \to 0} x_{z,t} = \lim_{\delta \to 0} \left[\delta i^X_{z,t} + (1-\delta)x_{z,t-1}\right] = x_{z,t-1}.$$

Hence, for sufficiently small δ, the stock of durables satisfies the approximation:

$$x_{z,t} \approx x_{z,t-1}, \quad \forall t.$$

This implies that the stock evolves approximately as a random walk with little or no adjustment. In particular, if the initial condition is $x_{z,0} = 0$, then recursively we have:

$$x_{z,t} \approx 0, \quad \forall t,$$

which characterizes the unique stationary solution to the accumulation equation with perpetual durables.

Now consider the log-linearized Euler equation associated with the optimal accumulation of durables:

$$q_t - \sigma c_{z,t} = \lambda_{z,t},$$

where $\lambda_{z,t} \equiv -\left[1-\beta(1-\delta)\right]\chi E_t \left\{\sum_{i=0}^{\infty} \beta^i (1-\delta)^i x_{z,t+i}\right\}$ is the shadow value associated with the accumulation of durables. When $x_{z,t} \approx 0 \; \forall t$, and durables remain nearly constant, the marginal utility from adjusting the stock is negligible. As such, we have:

$$\lambda_{z,t} \approx 0.$$

Substituting this result into the durable Euler equation yields:

$$q_t - \sigma c_{z,t} \approx 0.$$

■

A.3 Proof of Proposition 2

When goods produced by both sectors display symmetric price stickiness, $q_t = 0$ and, by virtue of (10), household-specific and aggregate nondurable consumption remain at their steady-state values. Under these circumstances, savers' bond Euler implies $r_t \approx E_t \pi_{C,t+1}$, which we assume to hold with equality. Combining this with the Taylor rule and $\pi_{C,t} =$

$\pi_{X,t} = \pi_t$, we obtain

$$\pi_t = \frac{1}{\phi_\pi} E_t \pi_{t+1} - \frac{1}{\phi_\pi} \nu_t. \tag{A.1}$$

This equation has many solutions (see, e.g., Woodford, 2003; Evans and Honkapohja, 2012), which we can write as

$$\pi_t = \frac{1}{\phi_\pi} \pi_{t+1} - \frac{1}{\phi_\pi} \nu_t + u^\pi_{t+1}, \tag{A.2}$$

where $u^\pi_{t+1} = E_t \pi_{t+1} - \pi_{t+1}$ is any conditionally mean-zero random variable. Multiple equilibria are indexed by arbitrary initial inflation π_0, and by the arbitrary random variables, or "sunspots", u^π_{t+1}. If $\|\phi_\pi\| > 1$, all of these equilibria except one eventually explode, i.e. $\mathbb{E}_t \pi_{t+j}$ grows without bound. If we disallow such solutions, then a unique locally-bounded solution remains. We can find this solution by solving the difference equation (A.1) forward:

$$\pi_t = -\frac{1}{\phi_\pi} E_t \sum_{s=0}^{\infty} \left(\frac{1}{\phi_\pi}\right)^s \nu_{t+s} = -\frac{1}{\phi_\pi - \rho_\nu} \nu_t, \tag{A.3}$$

where we have used $E_t[\nu_{t+s}] = \rho^s_\nu \nu_t$, relying on the AR(1) structure and the zero-mean property of ε^ν_t. ∎

A.4 Further derivations in the limit case of perpetual durables

Next—sticking to the case of a monetary policy shock—as $\sigma c_{z,t} = q_t = 0$ is assumed to hold in the case of perpetual durables, for $z = \{S, H\}$, individual labor supply implies $\phi n_{z,t} = \omega_t$. Aggregating the latter over the two households and combining it with the aggregate production technology, $y_t = n_t$:

$$y_t = \frac{1}{\phi} \omega_t. \tag{A.4}$$

As for the aggregate NKPC, this can be represented as

$$\pi_t = \beta E_t \pi_{t+1} + \psi \omega_t, \tag{A.5}$$

which can be combined with (A.3) to obtain

$$\omega_t = -\frac{1 - \beta \rho_\nu}{\psi\left(\phi_\pi - \rho_\nu\right)} \nu_t. \tag{A.6}$$

Therefore, combining the latter with (A.4), we obtain

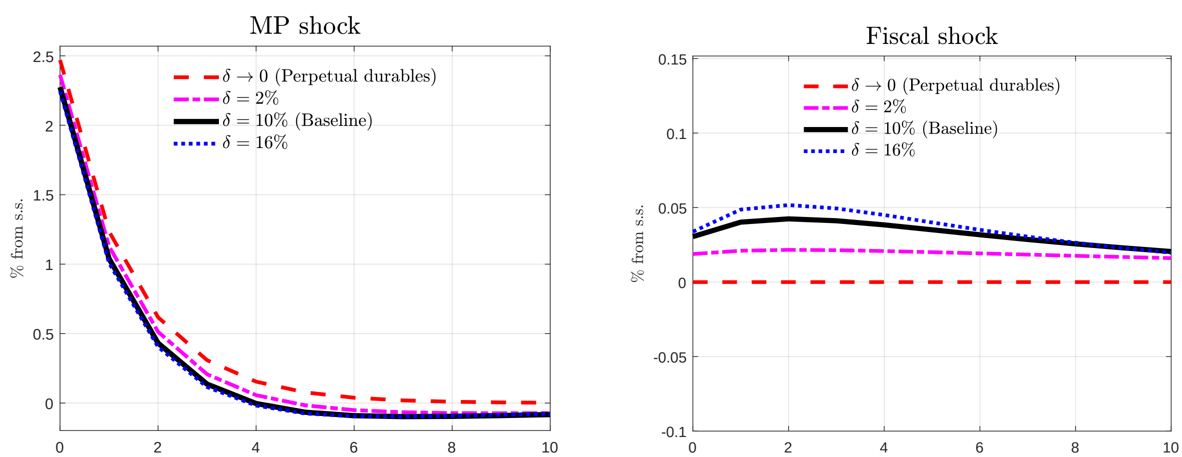
$$y_t = -\frac{1-\beta\rho_\nu}{\psi\phi\left(\phi_\pi - \rho_\nu\right)}\nu_t. \tag{A.7}$$

As for sectoral dynamics, $y_{C,t} = 0$ and $y_{X,t} = -\frac{Y}{Y_X}\frac{1-\beta\rho_\nu}{\psi\phi(\phi_\pi-\rho_\nu)}\nu_t$, which are equivalent to their counterparts from a two-sector RANK economy in the limits case of perpetual durables.

A.5 Approximation in the limit case of perpetual durables

Figure A.1 displays the response of aggregate output to a monetary policy shock (LHS) and a fiscal shock (RHS), both in the baseline model and the limit case with perpetual durables. Plots also include IRFs from two alternative values of the depreciation rate: one implying long-lived durables (2%)—calibrated to match the depreciation of housing as in Harding et al. (2007)—and another with a higher depreciation rate (16%), reflecting a calibration that explicitly excludes housing, as in Cao et al. (2025). While the quantitative responses vary somewhat across specifications, the impulse-response functions remain qualitatively similar. Deviations arising from $\delta > 0$ have only a modest effect on the model's dynamics, thus supporting the use of the limit case as a valid approximation for building intuition about the baseline model. More broadly, various implications of our analysis are expected to carry through even for durables with higher depreciation rates.

Figure A.1: Output responses for different rates of depreciation



A.6 Equilibrium dynamics under asymmetric sectoral stickiness

This appendix derives the sectoral equilibrium dynamics in response to a monetary shock in the limit case of perpetual durables, focusing on polar cases of asymmetric price stickiness—where one sector features fully flexible prices and the other exhibits sticky prices. The analysis highlights the resulting negative comovement in sectoral output. For clarity of exposition, we abstract from fiscal spending by setting $\gamma = 0$.

A.6.1 Flexible prices of durables

From S's labor supply:

$$\phi n_{S,t} = w_t - p_{X,t} + q_t - \sigma c_{S,t}, \tag{A.8}$$

where $w_t - p_{X,t} = 0$ due to the assumption of flexible prices in the durables sector, and $q_t - \sigma c_{S,t}$ is approximately zero due to full durability. Analogous reasoning for H leads us to conclude that $n_{H,t} = n_{S,t} = n_t = y_t = 0$, and $y_{C,t} = -\frac{Y_X}{Y_C} y_{X,t}$ (in line with Barsky et al., 2007), thus implying negative sectoral comovement. Therefore, the following autonomous system characterizes the equilibrium under flexible prices in the durable sector:

$$y_{C,t} = E_t y_{C,t+1} - \sigma^{-1} \left(r_t - E_t \pi_{C,t+1} \right), \tag{A.9}$$

$$\pi_{C,t} = \beta E_t \pi_{C,t+1} + \psi_C \sigma y_{C,t}, \tag{A.10}$$

$$r_t = \phi_\pi \pi_{C,t} + \nu_t. \tag{A.11}$$

Conjecturing a solution of the form

$$\begin{aligned}
y_{C,t} &= a_y \nu_t, \\
\pi_{C,t} &= a_\pi \nu_t, \\
E_t y_{C,t+1} &= a_y \rho_\nu \nu_t, \\
E_t \pi_{C,t+1} &= a_\pi \rho_\nu \nu_t,
\end{aligned}$$

we obtain

$$\begin{aligned}
a_y &= -\frac{1 - \beta \rho_\nu}{\sigma \left[\left(1 - \beta \rho_\nu\right)\left(1 - \rho_\nu\right) + \psi_C \left(\phi_\pi - \rho_\nu\right) \right]}, \\
a_\pi &= -\frac{\psi_C}{\left(1 - \beta \rho_\nu\right)\left(1 - \rho_\nu\right) + \psi_C \left(\phi_\pi - \rho_\nu\right)},
\end{aligned}$$

so that

$$y_{C,t} = -\frac{(1-\beta\rho_\nu)\sigma^{-1}}{(1-\beta\rho_\nu)(1-\rho_\nu)+\psi_C(\phi_\pi-\rho_\nu)}\nu_t, \tag{A.12}$$

$$y_{X,t} = \frac{Y_C}{Y_X}\cdot\frac{(1-\beta\rho_\nu)\sigma^{-1}}{(1-\beta\rho_\nu)(1-\rho_\nu)+\psi_C(\phi_\pi-\rho_\nu)}\nu_t, \tag{A.13}$$

confirming negative sectoral comovement.

A.6.2 Flexible prices of nondurables

In this case, from z's labor supply:

$$\phi n_{z,t} = \omega_t - \sigma c_{z,t}, \text{for } z = \{S, H\}, \tag{A.14}$$

where $\omega_t = 0$ due to the assumption of flexible prices in the nondurables sector, and $c_{S,t} = c_{H,t} = y_{C,t}$ in the limit case of perpetual durables. Thus, aggregating over households' labor supply schedules:

$$n_t = y_t = -\frac{\sigma}{\phi}y_{C,t}. \tag{A.15}$$

From the aggregate resource constraint, it follows:

$$y_{C,t} = -\frac{Y_X}{\phi Y_C + \sigma Y}y_{X,t}, \tag{A.16}$$

confirming negative sectoral comovement. Conjecturing

$$\begin{aligned}
y_{C,t} &= a_y\nu_t, \\
\pi_{X,t} &= a_\pi\nu_t, \\
E_t y_{C,t+1} &= a_y\rho_\nu\nu_t, \\
E_t\pi_{X,t+1} &= a_\pi\rho_\nu\nu_t,
\end{aligned}$$

we obtain

$$\begin{aligned}
a_y &= -\frac{(1-\beta\rho_\nu)\,\sigma^{-1}}{(1-\beta\rho_\nu)(1-\rho_\nu)-\phi_\pi\psi_X}, \\
a_\pi &= \frac{\psi_X}{(1-\beta\rho_\nu)(1-\rho_\nu)-\phi_\pi\psi_X}.
\end{aligned}$$

Thus,

$$y_{C,t} = -\frac{(1-\beta\rho_\nu)\,\sigma^{-1}}{(1-\beta\rho_\nu)\,(1-\rho_\nu)-\phi_\pi\psi_X}\nu_t, \tag{A.17}$$

$$y_{X,t} = \frac{\phi Y_C+\sigma Y}{Y_X}\frac{(1-\beta\rho_\nu)\,\sigma^{-1}}{(1-\beta\rho_\nu)\,(1-\rho_\nu)-\phi_\pi\psi_X}\nu_t, \tag{A.18}$$

again implying negative sectoral comovement.

B The two-state THANK economy

The problem for the family head in the two-state THANK economy reads as:

$$\max_{C_{S,t},C_{H,t},X_{S,t},X_{H,t},N_{S,t},N_{H,t},\Omega_{S,t},Z_{S,t},Z_{H,t}} E_t\left\{\sum_{i=0}^{\infty}\beta^i\left[\lambda_S\left(\frac{C_{S,t+i}^{1-\sigma}}{1-\sigma}+\eta\frac{X_{S,t+i}^{1-\chi}}{1-\chi}-\varpi\frac{N_{S,t+i}^{1+\phi}}{1+\phi}\right)\right.\right.$$
$$\left.\left.+\lambda_H\left(\frac{C_{H,t+i}^{1-\sigma}}{1-\sigma}+\eta\frac{X_{H,t+i}^{1-\chi}}{1-\chi}-\varpi\frac{N_{H,t+i}^{1+\phi}}{1+\phi}\right)\right]\right\}$$

s.t.

$$\begin{aligned}
C_{S,t}+Q_tI_{S,t}^X+\Omega_{S,t}V_t+Z_{S,t} &= \frac{1+r_{t-1}}{1+\pi_{C,t}}B_{S,t-1}+\Omega_{S,t-1}\left(V_t+D_t\right)+\frac{W_t}{P_{C,t}}N_{S,t}-\Upsilon_{S,t},\\
C_{H,t}+Q_tI_{H,t}^X+Z_{H,t} &= \frac{1+r_{t-1}}{1+\pi_{C,t}}B_{H,t-1}+\frac{W_t}{P_{C,t}}N_{H,t}+T_{H,t}-\Upsilon_{H,t},\\
\lambda_S\widetilde{X}_{S,t} &= \lambda_S\varrho_{SS}X_{S,t}+\lambda_H\varrho_{HS}X_{H,t},\\
\lambda_H\widetilde{X}_{H,t} &= \lambda_S\varrho_{SH}X_{S,t}+\lambda_H\varrho_{HH}X_{H,t},\\
\lambda_SB_{S,t} &= \lambda_S\varrho_{SS}Z_{S,t}+\lambda_H\varrho_{HS}Z_{H,t},\\
\lambda_HB_{H,t} &= \lambda_S\varrho_{SH}Z_{S,t}+\lambda_H\varrho_{HH}Z_{H,t},
\end{aligned}$$

where, for $z\in\{H,S\}$, $I_{z,t}^X = X_{z,t}-(1-\delta)\widetilde{X}_{z,t-1}$, $\widetilde{X}_{z,t}$ and $X_{z,t}$ respectively denote the beginning-of-period-t and end-of-period-$t-1$ stocks of durables, while $B_{z,t}$ ($Z_{z,t}$) denotes the beginning-of-period-t (end-of-period-$t-1$) stock of bonds. In the remainder, we consider no government provided liquidity (see, e.g., Krusell et al., 2011). Therefore, bond supply is zero, even in the presence of a well-defined demand, such as that expressed by S. As for households drawn to move/stay on island H, we assume they are constrained in the access to any financial saving technology.[28]

Under our assumptions, the only equilibrium condition governing bond-holding demand is S's Euler equation:

$$C_{S,t}^{-\sigma} = \beta E_t \left\{ \frac{1+r_t}{1+\pi_{C,t+1}} \left[\varrho_{SS} C_{S,t+1}^{-\sigma} + \varrho_{SH} C_{H,t+1}^{-\sigma} \right] \right\}, \tag{B.1}$$

which characterizes, compared with the analogous equation in the TANK model, in that it accounts for potential transition across states.

The two-state THANK model also differs from its TANK counterpart with respect to the Euler equations for durables:

$$Q_t C_{S,t}^{-\sigma} = \eta X_{S,t}^{-\chi} + \beta(1-\delta) E_t \left\{ \varrho_{SS} Q_{t+1} C_{S,t+1}^{-\sigma} + \varrho_{SH} Q_{t+1} C_{H,t+1}^{-\sigma} \right\}, \tag{B.2}$$

$$Q_t C_{H,t}^{-\sigma} = \eta X_{H,t}^{-\chi} + \beta(1-\delta) E_t \left\{ \varrho_{HH} Q_{t+1} C_{H,t+1}^{-\sigma} + \varrho_{HS} Q_{t+1} C_{S,t+1}^{-\sigma} \right\}. \tag{B.3}$$

B.1 Proof of Proposition 3

Let $x_t = [x_{S,t}, x_{H,t}]'$ denote the vector of agents' stocks of durables, and let $i_t^X = [i_{S,t}^X, i_{H,t}^X]'$ denote the vector of corresponding durable investment flows. Define the transition matrix

$$A = \begin{pmatrix} \varrho_{SS} & \varrho_{SH} \\ \varrho_{HS} & \varrho_{HH} \end{pmatrix},$$

so that the law of motion for durables can be written compactly as $x_t = \delta i_t^X + (1-\delta) A x_{t-1}$. Since A is a matrix of transition probabilities with each of its rows summing to one, its spectral radius satisfies $\rho(A) = 1$. Consequently, the scaled matrix $(1-\delta)A$ has spectral radius $\rho((1-\delta)A) = 1-\delta < 1$ for any $\delta > 0$, and is therefore a contraction.

Forward iteration yields:

$$x_t = (1-\delta)^t A^t x_0 + \delta \sum_{j=0}^{t-1} (1-\delta)^j A^j i_{t-1-j}^X.$$

Each term on the right side of this expression is continuous in δ and uniformly bounded. The first term decays geometrically in t as $\delta \to 0$, while the second term is of order $\mathcal{O}(\delta)$, as it

[28] Bilbiie (2024) proposes different explanations why liquidity-constrained households' bond Euler may not hold, including the presence of potential technological constraint that prevents them from investing in liquid financial assets.

represents a weighted sum of bounded investment flows, each scaled by δ. It follows that

$$x_t = \mathcal{O}((1-\delta)^t) + \mathcal{O}(\delta) \to 0 \quad \text{as } \delta \to 0, \quad \forall t \geq 0.$$

Therefore, $x_{S,t} \approx x_{H,t} \approx 0 \; \forall t \geq 0$ as $\delta \to 0$. This in turn implies $\sigma c_{S,t} \approx q_t \approx \sigma c_{H,t}$, from the log-linear counterparts of equations (B.2) and (B.3). Accordingly, one can derive an aggregate Euler equation for nondurable consumption:

$$c_t = (\varrho_{SS} + \varrho_{SH}) E_t c_{t+1} - \frac{1}{\sigma} (r_t - E_t \pi_{t+1}) \,. \tag{B.4}$$

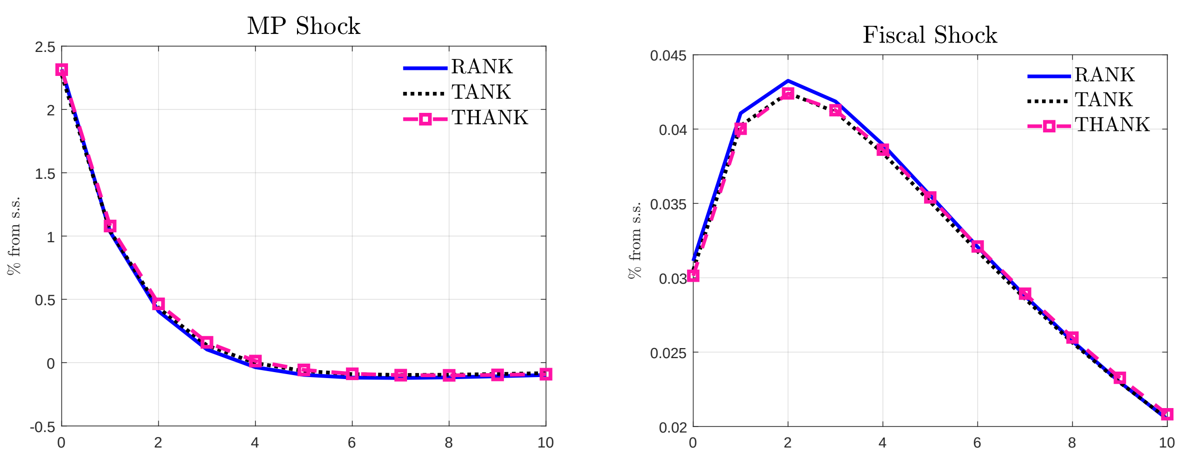
However, since $\varrho_{SS} + \varrho_{SH} = 1$, equation (B.4) is equivalent to the Euler equation in a TANK setting, which coincides with that of a RANK model in the presence of durable goods.

■

B.2 Two-sector RANK, TANK and THANK

In Figure B.1, we report the output response to expansionary monetary and fiscal spending shocks in the two-sector RANK, TANK and two-state THANK models. The impulse responses of the three frameworks closely align—consistent with the results of Proposition 3.

Figure B.1: RANK, TANK and THANK – responses of aggregate output



C The three-state THANK economy

C.1 Utility maximization

Relative to the two-state THANK model, a distinctive trait of this economy is that the stock of durables cannot be modified relative to the level inherited from the preceding period, on island K. This amounts to impose the restriction $X_{K,t} = (1-\delta)\widetilde{X}_{K,t-1}$.

The head of family's optimization problem reads as

$$
\begin{aligned}
\max_{C_{S,t},C_{H,t},C_{K,t},X_{S,t},X_{H,t},N_{S,t},N_{H,t},N_{K,t},\Omega_{S,t},Z_{S,t},Z_{H,t}} E_t \Bigg\{ \sum_{i=0}^{\infty} \beta^i \Bigg[& \lambda_S \left(\frac{C_{S,t+i}^{1-\sigma}}{1-\sigma} + \eta \frac{X_{S,t+i}^{1-\chi}}{1-\chi} - \varpi \frac{N_{S,t+i}^{1+\phi}}{1+\phi} \right) \\
& + \lambda_H \left(\frac{C_{H,t+i}^{1-\sigma}}{1-\sigma} + \eta \frac{X_{H,t+i}^{1-\chi}}{1-\chi} - \varpi \frac{N_{H,t+i}^{1+\phi}}{1+\phi} \right) \\
& + \lambda_K \left(\frac{C_{K,t+i}^{1-\sigma}}{1-\sigma} - \varpi \frac{N_{K,t+i}^{1+\phi}}{1+\phi} \right) \Bigg] \Bigg\}
\end{aligned}
$$

s.t.

$$
\begin{aligned}
C_{S,t} + Q_t \left[X_{S,t} - (1-\delta)\widetilde{X}_{S,t-1} \right] + \Omega_{S,t} V_t + Z_{S,t} &= \frac{1+r_{t-1}}{1+\pi_{C,t}} B_{S,t-1} + \Omega_{S,t-1}(V_t + D_t) + \frac{W_t}{P_{C,t}} N_{S,t} - \Upsilon_{S,t}, \\
C_{H,t} + Q_t \left[X_{H,t} - (1-\delta)\widetilde{X}_{H,t-1} \right] + Z_{H,t} &= \frac{1+r_{t-1}}{1+\pi_{C,t}} B_{H,t-1} + \frac{W_t}{P_{C,t}} N_{H,t} + T_{H,t} - \Upsilon_{H,t}, \\
C_{K,t} + Q_t \left[X_{K,t} - (1-\delta)\widetilde{X}_{K,t-1} \right] + \Xi_K + Z_{K,t} &= \frac{1+r_{t-1}}{1+\pi_{C,t}} B_{K,t-1} + \frac{W_t}{P_{C,t}} N_{K,t} + T_{K,t} - \Upsilon_{K,t} \\
\lambda_S \widetilde{X}_{S,t} &= \varrho_{SS}\lambda_S X_{S,t} + \varrho_{HS}\lambda_H X_{H,t} + \varrho_{KS}\lambda_K X_{K,t}, \\
\lambda_H \widetilde{X}_{H,t} &= \varrho_{SH}\lambda_S X_{S,t} + \varrho_{HH}\lambda_H X_{H,t} + \varrho_{KH}\lambda_K X_{K,t}, \\
\lambda_K \widetilde{X}_{K,t} &= \varrho_{SK}\lambda_S X_{S,t} + \varrho_{HK}\lambda_H X_{H,t} + \varrho_{KK}\lambda_K X_{K,t}, \\
\lambda_S B_{S,t} &= \varrho_{SS}\lambda_S Z_{S,t} + \varrho_{HS}\lambda_H Z_{H,t} + \varrho_{KS}\lambda_K Z_{K,t}, \\
\lambda_H B_{H,t} &= \varrho_{SH}\lambda_S Z_{S,t} + \varrho_{HH}\lambda_H Z_{H,t} + \varrho_{KH}\lambda_K Z_{K,t}, \\
\lambda_K B_{K,t} &= \varrho_{SK}\lambda_S Z_{S,t} + \varrho_{HK}\lambda_H Z_{H,t} + \varrho_{KK}\lambda_K Z_{K,t}, \\
X_{K,t} &= (1-\delta)\widetilde{X}_{K,t-1}.
\end{aligned}
$$

The main novelty brought by this setup, compared to the two-state THANK model, is represented by the Euler equations for durables on islands S, H, and K, respectively:

$$C_{S,t}^{-\sigma}Q_t = \eta X_{S,t}^{-\chi} + \beta(1-\delta)E_t\left\{\varrho_{SS}C_{S,t+1}^{-\sigma}Q_{t+1} + \varrho_{SH}C_{H,t+1}^{-\sigma}Q_{t+1} + \varrho_{SK}\Psi_{t+1}\right\}, \quad (C.1)$$

$$C_{H,t}^{-\sigma}Q_t = \eta X_{H,t}^{-\chi} + \beta(1-\delta)E_t\left\{\varrho_{HS}C_{S,t+1}^{-\sigma}Q_{t+1} + \varrho_{HH}C_{H,t+1}^{-\sigma}Q_{t+1} + \varrho_{HK}\Psi_{t+1}\right\}, \quad (C.2)$$

$$\Psi_t = \eta_K X_{K,t}^{-\chi} + \beta(1-\delta)E_t\left\{\varrho_{KS}C_{S,t+1}^{-\sigma}Q_{t+1} + \varrho_{KH}C_{H,t+1}^{-\sigma}Q_{t+1} + \varrho_{KK}\Psi_{t+1}\right\}. \quad (C.3)$$

where Ψ_t is the multiplier applying to the liquidity constraint. Otherwise, our assumptions ensure once again that the only equilibrium condition governing bond-holding demand is S's Euler equation:

$$C_{S,t}^{-\sigma} = \beta E_t\left\{\frac{1+r_t}{1+\pi_{C,t+1}}\left[\varrho_{SS}C_{S,t+1}^{-\sigma} + \varrho_{SH}C_{H,t+1}^{-\sigma} + \varrho_{SK}C_{K,t+1}^{-\sigma}\right]\right\}, \quad (C.4)$$

C.2 Log-linear economy

Based on the restrictions of the transition probabilities, we obtain the following log-linear economy:

Island S:

$$c_{S,t} = \varrho_{SS}E_tc_{S,t+1} + \varrho_{SH}E_tc_{H,t+1} + \varrho_{SK}E_tc_{K,t+1} - \tfrac{1}{\sigma}\left(r_t - E_t\pi_{C,t+1}\right)$$

$$q_t - \sigma c_{S,t} = -[1-\beta(1-\delta)]\chi x_{S,t} + \beta\left(1-\delta\right)\left[\varrho_{SS}\left(E_tq_{t+1} - \sigma E_tc_{S,t+1}\right) + \varrho_{SH}\left(E_tq_{t+1} - \sigma E_tc_{H,t+1}\right)\right]$$

$$\phi n_{S,t} = \omega_t - \sigma c_{S,t}$$

$$c_{S,t} + (1+\gamma)\tfrac{Y_X}{Y_C}e_{S,t} = (1+\gamma)\left[\tfrac{Y}{Y_C}\left(\omega_t + n_{S,t}\right) + \tfrac{1-\tau_K^D-\tau_H^D}{\lambda_S}d_{C,t} + \tfrac{1-\tau_K^D-\tau_H^D}{\lambda_S}\tfrac{Y_X}{Y_C}d_{X,t}\right] - \gamma\tfrac{1-\kappa_H-\kappa_K}{\lambda_S}\upsilon_t$$

$$e_{S,t} = q_t + \tfrac{1}{\delta}x_{S,t} - \tfrac{1-\delta}{\delta}\left(\varrho_{SS}x_{S,t-1} + \varrho_{HS}\tfrac{\lambda_H}{\lambda_S}x_{H,t-1} + \varrho_{KS}\tfrac{\lambda_K}{\lambda_S}x_{K,t-1}\right)$$

Island H:

$$q_t - \sigma c_{H,t} = -[1-\beta(1-\delta)]\chi x_{H,t}$$
$$+\beta\left(1-\delta\right)\left[\varrho_{HS}\left(E_tq_{t+1} - \sigma E_tc_{S,t+1}\right) + \varrho_{HH}\left(E_tq_{t+1} - \sigma E_tc_{H,t+1}\right) + \varrho_{HK}E_t\psi_{t+1}\right]$$

$$\phi n_{H,t} = \omega_t - \sigma c_{H,t}$$

$$c_{H,t} + (1+\gamma)\tfrac{Y_X}{Y_C}e_{H,t} = (1+\gamma)\left[\tfrac{Y}{Y_C}\left(\omega_t + n_{H,t}\right) + \tfrac{\tau_H^D}{\lambda_H}d_{C,t} + \tfrac{\tau_H^D}{\lambda_H}\tfrac{Y_X}{Y_C}d_{X,t}\right] - \gamma\tfrac{\kappa_H}{\lambda_H}\upsilon_t$$

$$e_{H,t} = q_t + \tfrac{1}{\delta}x_{H,t} - \tfrac{1-\delta}{\delta}\left(\varrho_{HH}x_{H,t-1} + \varrho_{SH}\tfrac{\lambda_S}{\lambda_H}x_{S,t-1} + \varrho_{KH}\tfrac{\lambda_K}{\lambda_H}x_{K,t-1}\right)$$

Island K:
$\psi_t = -[1-\beta(1-\delta)]\chi x_{K,t} + \beta(1-\delta)\left[\varrho_{KH}\left(E_t q_{t+1} - \sigma E_t c_{H,t+1}\right) + \varrho_{KK} E_t \psi_{t+1}\right]$
$\phi n_{K,t} = \omega_t - \sigma c_{K,t}$
$c_{K,t} = (1+\gamma)\left[\frac{Y}{Y_C}\left(\omega_t + n_{K,t}\right) + \frac{\tau_K^D}{\lambda_K} d_{C,t} + \frac{\tau_K^D}{\lambda_K}\frac{Y_X}{Y_C} d_{X,t}\right] - \gamma\frac{\kappa_K}{\lambda_K}\upsilon_t$
$x_{K,t} = (1-\delta)\widetilde{x}_{K,t-1}$

Production, pricing and profits:
$y_{j,t} = n_{j,t},\ j = \{C, X\}$
$rmc_{j,t} = w_t - p_{j,t},\ j = \{C, X\}$
$d_{j,t} = -rmc_{j,t},\ j = \{C, X\}$
$\pi_{j,t} = \beta E_t \pi_{j,t+1} + \psi_j rmc_{j,t}, \psi_j \equiv (1-\theta_j)(1-\beta\theta_j)/\theta_j,\ j = \{C, X\}$
$q_t = q_{t-1} + \pi_{X,t} - \pi_{C,t}$

Market clearing:
$n_t = \frac{Y_X}{Y} n_{X,t} + \frac{Y_C}{Y} n_{C,t} = \lambda_H n_{H,t} + \lambda_K n_{K,t} + \lambda_S n_{S,t}$
$y_{C,t} = \frac{1}{1+\gamma} c_t + \frac{\gamma}{1+\gamma} g_t$
$c_t = \lambda_H c_{H,t} + \lambda_K c_{K,t} + \lambda_S c_{S,t}$
$y_{X,t} = \frac{1}{\delta} x_t - \frac{1-\delta}{\delta} x_{t-1}$

Monetary policy:
$r_t = \phi_\pi \pi_t + \nu_t$
$\pi_t = \alpha \pi_{C,t} + (1-\alpha)\pi_{X,t}$
$\nu_t = \rho_\nu \nu_{t-1} + \varepsilon_t^\nu$

Fiscal Policy:
$g_t = \rho_g g_{t-1} + \varepsilon_t^g,$ with $\varepsilon_t^g \sim \text{iid}(0, \sigma_g^2)$
$g_t = \upsilon_t$

C.3 Sectoral dynamics in the limit case

As in the case of the two-state THANK economy, assuming $\delta \to 0$ implies that the log-linear counterparts of equations (C.1)-(C.3) form a stationary system that converges to zero. Therefore, even in this case we can rely on the consumption risk-sharing condition involving H and S. Furthermore, as we focus on the transmission of monetary shocks, we set $\gamma = 0$, without loss of generality.

In the case of symmetric sectoral price stickiness, the real wage can be determined as in the corresponding TANK scenario. Combine the bond Euler and the Taylor rule to obtain

$$\pi_t = \frac{1}{\phi_\pi} E_t \pi_{t+1} - \frac{1}{\phi_\pi} \nu_t, \tag{C.5}$$

So that we iterate the equation forward, assuming $\phi_\pi > 1$, and pin down the rate of inflation:

$$\pi_t = -\frac{1}{\phi_\pi} E_t \sum_{s=0}^{\infty} \left(\frac{1}{\phi_\pi} \right)^s \nu_{t+s} = -\frac{1}{\phi_\pi - \rho_\nu} \nu_t, \tag{C.6}$$

Thus, from the aggregate NKPC:

$$\omega_t = -\frac{1 - \beta \rho_\nu}{\psi \left(\phi_\pi - \rho_\nu \right)} \nu_t, \tag{C.7}$$

which is equivalent to the solution obtained in the RANK, TANK and the two-state THANK settings (cf. equation A.6).

Now take the budget constraints of H and S, and consolidate them in light of full durability: *i)* $c_{H,t} = c_{S,t} = q_t = 0$, so that $\omega_t = w_t - p_{X,t}$ and $d_{C,t} = d_{X,t} = -\omega_t$; *ii)* $n_{S,t} = n_{H,t} = \frac{1}{\phi} \omega_t$:

$$\frac{Y_X}{Y_C} (\lambda_H e_{H,t} + \lambda_S e_{S,t}) = \frac{Y}{Y_C} \frac{(\lambda_H + \lambda_S)(1 + \phi)}{\phi} \omega_t - (1 - \tau_K^D) \frac{Y}{Y_C} \omega_t. \tag{C.8}$$

As $e_{S,t}$ is null by virtue of the liquidity constraint applying to K, $y_{X,t} = \lambda_S e_{S,t} + \lambda_H e_{H,t}$, so that

$$y_{X,t} = \frac{Y}{Y_X} \left(\frac{(\lambda_S + \lambda_H)(1 + \phi) - \phi}{\phi} + \tau_K^D \right) \omega_t. \tag{C.9}$$

Take now K's budget constraint:

$$c_{K,t} = \frac{Y}{Y_C} \left(\omega_t + n_{K,t} \right) + \frac{\tau_K^D}{\lambda_K} d_{C,t} + \frac{\tau_K^D}{\lambda_K} \frac{Y_X}{Y_C} d_{X,t}, \tag{C.10}$$

and combine it with $d_{C,t} = d_{X,t} = -\omega_t$, $c_{K,t} = \frac{1}{\lambda_K} y_{C,t}$ and $n_{K,t} = \frac{1}{\phi} \omega_t - \frac{\sigma}{\phi} c_{K,t}$ to obtain

$$y_{C,t} = \frac{\lambda_K \phi Y}{\phi Y_C + \sigma Y} \left(\frac{1 + \phi}{\phi} - \frac{\tau_K^D}{\lambda_K} \right) \omega_t. \tag{C.11}$$

Together with (C.9), the latter allows us to obtain

$$y_t = \left(\frac{(\lambda_S + \lambda_H)(1+\phi) - \phi}{\phi} + \frac{\widetilde{\lambda}_K(1+\phi)}{\phi} \right) \omega_t + \frac{\sigma Y}{\phi Y_C + \sigma Y} \tau_K^D \omega_t, \tag{C.12}$$

where $\widetilde{\lambda}_K \equiv \frac{\phi Y_C}{\phi Y_C + \sigma Y} \lambda_K$ and we have collected terms so as to isolate the part of passthrough that depends on τ_K^D.

C.4 Proof of Proposition 4

As equation (C.7) characterizes the equilibrium response of the real wage in both the two-agent/state and the three-state THANK models, it suffices to compare the passthrough from ω_t to y_t in the latter with that in the RANK model (or equivalently, the TANK and two-state THANK models), where the relationship is given by $y_t = \frac{1}{\phi}\omega_t$ (see Appendix A.4 for derivations).

Imposing $\tau_K^D = 0$ in equation (C.12), the response of aggregate demand in the three-state model is strictly lower than in the benchmark settings if the following inequality holds:

$$\frac{(\lambda_S + \lambda_H)(1+\phi) - \phi}{\phi} + \frac{\widetilde{\lambda}_K(1+\phi)}{\phi} < \frac{1}{\phi}. \tag{C.13}$$

This expression simplifies to the condition $\lambda_S + \lambda_H + \widetilde{\lambda}_K < 1$, which is always satisfied since $\widetilde{\lambda}_K \equiv \frac{\phi Y_C}{\phi Y_C + \sigma Y} \lambda_K < \lambda_K$ by construction.

■

C.5 Proof of Proposition 5

As shown in equation (C.7), the real wage responds negatively to a monetary policy shock with a given sign. It follows from equation (C.12) that aggregate output moves in the same direction as the real wage, and that the magnitude of this response increases monotonically with τ_K^D.

■