Consumer Durables in T(H)ANK Economies*

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March 19, 2024

Abstract

Introducing consumer durables in otherwise standard one-sector heterogeneous-agent New Keynesian economies—where some consumers may infrequently participate in financial markets—drastically affects some fundamental properties of these frameworks, in the face of monetary policy shocks. Along with producing utility from a stream of services, durables may be used as a store of value, thus facilitating the emergence of a risk-sharing condition that links nondurable purchases of savers and liquidity-constrained households. Factors typically key in shaping monetary transmission in benchmark one-sector economies—such as fiscal transfers from liquidity unconstrained to constrained households—only affect household-specific durable expenditure, while having no effects in the aggregate. Accounting for illiquidity in durable adjustment makes fiscal transfers non-neutral, both at the household and at the sectoral level. Moreover, fiscal redistribution *amplifies* the response of GDP to monetary shocks, unlike what found in economies featuring nondurable production only.

Keywords: Heterogeneous agents, durable goods, monetary policy, fiscal transfers.

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

*We wish to thank Davide Debortoli, Jeppe Druedahl, Francesco Saverio Gaudio, Riccardo Masolo, Erik Öberg, Celine Poilly, Søren Hove Ravn, Petr Sedlacek, as well as seminar participants at Aix-Marseille University (AMSE) and Catholic University of Milan for useful comments.

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1 Introduction

In recent years, the macroeconomic literature has established various lines of enquiry on the connection between incomplete markets and household heterogeneity, with the aim of understanding both the aggregate and the distributive outcomes of shocks to the economy (Coibion et al., 2017; Kaplan et al., 2018; Kogan et al., 2020, among others). Concurrently, a certain interest has emerged in developing analytically tractable models that can capture the salient features of heterogeneous-agent (HA) economies (see, e.g., Bilbiie, 2020; Bilbiie, 2021; Ravn and Sterk, 2021). That said, much of our understanding of the trasmission of monetary policy—and most of the analytical literature employing HA New Keynesian (HANK) models is no exception—comes from one-sector economies where only nondurable goods are available for consumption. Yet, it is well known that large part of consumption fluctuations reflect movements in the durable component (both at the household and at the aggregate level; see Attanasio, 1999; Stock and Watson, 1999). Moreover, consumer spending on durables is far more sensitive to changes in the interest rate than is expenditure on nondurables and services (Mankiw, 1985).

This paper examines the role of consumer durables for monetary transmission in sticky-price HA models. To this end, we devise a tractable setting where households may infrequently participate in financial markets and, crucially, have no access to liquid financial assets. The common trait of the economies we consider is that households derive utility from both nondurable consumption goods and services from durable holdings. Our key contribution is to show how durables non-trivially affect some fundamental properties of comparable one-sector HANK models (e.g., Bilbiie, 2008, 2020), particularly in connection with the aggregate implications of fiscal redistribution involving agents with different access to liquid financial assets.

Durable goods are peculiar in that they can be both accumulated and traded on second-hand markets. As such, they represent a store of value to transfer wealth across time, a valuable property for households that are constrained in the access to financial assets. When subject to slow depreciation, durables preserve a quasi-constant shadow value, in the face of temporary shocks, (Barsky et al., 2007). In light of this, the shadow value of income for an agent that buys durables mirrors changes in their price relative to that of nondurables. When transposing this logic to HA settings, an endogenous *risk-sharing* condition obtains. We show this to be the case both in a two-agent New Keynesian (TANK) setting where limited participation to the financial market applies deterministically—so that households are inviariantly sorted into savers and hand-to-mouth (HtM) consumers—and in a setting characterized by idiosyncratic risk, where consumers may switch between the two financial states. The latter is referred to as the 2-state THANK model (where "T" stands for "tractable", as in Bilbiie, 2021).

Even if HtM households do not access a saving technology—at least from time to time—they can still smooth their nondurable consumption profile through durable purchases. Following a monetary shock, both savers' and HtM households' nondurable consumption levels remain at the (symmetric) steady state—when the relative price of durables does not vary—or display analogous deviations from the steady state—net of a factor that depends on agent-specific curvature of nondurable utility—when sectors exhibit asymmetric price stickiness (and, thus, the relative price changes). In this second scenario, contrary to the prediction of one-sector TANK economies (Bilbiie, 2008), a rise in the real interest rate consistently leads to a contraction in aggregate nondurable expenditure, irrespective of the HtM population's size.

A defining feature of HANK models is that fiscal policy plays a key role in shaping monetary transmission. Bilbiie (2020), for instance, this property is embodied by fiscal redistribution of monopoly profits from savers to HtM consumers. When durables are available, instead, fiscal redistribution is neutral to both household-specific and sectoral *nondurable* consumption, regardless of how sectoral price stickiness is calibrated.[1] In fact, only preference heterogeneity may activate the HtM channel, in a setting where liquidity-constrained households may effectively save by accumulating durables. This is because durables insulate HtM households' nondurable consumption from changes in sectoral profits that occur when demand (and, thus, real wages) vary, for whatever reason, and in either sector. Consequently, transfers are also neutral to the sectoral demand of *durables*, while being purely redistributive at the household level.

These properties survive when we move from the TANK to the 2-state THANK model, thus complementing the *HtM* channel with a *self-insurance* channel emerging from the interaction between aggregate and idiosyncratic uncertainty, in the vein of Bilbiie (2020, 2021). A notable feature of the Euler governing aggregate demand for nondurables in the 2-state THANK model, as compared with its TANK counterpart, is that discounting (compounding) of news about future expenditure may arise when sectors exhibit asymmetric price stickiness; but, again, only to the extent that HtM households are more (less) risk averse than savers. In fact, even if they acknowledge that in some states of the world they might find themselves liquidity-constrained, households are still able to exploit durable goods as a saving device, so that only preference heterogeneity modulates self insurance. This finding challenges the conventional emphasis on the interplay between idiosyncratic uncertainty and HtM behavior

[1] In Bilbiie (2020), instead, fiscal transfers invariantly reduce constrained agents' income elasticity to aggregate income, dampening the effects of shocks and policies.

as a key driver of aggregate *nondurable* consumption (Bilbiie, 2008), especially in connection with the self-insurance channel, which is regarded as a powerful intertemporal propagator of the HtM channel. Seen in this perspective, the role of durables as a store of value—along with the possibility of adjusting their stock regardless of the financial state of a given household—brings the 2-state THANK model closer to a setting with complete markets (to the extent that preference heterogeneity is considered of second-order importance).

One may object that durable goods are not always easy to adjust or liquidate, so that risk-sharing in nondurable consumption does not apply indistinctively. To accommodate this property, we extend the THANK economy to contemplate the possibility that households are limited in their capacity to smooth consumption, from time to time, for they have no access to liquid financial assets and they cannot adjust their durable holdings. *De facto*, durables are illiquid for these households. Within this setting, we retrieve two core properties: *i*) first, fiscal redistribution becomes non-neutral with respect to both durable and nondurable sectoral production; *ii*) second, based on *i*) we observe that durables flip the impact of fiscal redistribution on the elasticity of GDP to monetary shocks, relative to what observed in comparable one-sector economies where GDP only accounts for the production of nondurables. In our setting, regardless of the relative degree of sectoral price stickiness, fiscal redistribution *amplifies* the response of GDP to monetary disturbances, while the opposite holds true in one-sector sticky-price models involving nondurables only (as well as in the nondurable production sector of our model economy, through the conventional channel described by Bilbiie, 2020).[2] Thus, durables play a crucial role not only in that they induce higher aggregate volatility, even if produced by a relatively small sector in the economy. Also the way they affect monetary transmission, both in the aggregate and at the household level, may bear very important implications about the interaction with fiscal policy.

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 policy may change profoundly. In this respect, we relate to Barsky et al. (2007) and other contributions employing RANK models

[2] All the model variations we consider feature sticky prices. However, it is important to stress that contemplating nominal wage stickiness—thus paving the way to inverting the cyclicality of firm profit—does not affect the baseline principle that adding durables to an otherwise standard one-sector economy implies that GDP inherits the response properties of durable production (Barsky et al., 2007). Even in this case, the one-sector and the two-sector economies would denote opposite effects of fiscal redistribution on monetary transmission.

with durables to investigate the transmission of monetary policy (e.g., Erceg and Levin, 2006; Monacelli, 2009; Sudo, 2012; Tsai, 2016; Petrella et al., 2019) in that we document how profit redistribution and other structural characteristics interact with sectoral price stickiness, and may ultimately affect monetary transmission as observed in representative-agent economies.

On the HANK front, Bilbiie (2020, 2021) surveys both the analytical and the quantitative literature. As for the first strand—which, to the best of our knowledge, has not examined the role of consumer durables for monetary transmission—he traces out the main differences between his framework, which emphasizes the role of cyclical inequality in THANK economies, and other contributions featuring cyclical income risk (see, e.g., Werning, 2015; Acharya and Dogra, 2020; Challe, 2020; Ravn and Sterk, 2021). As for the second strand of the literature, our paper relates to McKay and Wieland (2022), who show how embedding durables into an otherwise standard HANK economy is key to attenuating the forward guidance puzzle, due to the sensitivity of their demand to the contemporaneous user cost. In a companion paper (Holst Partsch et al., 2022), we devise a quantitative two-sector HANK in the vein of Kaplan et al. (2018), and show how the key implications of the present work survive in a more general environment.

Finally, we relate to some contributions examining households' adjustment of the durable-nondurable consumption mix in the face of transitory income shocks. In this respect, Parker (1999) suggests that constrained households cut back more on goods that exhibit high intertemporal substitution, because the utility cost of fluctuations in these is lower than goods that are less substitutable over time. Browning and Crossley (2000) formally show this effect is equivalent to that characterizing the adjustment of luxury-goods expenditure in Hamermesh (1982).[3] While our main focus is on the transmission of monetary policy shocks, a point of tangency with these studies is that durables act as an ″inefficient″ saving device that bears the burden of the adjustment, for they display a quasi-constant shadow value and, thus, close-to-infinite intertemporal substitutability. Also Cerletti and Pijoan-Mas (2012) and Asdrubali et al. (2020) point to durable expenditure as an additional self-insurance channel, stressing their timely purchases as a way of (dis-)saving. To some extent, Attanasio et al. (2020) retrieve this tendency in car expenditure during the Great Recession. However, they highlight that adjustment along the extensive margin in their S-s model mostly reflects the emergence of adverse conditions during recessions, while procyclical variation along the intensive margin has mostly to do with households who are less severely affected by the contraction.

Structure The rest of the paper is organized as follows. In Section 2 we outline the baseline structure of our modular economies. Section 3 discusses the specific role of durables from the

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

perspective of liquidity-constrained agents and unconstrained households. Section 4 takes the benchmark TANK model to examine the effects of monetary policy—as well as its interaction with fiscal redistribution—on household-specific and sectoral consumption. Thus, it extends the TANK to a 2-state THANK economy where consumers switch between different states (liquidity-constrained vs. unconstrained). Section 5 focuses on aggregate amplification, extending the 2-state THANK economy to a 3-state one, where we limit the ability of some agents to smooth consumption intertemporally through durable adjustment. Section 6 concludes.

2 Durables in a TANK economy

The baseline TANK model is a standard cashless dynamic general equilibrium economy augmented with limited asset market participation (LAMP). In line with Bilbiie (2008, 2020, 2021), 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). 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.[4] There is also a government pursuing a redistributive fiscal policy and a nominal interest-rate monetary policy. A continuum of households is envisaged over the support $[0, 1]$, all having a similar utility function. A λ_S share is represented by households who can trade in all markets for state-contingent securities. We will interchangeably refer to these as assetholders or savers.

2.1 Households

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

$$\max_{C_{S,t},B_{S,t},X_{S,t},N_{S,t}} E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left(\frac{C_{S,t}^{1-\sigma_S}}{1-\sigma_S} + \eta_S \frac{X_{S,t}^{1-\chi_S}}{1-\chi_S} - \varpi_S \frac{N_{S,t}^{1+\phi_S}}{1+\phi_S} \right) \right\}$$

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

s.t.

$$B_{S,t}+\Omega_{S,t}V_t \leqslant (1+r_{t-1})\,B_{S,t-1}+\Omega_{S,t-1}\,(V_t+P_{C,t}D_t)+W_tN_{S,t}-P_{C,t}C_{S,t}-P_{X,t}I^X_{S,t},$$

where $\beta \in (0,1)$ is the discount factor, $\eta_S > 0$ and $\varpi_S > 0$ indicate how durable consumption and leisure are valued relative to nondurable consumption, $\phi_S > 0$ is the inverse of the labor supply elasticity, while $\sigma_S \geq 1$ and $\chi_S \geq 1$ 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 by saver (the time endowment is normalized to unity), while $I^X_{S,t} \equiv X_{S,t}-(1-\delta)\,X_{S,t-1}$ denotes real durable expenditure. $P_{C,t}$ (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-good firms, while $D_t = D_{C,t}+D^C_{X,t}$ are total dividend payoffs aggregated over the two sectors in terms of nondurable prices, with $D_{C,t}$ denoting profits from the nondurable goods sector and $D^C_{X,t}$ indicating profits from the durable goods sector (deflated by $P_{C,t}$).

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

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

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

$$Q_tC^{-\sigma_S}_{S,t}=\eta_SX^{-\chi_S}_{S,t}+\beta(1-\delta)E_t\left\{Q_{t+1}C^{-\sigma_S}_{S,t+1}\right\}, \tag{3}$$

$$\varpi_SN^{\phi_S}_{S,t}=C^{-\sigma_S}_{S,t}\frac{W_t}{P_{C,t}}, \tag{4}$$

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 rest of the households (labeled non-assetholders or HtM households, and indexed by H) have no financial assets and solve

$$\max_{C_{H,t},X_{H,t},N_{H,t}} E_t\left\{\sum_{i=0}^{\infty}\beta^i\left(\frac{C^{1-\sigma_H}_{H,t}}{1-\sigma_H}+\eta_H\frac{X^{1-\chi_H}_{H,t}}{1-\chi_H}-\varpi_H\frac{N^{1+\phi_H}_{H,t}}{1+\phi_H}\right)\right\}$$

s.t.

$$C_{H,t} + Q_t I^X_{H,t} = \frac{W_t}{P_{C,t}} N_{H,t} + T^H_t,$$

where $I^X_{H,t} \equiv X_{H,t} - (1-\delta) X_{H,t-1}$ and T^H_t denotes fiscal transfers. The first-order conditions are

$$Q_t C^{-\sigma_H}_{H,t} = \eta_H X^{-\chi_H}_{H,t} + \beta(1-\delta) E_t \left\{ Q_{t+1} C^{-\sigma_H}_{H,t+1} \right\}. \tag{5}$$

$$\varpi_H N^{\phi_H}_{H,t} = C^{-\sigma_H}_{H,t} \frac{W_t}{P_{C,t}}, \tag{6}$$

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 : $Y_{j,t} = \left(\int_0^1 Y_{j,t}(i)^{(\varepsilon_j-1)/\varepsilon_j} di \right)^{\varepsilon_j/(\varepsilon_j-1)}$. Final-good producers behave competitively, 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 $P^{1-\varepsilon_j}_{j,t} = \int_0^1 P_{j,t}(i)^{1-\varepsilon_j} di$. 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 which is common across sectors, W_t. The profit function in real terms is thus given by: $D_{j,t}(i) = \left(1 + \tau^S_j\right) \left[P_{j,t}(i)/P_{j,t}\right] Y_{j,t}(i) - (W_t/P_{j,t}) N_{j,t}(i) - T^F_{j,t}$, where $1 + \tau^S_j$ is a production subsidy, while $T^F_{j,t}$ stands for a lump-sum profit tax. We assume the subsidy to be set to eliminate the markup distortion in the steady state: the pricing condition under flexible prices, $P^*_{j,t}(i)/P_{j,t} = 1 = \varepsilon_j \left(W^*_{j,t}/P_{j,t}\right) \left[\left(1 + \tau^S_j\right)(\varepsilon_j - 1)\right]^{-1}$, allows us to pin down this value at $\tau^S_j = (\varepsilon_j - 1)^{-1}$. Financing the total cost of this subsidy by the profit tax ($T^F_{j,t} = \tau^S_j Y_{j,t}$) 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 $d_{j,t} = -(w_t - p_{j,t})$.[5] Moreover, in the remainder of the analysis ω_t will denote the real wage expressed in units of nondurables, i.e. $\omega_t \equiv w_t - p_{C,t}$.

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

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 $P_{j,t}^{1-\varepsilon_j} = (1-\theta_j)\left(P_{j,t}^*\right)^{1-\varepsilon_j} + \theta_j P_{j,t-1}^{1-\varepsilon_j}$.

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^D and rebates the proceedings to H, so that $T_t^H = \frac{\tau^D}{\lambda_H} D_t$.

Monetary policy is conducted by means of a standard interest-rate rule that sets the nominal rate of interest in reaction to aggregate inflation, $\pi_t = \alpha\pi_{C,t} + (1-\alpha)\pi_{X,t}$ (with $\alpha \in [0,1]$),[6] and features a non-systematic component. 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 $\varepsilon_t^\nu \sim iid(0, \sigma_\nu^2)$.

2.4 Equilibrium and market clearing

A rational expectations equilibrium 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

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

assetholder are

$$\Omega_{S,t+1} = \Omega_{S,t} = \Omega = \frac{1}{\lambda_S}. \tag{8}$$

Finally, by Walras's Law, the goods markets also clear, so 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 $x_t = \lambda_H x_{H,t} + \lambda_S x_{S,t}$.

3 The role of durability

Consider the Euler equations for durables. These may be solved forward to yield an expression for the households-specific shadow value of durables:

$$Q_t C_{z,t}^{-\sigma z} = \eta_z E_t \left\{ \sum_{i=0}^{\infty} \beta^i (1-\delta)^i X_{z,t+i}^{-\chi_z} \right\} \equiv \Lambda_{z,t}, \quad z = \{S, H\}. \tag{9}$$

As noted by Barsky et al. (2007), $\Lambda_{z,t}$ is largely time-invariant to shocks with short-lived effects, when durables are long-lived enough, based on two considerations: *i*) a large $1/\delta$ implies a high steady-state stock-flow ratio, so that even large changes in the flow have little impact on the stock; *ii*) for $\beta(1-\delta)$ close to one, $\Lambda_{z,t}$ is influenced by marginal utility of durables terms in the distant future, implying a close-to-infinite intertemporal elasticity of substitution in durables demand. Thus, short-term movements in $X_{z,t}$—as those generated by a temporary shock to fiscal spending or the nominal rate of interest—affect the right side of the equation above relatively little, so that $Q_t C_{z,t}^{-\sigma_H} \approx \Lambda_z$. According to this, movements in the relative price of durables are forced to mirror those in either household's shadow value of income, thus reflecting the emergence of an endogenous risk-sharing condition, as enunciated in Proposition 1.

Proposition 1 *Assuming that durables exhibit slow depreciation implies $\Lambda_S C_{S,t}^{\sigma_S} \approx \Lambda_H C_{H,t}^{\sigma_H}$, in the face of shocks with short-lived effects.*

This relationship, which we rely upon to develop an analytical intuition of our results, implies that comovement between the consumption of nondurables of the two households in response to monetary shocks hinges on the relative curvature of their nondurables' utility.[7]

[7]Our intuition remains valid for a wide range of depreciation rates, without necessarily resorting to the approximation of the Euler equations for durables based on quasi-constancy. In the remainder of the paper we will discuss different examples where the exact risk-sharing condition is not imposed *a priori*.

In a log-linear setting, the risk-sharing condition reported in Proposition 1 translates into

$$\sigma_H c_{H,t} = q_t = \sigma_S c_{S,t}. \tag{10}$$

Combining this with $c_t = \lambda_H c_{H,t} + \lambda_S c_{S,t}$ returns[8]

$$c_t = \left[1 - \lambda_H \left(1 - \gamma\right)\right] c_{S,t}, \text{ where } \gamma \equiv \frac{\sigma_S}{\sigma_H}. \tag{11}$$

We combine the latter with savers' bond Euler and nondurables' market clearing ($y_{C,t} = c_t$), to obtain:

$$y_{C,t} = E_t y_{C,t+1} - \chi^{-1} \left(r_t - E_t \pi_{C,t+1}\right), \tag{12}$$

where $\chi \equiv \frac{\sigma_S}{1-\lambda_H(1-\gamma)}$. Therefore, the elasticity of intertemporal substitution over aggregate nondurable consumption depends on household heterogeneity in the curvature of nondurable utility and, conditional on such heterogeneity, on the fraction of constrained agents. However, unlike to one-sector models (e.g., Bilbiie, 2008), in this TANK setting there can be no inversion of the slope of the Euler equation governing aggregate demand for nondurables, as the demand's elasticity to the real interest rate is always less than or equal to zero. Moreover, increasing the wedge between the curvature of S's nondurable consumption utility and that of H amplifies the impact of $r_t - E_t \pi_{C,t+1}$ on $\Delta E_t y_{C,t+1}$.

3.1 Robustness, extensions, and empirical insights

Having outlined the risk-sharing property entailed by long-lasting durability in our dual-sector, dual-agent framework, we discuss some distinctive elements connected with its applicability, before delving into the interplay between monetary transmission and fiscal redistribution.

What type of durables? From a practical viewpoint, our analysis contemplates durables as goods for which it is possible to envisage second-hand market transactions. In these circumstances, also agents with no access to financial assets may be able to transfer resources intertemporally, to some extent. As documented by Oh (2019), items for which this principle applies—such as vehicles and white goods—typically feature large and procyclical value-added expenditures. A variety of goods with diverse degrees of price stickiness and durability may belong to this category, while still displaying extremely small conditional volatility in

[8]Note also that, after combining the two labor supply schedules with $c_{H,t} = \gamma c_{S,t}$, the following restriction applies: $\phi_S n_{S,t} = \phi_H n_{H,t}$.

their shadow values. This aspect is extensively discussed and numerically tested by Barsky et al. (2007).[9]

Frictional adjustment and illiquidity Frictional adjustment is a key element in connection with households' stock of durables. Barsky et al. (2007) indicate how introducing investment adjustment costs in a model including capital goods further inhibits changes in durables, so that quasi-constancy is preserved.[10] We do confirm this property in our framework when introducing a quadratic cost of adjustment of the stock of durables, and show how this feature moves the model even closer to a benchmark relying on quasi-constancy and the approximation of households' Euler equations for durable purchases (see Figure D.1 in Appendix A).[11] When it comes to convex costs, though, one might question their efficacy in capturing households' adjustment of the stock of durables. In fact, a potential limitation of the framework we present is to rule out fixed costs and other non-convexities, as well as irreversibilities, which are typically seen as key in the emergence of lumpiness in individual durable purchases (see, e.g., Caballero, 1993). In this regard, King and Thomas (2006) emphasize that lumpy adjustment at the *microeconomic level* closely aligns with *macroeconomic adjustment* patterns predicted by partial-adjustment models—a concept encapsulated within the convex-cost assumption under consideration for robustness-testing purposes. A strictly related aspect is the inherent *illiquidity* of durables. To address this point, in Section 5 we envisage transition to/from a state wherein a portion of households experience impairment in durable adjustment, coupled with a lack of access to liquid financial assets. This allows us to generalize the analysis that rests on the consumption risk-sharing property, thus producing some key insights about the interaction between fiscal redistribution and monetary transmission, when durables are illiquid for part of the population.

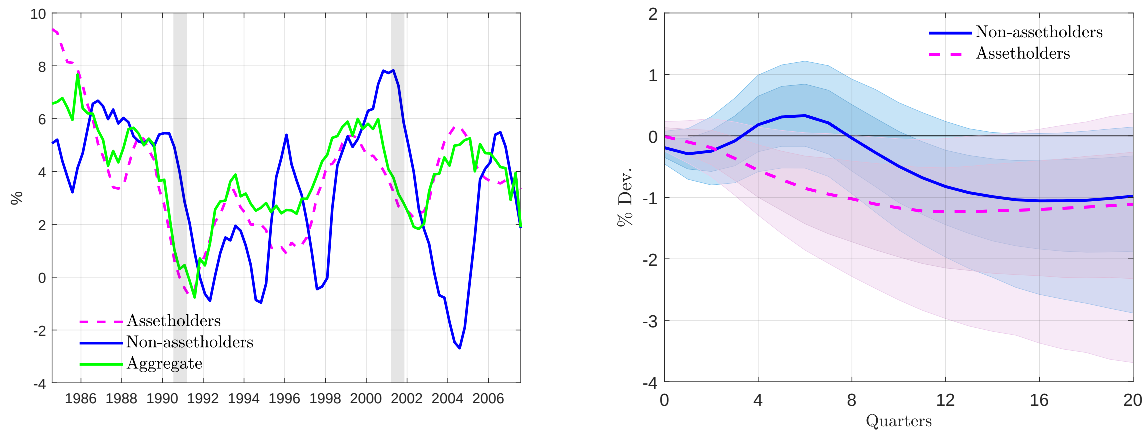
Nondurable consumption responses in survey data Taking at face value the implications of long-run durability might still seem like a stretch. To provide empirical support for the risk-sharing prediction, we examine the transmission of monetary policy shocks on the nondurable expenditure of households participating to the US Consumption Expenditure Survey (CEX). We sort survey participants into savers and HtM consumers depending on their hold-

[9] In fact, Barsky et al. (2007) dig into the nature of a long-lived durable, conducting a robustness exercise on the interaction between sectoral price rigidity and the speed of depreciation, and concluding that durables as they contemplate in their framework are "idealized" ones for a large parameter space.

[10] 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 $X_{z,t}$ is nearly constant, in the face of temporary shocks.

[11] We report analogous properties in a companion paper where we devise a quantitative 2-sector HANK model with cyclical income risk and a quadratic cost of adjustment, and where idiosyncratic risk is relied upon to match the distribution of household wealth (see Holst Partsch et al., 2022).

Figure 1: Nondurable consumption and monetary shocks



Notes. The left panel displays the two-year growth rate in the consumption of nondurable goods and services, both at the aggregate level and, separately, for assetholders and non-assetholders. On the right side, we present the response of assetholders' and non-assetholders' nondurable consumption to a 1 s.d. contractionary monetary policy shock, together with 68% and 90% confidence bands.

ings of liquid financial assets.[12] Thus, we formulate a 5-variable VAR model that includes (detrended) assetholders' and non-assetholders' nondurable expenditure, (detrended) aggregate durable and nondurable expenditure, and the Federal Funds rate. To identify the impact of a monetary policy innovation, we employ the Romer and Romer (2004) proxy updated by Wieland and Yang (2020) as an internal instrument within our VAR (see Plagborg-Møller and Wolf, 2021).[13] Despite the two series capturing the (2-year) growth of median household-specific consumption are rather dissimilar (see the left panel of Figure 1), the two shock responses closely resemble one another (see the right panel of the figure). This is consistent with the possibility that durables may in fact be exploited, albeit with frictions, as an alternative to smooth consumption intertemporally, in cases where households lack access to financial-saving technologies.

[12]Following Mankiw and Zeldes (1991), we define a household to be an assetholder if the dollar value of held assets (namely, stocks, bonds, and mutual funds) together with liquid accounts, such as savings and checking accounts, exceeds 1000$. We employ the data organized by Gaudio et al. (2023), who rely on the CEX and the Survey of Consumer Finances (SCF) to construct the consumption series for assetholders and non-assetholders (for more details on household data, please refer to Gaudio et al., 2023).

[13]The VAR is estimated over the 1982:Q3-2007:Q3 sample, where the start date is determined by the availability of disaggregated data and the end date by the availability of the monetary policy proxy. We include 8 lags and estimate the model using Bayesian techniques with standard Minnesota priors. The impulse-response functions correspond to a 1-standard deviation monetary policy tightening and are calculated from 5000 replications of the Gibbs sampler.

4 Monetary transmission

We now are in the position to examine equilibrium behavior in the TANK economy. We do so by focusing on both sectoral dynamics and household-specific expenditure in either type of good. Thus, we consider a framework where households face idiosyncratic uncertainty, and may intermittently self-insure, through bond investment, against the risk of becoming financially-constrained.

4.1 Equilibrium dynamics in the TANK economy

To elicit the distinctive role of durability in monetary transmission, we take an economy with symmetric price stickiness as the most straightforward extension of the one-sector framework. Thus, in line with Barsky et al. (2007), we alternatively consider the case of purely flexible prices of durables and nondurables. Based on this plan, we detail the behavior of *sectoral* production, as well as the determinants of *household-specific* consumption of durables and nondurables, with a focus on the role of fiscal redistribution. The complete log-linear TANK economy, as well as the analytics for each scenario, are reported in Appendix B.

4.1.1 Symmetric price stickiness

When goods produced by both sectors display symmetric price stickiness, $q_t = 0$, so that also household-specific and aggregate nondurable consumption remain at their steady-state values, in light of (10) and (11). Thus, combining S's bond Euler and the Taylor rule, together with households' labor supply:

$$y_{C,t} = 0 \qquad\qquad y_{X,t} = \frac{Y}{Y_X}\frac{1}{\zeta\psi(\rho_\nu - \phi_\pi)}\varepsilon_t^\nu,$$

where $\zeta \equiv \phi_S \left[1 - \lambda_H \left(1 - \vartheta\right)\right]^{-1}$ and $\vartheta \equiv \phi_S/\phi_H$. As in the one-sector RANK model discussed by Barsky et al. (2007), movements in aggregate production are accounted for entirely by durable production, with nondurable production remaining at the steady state. This is because HtM households can smooth nondurable purchases through durables and, due to the combination of equally sticky sectoral prices and slow depreciation, they end up not adjusting their nondurable consumption at all, in the face of monetary shocks. A key property of sectoral equilibrium production in the TANK economy is that household heterogeneity only matters to the extent it characterizes household preferences about nondurable consumption and labor supply. Appendix B shows how this result extends to the economies featuring asymmetric price stickiness across sectors. In light of this, we formulate Proposition 2.

Proposition 2 *Sectoral equilibrium production in the TANK economy under homogeneous preferences is equivalent to that obtained in the RANK benchmark.*

With this picture in mind, we focus on household-specific durable expenditure. For illustrative purposes, we report this as a function of sectoral durable production, while (temporarily) neutralizing preference heterogeneity in terms of labor supply (so that $\zeta = \phi$), without loss of generality. In the economy with symmetric price stickiness, durable spending (in units of nondurables) can be expressed as

$$e_{z,t} = \left(1 + \phi \frac{\mathscr{I}_z(\tau^D - \lambda_H)}{\lambda_z}\right) y_{X,t}, \quad z = \{S, H\}, \tag{13}$$

At the sectoral level, though, no amplification/attenuation is induced by τ^D. In fact, fiscal transfers are purely redistributive in any model where durables insulate HtM households from the adverse effects of profits going down as demand (and, thus, the real wage) expands, for whatever reason, and in either sector. Such *neutrality* of fiscal transfers has nothing to do with the degree of sectoral price stickiness, while only hinging on the goods-demand structure of the economy, as we will see in Section 4.1.2. In fact, when both household types buy durables, household-specific durable spending adjusts as a reflection of the implicit risk-sharing condition—so that both household-specific nondurable consumption and labor supply move *in tandem*—and transfers have no impact on $y_{X,t}$.[14] Notably, this property is also invariant to allowing agents to switch between the (liquidity) constrained and the unconstrained state (as we will see in Section 4.2). Contemplating agents with no access to financial assets and no capacity to adjust their durable holdings will break the neutrality of fiscal transfers, yielding some important insights about the effects of fiscal redistribution on the amplification of monetary shocks in the aggregate (see Section 5).

4.1.2 Asymmetric price stickiness

We reintroduce parameter heterogeneity into our analysis to emphasize potential asymmetries in durable and nondurable consumption at the household level. As for sectoral price stickiness, we assume that one sector at a time exhibits pure price flexibility. Formally: $\theta_j = 0$ and $\theta_i > 0$, with $j, i = \{C, X\}$ and $j \neq i$. Table 1 summarizes the elasticity of household-specific nondurable and durable expenditure to their respective sector-specific production.

[14] As an alternative to deriving $y_{X,t}$ from the aggregate block of the economy, this property can be appreciated by consolidating the household-specific budget constraints in light of the risk-sharing condition (10) and the household-specific labor supplies, so as to express $y_{X,t}$ as a function of ω_t.

In the analysis of Bilbiie (2020), such elasticity is key to examine the cyclical behavior of aggregate nondurable consumption. We take a similar standpoint.

Table 1: Household-specific elasticity of spending with respect to sectoral production

	Nondurable consumption	
Sectoral price stickiness	$c_{S,t}$	$c_{H,t}$
Flexible p_X, sticky p_C	$\frac{1}{1-\lambda_H(1-\gamma)}$	$\frac{\gamma}{1-\lambda_H(1-\gamma)}$
Sticky p_X, flexible p_C	$\frac{1}{1-\lambda_H(1-\gamma)}$	$\frac{\gamma}{1-\lambda_H(1-\gamma)}$
	Durable expenditure	
Sectoral price stickiness	$e_{S,t}$	$e_{H,t}$
Flexible p_X, sticky p_C	$\frac{1-\left(\frac{Y}{Y_C}-\frac{1-\tau^D}{\lambda_S}\right)\sigma_S}{1-\lambda_H(1-\gamma)}$	$\frac{\lambda_H[1-\lambda_H(1-\gamma)]-\lambda_S\left[1-\left(\frac{Y}{Y_C}-\frac{1-\tau^D}{1-\lambda}\right)\sigma_S\right]}{\lambda_H[1-\lambda_H(1-\gamma)]}$
Sticky p_X, flexible p_C	$\frac{\left[1-\sigma_S\left(\frac{1-\tau^D}{\lambda_S}\frac{Y_X}{Y_C}-\frac{1}{\phi_S}\frac{Y}{Y_C}\right)\right]Y_C}{(Y_C\zeta+\chi Y)[1-\lambda_H(1-\gamma)]}$	$\frac{1}{\lambda_H} - \frac{\lambda_S}{\lambda_H}\frac{1-\sigma_S\left(\frac{1-\tau^D}{\lambda_S}\frac{Y_X}{Y_C}-\frac{1}{\phi_S}\frac{Y}{Y_C}\right)}{(Y_C\zeta+\chi Y)[1-\lambda_H(1-\gamma)]}$

Notes: We report the elasticity of S's and H's nondurable expenditure to sectoral nondurable production, as well as the elasticity of S's and H's durable expenditure to sectoral durable production. In all cases, we consider asymmetric price stickiness, in that one sector at a time features fully flexible prices.

Nondurable consumption As previously examined, fiscal redistribution and labor market characteristics have no relevance to household-specific responses of nondurable consumption to monetary shocks.[15] Instead, both $c_{S,t}$'s and $c_{H,t}$'s elasticity with respect to aggregate nondurable expenditure only hinges on the magnitude of σ_S relative to σ_H and, conditional on these being different, on how households split between savers and HtM. Whenever the curvature of H's nondurable utility exceeds that of S, i.e. $\gamma < 1$, $c_{S,t}$ ($c_{H,t}$) moves more (less) than one-for-one with $y_{C,t}$. In light of this, nondurable consumption inequality, as captured by $c_{S,t} - c_{H,t}$, is procyclical when $\gamma < 1$. As for the population shares, instead, increasing λ_H inflates (deflates) the elasticity of household-specific nondurable consumption to its sectoral aggregate, for $\gamma < 1$ (> 1), as is expected on *a priori* grounds.

Durable expenditure Fiscal redistribution and labor market characteristics do matter for the behavior of household-specific durable consumption (and, thus, for cyclical inequality). In fact, both $e_{S,t}$'s and $e_{H,t}$'s degree of comovement with aggregate durable expenditure

[15] Appendix B confirms the neutrality of fiscal transfers with respect to both durable and nondurable *sectoral* demand.

hinges on τ^D and ϕ_z, for $z = \{S, H\}$.[16] Before seeing how such features combine, it is important to recall how sectoral production behaves in response to monetary shocks. In fact: *i*) $y_{C,t}$ increases in the face of a monetary expansion, when durables feature flexible prices, while *ii*) it contracts when it is up to nondurables to display no price stickiness (assuming that the shock is persistent enough). As for $y_{X,t}$, this necessarily comoves negatively with $y_{C,t}$ (this property may be relaxed by envisaging a franction of households who consume no durables—as we do in Section 5—or in 2-agent/state frameworks where movements in the relative price are mitigated by assuming mildly asymmetric degrees of sectoral price rigidity). With this picture in mind, fiscal policy is always redistributive towards H's durable expenditure, conditional on the sign of $y_{X,t}$'s response to the monetary shock. Whenever, $y_{X,t}$ contracts (expands), increasing τ^D attenuates (amplifies) the response of $e_{H,t}$. At the same time, whenever labor hours vary—and this is not the case when durables feature flexible prices, in which case $n_{S,t} = n_{H,t} = 0$—increasing the elasticity of labor supply works in the same direction as τ^D, as the slope of the labor supply schedule drops, and a given demand increase corresponds to a more muted contraction of sectoral profits.

Let us delve into the rationale underlying these effects. H's and S's durable expenditure rests on the cyclicality of sectoral profits with respect to aggregate durable production. In this respect, take the case of *flexible prices in the durable sector*, first: following a monetary expansion, the real wage in units of nondurables (ω_t) increases, while households' labor supply remains at the steady state—explaining why the elasticity of labor supply plays no role, in this context—and also the real wage in units of durables remains unaffected (so that $d_{X,t} = 0$, too). At the same time, $d_{C,t}$ contracts: thus, as τ^D increases, H (S) has less (more) resources to buy durables, for given $y_{X,t}$. In the case of *flexible prices in the nondurable sector* (and relatively inertial monetary shocks), instead, a monetary loosening expands the real wage in units of durables ($w_t - p_{X,t}$ or, equivalently, $\omega_t - q_t$), so that $d_{X,t}$ shrinks, while leaving ω_t—and, thus, $d_{C,t}$—unaffected. Concurrently, households' labor supply increases. For given $y_{X,t}$, while the first effect restricts (increases) H's (S's) resources to buy durables, as τ^D increases, the second effect expands either household's durable purchase opportunities, though less so as ϕ_z increases, for $z = \{S, H\}$.

4.2 A 2-state THANK economy

TANK economies miss a key channel in that unconstrained agents do not face the possibility of becoming constrained in the future, and *vice versa*. We now introduce idiosyncratic

[16] While extending the analysis to a two-sector economy, we will mainly focus on these two determinants, taking as given other household-specific or sector-specific traits, such as the curvature of nondurable consumption utility and the relative size of each sector.

risk, and show how "fiscal neutrality" as highlighted in the TANK economy holds not only in connection with the functioning of the HtM channel, but also with respect to the emergence of a precautionary motive. In addition, we discuss the role of compounding/discounting news about future nondurable production for sectoral conditional dynamics.

Following Bilbiie (2020, 2021), we envisage the problem as featuring a unit mass of households that infrequently participate in financial markets: when they do, they can adjust their portfolio with no friction, and receive dividends from firms in either sector. When they do not participate, they only receive the return on their bond holdings from the previous period. Denote the two states as S and H, respectively. The exogenous change of state follows a Markov chain: the probability to stay type S is ϱ_{SS}, while households have a probability ϱ_{HH} to stay type H (with transition probabilities ϱ_{SH} and ϱ_{HS}, respectively). We focus on stationary equilibria whereby the mass of H is, by standard analysis, $\lambda_H = \frac{\varrho_{SH}}{\varrho_{SH}+\varrho_{HS}}$, with $\varrho_{SS} \geq \varrho_{SH}$, implying that the probability to stay a saver is larger than the probability to become one.

We follow Bilbiie (2021) in that we make some assumptions to allow for analytical tractability. Households are members of a family, whose intertemporal utility is maximized by the head, given limits to risk-sharing. In fact, households can be located on two *islands* depending on their financial-market participation status—one island is for savers, and one for HtM households—and the family head can transfer resources within islands, although only some resources can be transferred between islands. Specifically, there is full insurance within type, in the face of idiosyncratic risk, but limited insurance across types. At the beginning of the period, the family head pools resources within the island. The aggregate shock realizes first, and the family head determines the consumption/saving choice for each island. Thus, the idiosyncratic shock realizes: households learn their next-period status and have to move to the corresponding island. Different financial assets have different liquidity: only one of the two financial assets (bonds) can be used to self-insure before idiosyncratic uncertainty is revealed—i.e., is liquid and may move between islands—while stocks are illiquid, and cannot be used to self-insure. Finally, we preserve preference heterogeneity, meaning that agents may change preferences depending on their financial status, primarily to show the role it plays in the presence of idiosyncratic risk.

In sum, the problem for the family head reads as:

$$\max_{C_{S,t},C_{H,t},X_{S,t},X_{H,t},N_{S,t},N_{H,t},\Omega_{S,t},Z_{S,t},Z_{H,t}} E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left[\lambda_S \left(\frac{C_{S,t+i}^{1-\sigma_S}}{1-\sigma_S} + \eta_S \frac{X_{S,t+i}^{1-\chi_S}}{1-\chi_S} - \varpi_S \frac{N_{S,t+i}^{1+\phi_S}}{1+\phi_S} \right) \right. \right.$$
$$\left. \left. + \lambda_H \left(\frac{C_{H,t+i}^{1-\sigma_H}}{1-\sigma_H} + \eta_H \frac{X_{H,t+i}^{1-\chi_H}}{1-\chi_H} - \varpi_H \frac{N_{H,t+i}^{1+\phi_H}}{1+\phi_H} \right) \right] \right\}$$

s.t.

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

where, for $z\in\{H,S\}$, $I^X_{z,t}\equiv X_{z,t}-(1-\delta)\widetilde{X}_{z,t-1}$, $\widetilde{X}_{z,t}$ 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.[17] Under these circumstances, the only equilibrium condition governing bond-holding demand is S's Euler equation:

$$
C^{-\sigma_S}_{S,t}=\beta E_t\left\{\frac{1+r_t}{1+\pi_{C,t+1}}\left[\varrho_{SS}C^{-\sigma_S}_{S,t+1}+\varrho_{SH}C^{-\sigma_H}_{H,t+1}\right]\right\}, \tag{14}
$$

which characterizes, compared with the analogous equation in the TANK model, in that it accounts for potential transition across states. Analogous properties characterize the two Euler equations governing durable purchases, as reported in Appendix C.

Once again, it is possible to show that slow depreciation of durables, in conjunction with the effects of a given temporary shock, imply an approximately constant shadow value of durables in both states/islands, so that a risk-sharing property can be retrieved.[18] Moreover, one may conveniently combine the two Euler equations for durables (see Appendix C) to

[17] Bilbiie (2021) 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.

[18] To see that, it is convenient to express the two Euler equations accounting for durable demand as $\mathbf{Y}_t=\mathbf{A}E_t\mathbf{Y}_{t+1}+\mathbf{B}\mathbf{X}_t$, with $\mathbf{Y}_t=\left[Q_tC^{-\sigma_S}_{S,t},Q_tC^{-\sigma_H}_{H,t}\right]'$ and $\mathbf{X}_t=\left[X^{-\chi_S}_{S,t},X^{-\chi_H}_{H,t}\right]'$. Thus, $\mathbf{Y}_t=\sum_{i=0}^{\infty}\mathbf{A}^i\mathbf{B}E_t\mathbf{X}_{t+i}$ by forward iteration. As in the TANK economy, slow depreciation implies a high stock-flow ratio, so that even relatively large changes in the production of the durable over a moderate horizon have small effects on the stock. Therefore, $\mathbf{Y}_t\approx(\mathbf{I}-\mathbf{A})^{-1}\mathbf{B}\mathbf{X}$. See Appendix C for further details.

obtain:

$$Q_t\left(\lambda_S C_{S,t}^{-\sigma_S}+\lambda_H C_{H,t}^{-\sigma_H}\right) = \sum_{i=0}^{\infty}\left[\beta(1-\delta)\right]^i\left\{\lambda_S\eta_S X_{S,t}^{-\chi_S}+\lambda_H\eta_H X_{H,t}^{-\chi_H}\right\}, \tag{15}$$

$$Q_t\left(C_{H,t}^{-\sigma_H}-C_{S,t}^{-\sigma_S}\right) = \sum_{i=0}^{\infty}\left[\beta(1-\delta)\left(\varrho_{HH}+\varrho_{SS}-1\right)\right]^i\left\{\eta_H X_{H,t}^{-\chi_H}-\eta_S X_{S,t}^{-\chi_S}\right\}. \tag{16}$$

These two equations emphasize a direct connection between the average and the gap between the state-specific shadow values of durables and, respectively, the average and the gap between the state-specific discounted marginal utilities of the service flow of durables. Specifically, equation (15) allows us to track how the discounted average of the service flow of durable holdings translates into the average shadow value of durables. In the absence of preference heterogeneity, this relationship represents an aggregate extension to the household-specific Euler equations for durables. As for equation (16), it captures an analogous channel involving the gaps between the marginal utilities of durables and of nondurables. Notably, when the shadow values of durables are quasi-constant, not only the relative price acts as a driver of aggregate nondurable consumption—a property highlighted by Barsky et al. (2007)—but it also shapes *household inequality* in nondurable consumption.

4.2.1 Log-linear economy

Quasi-constancy implies a relationship analogous to (10). In a log-linear setting, combining this relationship with the definition of aggregate nondurable consumption returns $c_t = \left[1-\lambda_H\left(1-\gamma\right)\right]c_{S,t}$. Combining the latter with the log-linearized counterparts of the self-insurance equation, (14), and of sectoral market clearing for nondurables, we obtain

$$y_{C,t} = \mu E_t y_{C,t+1} - \chi^{-1}\left(r_t - E_t\pi_{t+1}\right), \tag{17}$$

where $\mu \equiv \varrho_{SS}+\gamma\varrho_{SH}$. Notably, the Euler equation governing aggregate demand for nondurable goods features the same elasticity to the real interest rate as the TANK economy, and is not affected by the share of liquidity-constrained households. As for the forward-looking term, idiosyncratic uncertainty (i.e., $\varrho_{SS} < 1$) implies discounting/compounding of news about future nondurable consumption—as captured by the factor loading μ—depending on $\gamma \lesseqgtr 1$.[19] In either of the two cases, even if they acknowledge that in some state of the world they might find themselves liquidity-constrained, households can still exploit durable goods as a store of value, so that the marginal utility from nondurable consumption is equalized

[19] Assuming homogeneous preferences, instead, implies that the Euler corresponds to that obtained in a RANK economy with no heterogeneity.

across states. As a consequence, different forms of household-specific consumption behave exactly in the same way they do in the TANK economy (cfr. Table 1), so that fiscal redistribution and labor market characteristics operate along the same direction across different scenarios, and do not interact with idiosyncratic risk. In light of this, also the 2-state THANK economy features neutrality of fiscal transfers with respect to both types of *sectoral* production.

Shifting our focus on compounding/discounting future news about nondurable production, and how they affect the elasticity of sectoral production to the monetary shock, Proposition 3 shows that μ amplifies the response of both $y_{C,t}$ and $y_{X,t}$, in either direction, when assuming asymmetric sectoral price rigidity. By contrast, μ plays no role under symmetric sectoral price stickiness, in which case the model is isomorphic to the corresponding TANK economy and, thus—by virtue of Proposition 2—to the RANK benchmark (under homogeneous preferences).

Proposition 3 *In the 2-state THANK economy where $\theta_j = 0$ and $\theta_i > 0$, with $j, i = \{C, X\}$, sectoral production is given by*

$$y_{C,t} = -\frac{1-\beta\rho_\nu}{(1-\beta\rho_\nu)(1-\rho_\nu\mu)+\psi_C(\phi_\pi-\rho_\nu)}\chi^{-1}\nu_t,$$
$$y_{X,t} = \frac{Y_C}{Y_X}\frac{1-\beta\rho_\nu}{(1-\beta\rho_\nu)(1-\rho_\nu\mu)+\psi_C(\phi_\pi-\rho_\nu)}\chi^{-1}\nu_t, \text{ when } \theta_X = 0 \text{ and } \theta_C > 0,$$

and

$$y_{C,t} = -\frac{1-\beta\rho_\nu}{(1-\beta\rho_\nu)(1-\rho_\nu\mu)-\phi_\pi\psi_X}\chi^{-1}\nu_t,$$
$$y_{X,t} = \frac{Y_C\zeta+\chi Y}{Y_X}\frac{1-\beta\rho_\nu}{(1-\beta\rho_\nu)(1-\rho_\nu\mu)-\phi_\pi\psi_X}\chi^{-1}\nu_t, \text{ when } \theta_X > 0 \text{ and } \theta_C = 0.$$

Notably, when $\gamma < 1$, the impact of monetary policy shocks on either form of sectoral consumption is attenuated, both with respect to the direct effect of the real rate of interest on $y_{C,t}$, and through discounting of future news about nondurable spending. This is a manifestation of the *self-insurance channel* in this economy, though the way this operates and interacts with the HtM channel is, again, different from what happens when only nondurable expenditure is envisaged. When good news about future aggregate nondurable production arrive, households recognize they will be constrained in the access to financial assets in some state of the world, while displaying lower intertemporal substitution in nondurable consumption. In light of this, even being able to purchase durables and, through these, smoothing nondurable purchases, households recognize they will not be able to make the most of the increase in $E_t y_{C,t+1}$.

The interaction between aggregate and idiosyncratic uncertainty represents the motive to self-insure, and more so as ϱ_{SS} drops, so that the HtM spell, as captured by λ_H, extends. Unlike Bilbiie (2020), though, self-insurance *de facto* operates only to the extent households display preference heterogeneity, with no role for the share of liquidity-constrained agents. This comes as no surprise, given that all households, in any state of the world/island, can use durables as a self-insurance device. The next section relaxes this property, allowing for some degree of illiquidity in durable adjustment in a given state of the world/island.

5 Illiquidity in durable adjustment, fiscal redistribution and aggregate amplification

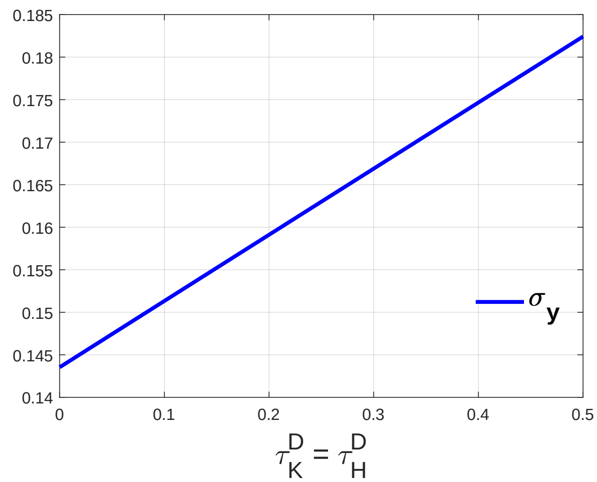
The THANK model with long-lived durables impairs the propagation stemming from the interaction between idiosyncratic uncertainty and HtM behavior, which is typically regarded as a key driver of aggregate *nondurable* consumption. In this section, we allow for the possibility that households are temporarily limited in their ability to access the market for durables. To this end, we devise a 3-state THANK economy. In this setting, household members might also inhabit a third island/state, K, characterized by no access to financial assets—as it is the case for H—and where durables are illiquid. Consequently, the stock of durables cannot be modified relative to the level inherited from the preceding period. This amounts to impose the restriction $X_{K,t} = (1-\delta)\widetilde{X}_{K,t-1}$. Moreover, a fixed cost Ξ_K is imposed for living on island K. This allows us to ensure that the condition of full consumption risk-sharing holds in the steady state of the economy. Again, the exogenous change of state follows a Markov chain: the probability to stay type f is ϱ_{ff} (with $f = \{K, S, H\}$), while we denote the transition probabilities with ϱ_{fl}, where $f, l = \{K, S, H\}$ and $f \neq l$. Even in this case, we focus on stationary equilibria.[20] The setup of the optimization problem faced by the head of family and the complete log-linear economy is reported in Appendix D.2.

We switch off preference heterogeneity, without loss of generality, while retaining the possibility of asymmetric sectoral price stickiness and size. Here we focus on the benchmark setting featuring symmetric price stickiness (see Appendix D.4 for the generalization to asymmetric sectoral price stickiness). Figure 2 reports the conditional volatility of GDP as a function of τ_K^D, which is the subsidy rate applied to K (assumed to be equal to that applied to H, τ_H^D, without loss of generality).[21] The key element to highlight is that, compared with the

[20]The transition matrix is set so that the Markov chain is ergodic. The steady-state solution of the transition probabilities is reported in Appendix D.1.

[21]It is important to stress that the numerical experiments in this section do not rely on the approximation obtained under quasi-constancy of the shadow value of durables. Moreover, our evidence does not depend on the specific calibration being used, so that the analysis remains valid for durables with no extremely slow depreciation. The calibration of the transition probabilities deserves some more details, though (the figure's caption reports the values of the other parameters). The steady-state shares of the three groups of household members are broadly in line with the evidence of Kaplan et al. (2014), where about one third of the U.S. households are some form of HtM consumers, of which two thirds can be defined as wealthy HtM, as they hold a

Figure 2: Aggregate volatility and fiscal redistribution



Notes. A period in the model corresponds to a quarter. Parameter values: $\sigma = 1$, $\phi = 1$, $Y_C = \alpha = 0.75$, $Y_X = 1 - Y_C$, $\beta = 0.97$, $\theta_X = \theta_C = 0.6$, $\delta = 0.025$, $\phi_\pi = 1.5$, $\lambda_S = 2/3$, $\lambda_K = 1/9$, $\lambda_H = 2/9$ (which, in light of the restrictions to the transition probability matrix, require $\varrho_{SS} = 0.9634$, $\varrho_{SH} = 1 - \varrho_{SS}$, $\varrho_{SK} = 0$, $\varrho_{HH} = 0.8901$, $\varrho_{HS} = \varrho_{HK} = (1 - \varrho_{HH})/2$, $\varrho_{KK} = 0.8901$, $\varrho_{KH} = 1 - \varrho_{KK}$ and $\varrho_{KS} = 0$).

economies examined so far, *fiscal transfers are no longer purely redistributive*.

A useful standpoint to provide some intuition about the driving forces behind this result is to inspect the equilibrium level of aggregate production under the property that the shadow values of durable holdings fulfill quasi-constancy:

$$y_t = \frac{Y_C\phi\left(1 + (1+\phi)\lambda_K\right) + Y\sigma}{(Y_C\phi + Y\sigma)\phi}\omega_t + \left(\frac{1}{1-\lambda_K} - \frac{Y_C\phi}{Y_C\phi + Y\sigma}\right)\tau_K^D\omega_t, \tag{18}$$

where we assume, without loss of generality, the same transfer for H and K. Importantly, $\omega_t = \frac{1}{\psi(\rho_\nu - \phi_\pi)}\varepsilon_t^\nu$, so that it is not a function of τ_K^D. This property allows us to focus on the factor loading applying to the second term of the sum on the right side of (18), for it collects all the terms affected by fiscal transfers. From an algebraic viewpoint, it is immediate to see that, under very general conditions, the passthrough of the real wage on aggregate production increases linearly in fiscal transfers, so that also the conditional volatility of aggregate output increases in τ_K^D. As we formalize in Proposition 4, the amplification entailed by fiscal

sizable amount of illiquid assets. In addition, we assume that savers cannot move to K without having first had the chance to adjust their stock of durables (i.e., $\varrho_{SK} = 0$). Conversely, households who are located on K cannot directly move to S (i.e., $\varrho_{KS} = 0$). Finally, we assume that households on H have an equal chance of becoming either savers or of not being able to smooth consumption at all (i.e., $\varrho_{HS} = \varrho_{HK}$).

redistribution crucially rests on the fulfillment of the $\frac{1}{1-\lambda_K} > \frac{Y_C\phi}{Y_C\phi+Y\sigma}$ inequality, for the element on the left side is strictly greater than one, as long as island K is not empty, while the object in the right side is strictly lower than one (as long as households have finite elasticity of labor supply). Crucially, this holds true irrespective of the size of the durable goods sector.

Proposition 4 *In the 3-state THANK economy with symmetric price stickiness, the response of y_t to monetary disturbances increases in fiscal redistribution, as long as the sufficient condition $\lambda_K > 0$ is fulfilled.*

Thus, unlike one-sector models featuring nondurables only, fiscal redistribution amplifies the passthrough of monetary shocks on gross production. The co-existence of durables and a friction in the adjustment of their stock applying to part of the consumers is key, to this property.[22] To provide deeper economic insights about sectoral dynamics, assume an unexpected monetary expansion that induces the real wage to increase, and consider equilibrium sectoral productions, as reported by equations (19) and (20). Take $y_{C,t}$, first: *de facto* this amounts to focusing on K's durable expenditure in equilibrium (in the present scenario, K is the only island where nondurable purchases change relative to the steady state). Recall that, through fiscal transfers, households located here internalize the downward pressure of wages on firm dividends. As in Bilbiie (2021), where HtM households internalize the negative income effect from firm profits contracting, in the face of a monetary expansion, this effect invariably decreases the passthrough of the real wage on nondurable production. As for the conditional volatility of nondurables, σ_{Y_C}, we may expect it to drop as we start increasing τ_K^D from zero, particularly in the presence of a relatively inelastic labor supply, and/or when λ_K is relatively small: in the first case, the negative wealth effect of an expansionary shock is magnified, relative to the size of K's budget constraint, while in the second case it is contrasted less forcefully by the expansion in labor income. However, as τ_K^D increases further, σ_{Y_C} increases through the sizable income effect borne by K. As for the response of durables, from the perspective of S (who accounts, *in tandem* with H, for the whole of total demand towards the durable-goods sector) increasing τ_K^D progressively allows to shift the negative effect from firm profits on K, so as to exploit more resources available for the consumption of durables. Thus, increasing fiscal transfers magnifies the passthrough of real-wage (monetary) shocks to durable expenditure, while attenuating that on nondurable consumption.

[22] One might suggest that, while not altering the emergence of risk-sharing among agents adjusting their durable stock, envisaging nominal wage rigidity would affect the cyclicality of sectoral profits (for a THANK example, see Broer et al., 2019) and, thus, the specific way fiscal redistribution shapes the conditional volatility of sectoral and aggregate production. Even in this case, though, we should stress that introducing durables—no matter how large a share of the economy they represent and how "sticky" their prices are—profoundly changes the properties of an otherwise standard one-sector economy with nominal wage stickiness. Analogous considerations apply to economies with a different asset structure (e.g., Ravn and Sterk, 2021).

$$y_{C,t} = \frac{\phi Y}{\phi Y_C + \sigma Y} \left(\frac{\lambda_K (1+\phi)}{\phi} - \tau_K^D \right) \omega_t, \tag{19}$$

$$y_{X,t} = \frac{Y}{Y_X (1 - \lambda_K)} \left(\frac{\lambda_S + \lambda_H}{\varphi} + \tau_K^D \right) \omega_t. \tag{20}$$

Notably, this tendency disappears as $\lambda_K \to 0$: in the limit situation where K is empty, fiscal transfers are back being neutral, in the aggregate. The main takeaway emerging from the analysis is that, in a one-sector economy producing nondurables, fiscal redistribution interacts with monetary policy so as to smooth its effects. The reverse implication emerges, instead, when contemplating consumer durables, no matter how large their sector of production is.

Notably, the same tendencies characterize economies with *any* degree of asymmetric sectoral price stickiness, as we report in Appendix D.4. Some notable observations arise in this context, though. When nondurables exhibit purely flexible prices, aggregate conditional volatility increases significantly. This stems from the inherently higher volatility of durables, further amplified by their price rigidity. Otherwise, when durables exhibit flexible prices—or in situations where they feature less pronounced price stickiness, a scenario likely more aligned with empirical observations—we observe higher sensitivity of aggregate volatility to fiscal transfers.

6 Concluding remarks

Durables are key to the transmission of monetary policy. Not just because they are more interest-rate sensitive than nondurables, but also because they represent a store of value through which households may shape their nondurable consumption profile, even when they have no access to liquid financial assets. We highlight this property within modular two-sector New Keynesian economies where part of the households are liquidity-constrained, but might still be able to adjust their stock of durables, along with buying nondurables. As a result, fiscal redistribution is neutral to either type of demand at the sectoral level. Therefore, the amplification/attenuation of either type of sectoral consumption—as well as of household-specific nondurable consumption—in TANK and THANK economies where all households can adjust their stock of durables only hinges on preference heterogeneity; by contrast, durable consumption at the household level also depends on other structural determinants, primarily the degree of fiscal redistribution from liquidity unconstrained to constrained households. When contemplating the presence of households with no access to liquid financial assets and no capacity to adjust their holdings of durables, such neutrality is broken, and the response of GDP to monetary shocks is amplified by fiscal transfers, unlike one-sector T(H)ANK economies featuring nondurables only. Such prediction ultimately depends on how fiscal redistribution shapes the response of durables to monetary innovations. These results call for further research on monetary policy's direct and indirect transmission in multi-sector settings with heterogeneous agents.

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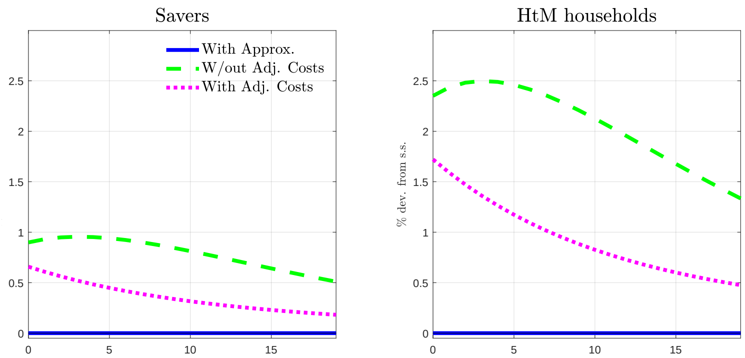
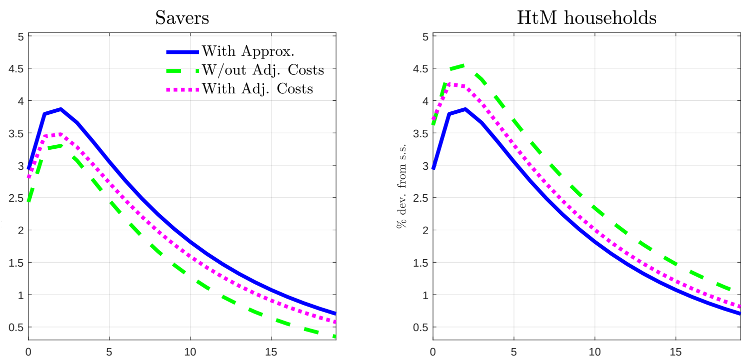
A Consumption risk-sharing in a TANK economy

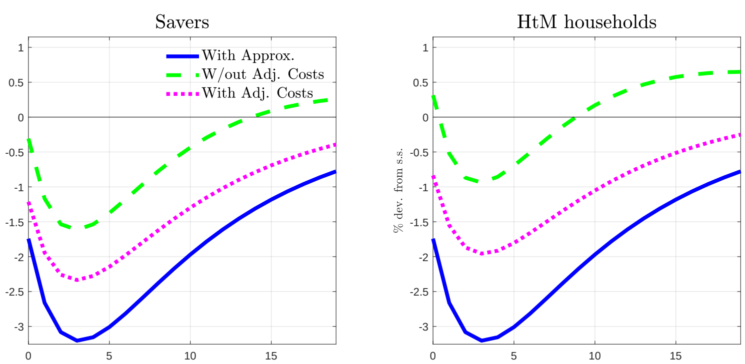
Figure A.1: Nondurable consumption responses in a TANK economy



(a) Equal Stickiness



(b) Sticky nondurables



(c) Sticky durables

Notes. A period in the model corresponds to a quarter. Each row reports the response to a monetary expansion of savers' and HtM consumers' nondurable consumption for the case of (a) $\theta_X = 0$ and $\theta_C = 0$, (b) $\theta_X = 0$ and $\theta_X = 0.6$, (c) $\theta_X = 0$ and $\theta_C = 0.6$. Other parameter values: $\sigma = 1$, $\phi = 1$, $Y_C = \alpha = 0.75$, $Y_X = 1 - Y_C$, $\beta = 0.97$, $\delta = 0.025$, $\phi_\pi = 1.5$, $\lambda_S = 2/3$. Within each panel, we consider the model embedding the approximation relying on quasi-constancy of the stocks of durables (continuous blue line), the model with no approximation (dashed green line), and the model with no approximation and a quadratic cost of adjustment (dotted magenta line).

B The log-linear TANK economy

The TANK economy can be summarized by the following log-linear relationships:

Savers:

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

$q_t - \sigma_S c_{S,t} = -[1-\beta(1-\delta)]\chi_S x_{S,t} + \beta(1-\delta)(E_t q_{t+1} - \sigma_S E_t c_{S,t+1})$

$\phi_S n_{S,t} = \omega_t - \sigma_S c_{S,t}$

$c_{S,t} + \frac{Y_X}{Y_C} e_{S,t} = \frac{Y}{Y_C}(\omega_t + n_{S,t}) + \frac{1-\tau^D}{\lambda_S} d_{C,t} + \frac{1-\tau^D}{\lambda_S}\frac{Y_X}{Y_C} d_{X,t}$

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

Hand-to-mouth:

$q_t - \sigma_H c_{H,t} = -[1-\beta(1-\delta)]\chi_H x_{H,t} + \beta(1-\delta)(E_t q_{t+1} - \sigma_H E_t c_{H,t+1})$

$\phi_H n_{H,t} = \omega_t - \sigma_H c_{H,t}$

$c_{H,t} + \frac{Y_X}{Y_C} e_{H,t} = \frac{Y}{Y_C}(\omega_t + n_{H,t}) + \frac{\tau^D}{\lambda_H} d_{C,t} + \frac{\tau^D}{\lambda_H}\frac{Y_X}{Y_C} d_{X,t}$

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

Production and pricing:

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

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

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

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

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

Market clearing:

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

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

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

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

Monetary Policy:

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

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

$\nu_t = \rho_\nu \nu_{t-1} + \varepsilon_t^\nu$

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

Benchmark economy under symmetric sectoral price stickiness

In this case:

$$q_t = y_{C,t} = 0. \tag{B.1}$$

Thus, by combining the S's bond Euler and the Taylor rule we obtain

$$\pi_t = \frac{1}{\phi_\pi} E_t \pi_{t+1} - \frac{1}{\phi_\pi} \nu_t. \tag{B.2}$$

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

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

As $\sigma_S c_{S,t} = 0$, labor supply implies

$$\phi_S n_{S,t} = \omega_t. \tag{B.4}$$

Since $\phi_S n_{S,t} = \zeta n_t$,aggregate inflation is dictated by

$$\pi_t = \beta E_t \pi_{t+1} + \zeta \psi n_t. \tag{B.5}$$

In light of $E_t \pi_{t+1} = 0$, $n_t = \frac{1}{\zeta\psi} \frac{1}{\rho_\nu - \phi_\pi} \varepsilon_t^\nu$ and

$$y_{X,t} = \frac{Y}{Y_X} y_t = \frac{Y}{Y_X} \frac{1}{\zeta\psi} \frac{1}{\rho_\nu - \phi_\pi} \varepsilon_t^\nu. \tag{B.6}$$

Thus, to obtain household-specific durable consumption, we plug household-specific labor supply and equilibrium profits into the budget constraints.

Flexible prices of durables

From S's labor supply:

$$\phi_S n_{S,t} = w_t - p_{X,t} + q_t - \sigma_S c_{S,t}, \tag{B.7}$$

where $w_t - p_{X,t} = 0$ due to the assumption of flexible prices in the durables sector, and $q_t - \sigma_S c_{S,t}$ is approximately null, due to durability. Analogous observations for H lead 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). Therefore, the following autonomous system obtains under flexible prices in the durable sector:

$$y_{C,t} = E_t y_{C,t+1} - \chi^{-1} \left(r_t - E_t \pi_{C,t+1} \right), \tag{B.8}$$

$$\pi_{C,t} = \beta E_t \pi_{C,t+1} + \psi_C \chi y_{C,t}, \tag{B.9}$$

$$r_t = \phi_\pi \pi_{C,t} + \nu_t. \tag{B.10}$$

Conjecturing a solution of this type:

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

we obtain

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

so that

$$y_{C,t} = -\frac{1 - \beta\rho_\nu}{\left(1 - \beta\rho_\nu\right)\left(1 - \rho_\nu\right) + \psi_C \left(\phi_\pi - \rho_\nu\right)} \frac{1}{\chi} \nu_t, \tag{B.11}$$

$$y_{X,t} = \frac{Y_C}{Y_X} \frac{1 - \beta\rho_\nu}{\left(1 - \beta\rho_\nu\right)\left(1 - \rho_\nu\right) + \psi_C \left(\phi_\pi - \rho_\nu\right)} \frac{1}{\chi} \nu_t, \tag{B.12}$$

where $\sigma_H < \sigma_S$ implies higher reactiveness of $y_{C,t}$ and $y_{X,t}$ in either direction (through the fact that χ is a negative function of $\sigma_S - \sigma_H$). As for agent-specific consumption, recall that $c_t = \left[1 - \lambda_H \left(1 - \gamma\right)\right] c_{S,t}$ and $c_t = \frac{1 - \lambda_H (1-\gamma)}{\gamma} c_{H,t}$, implying:

$$c_{S,t} = -\frac{1 - \beta\rho_\nu}{\left(1 - \beta\rho_\nu\right)\left(1 - \rho_\nu\right) + \psi_C \left(\phi_\pi - \rho_\nu\right)} \frac{1}{\sigma_S} \nu_t, \tag{B.13}$$

$$c_{H,t} = -\frac{1 - \beta\rho_\nu}{\left(1 - \beta\rho_\nu\right)\left(1 - \rho_\nu\right) + \psi_C \left(\phi_\pi - \rho_\nu\right)} \frac{1}{\sigma_H} \nu_t, \tag{B.14}$$

so that the sign of the response follows from that of $y_{C,t}$. Finally, to obtain household-specific durable expenditure—which expressed in unit of nondurables is defined as $q_t + \frac{1}{\delta}x_{z,t} - \frac{1-\delta}{\delta}x_{z,t-1}$, with $z = \{S, H\}$—we turn to the budget constraints. Thus, recall that $n_{H,t} = n_{S,t} = 0$, along with $d_{X,t} = -(w_t - p_{X,t}) = -\omega_t + q_t = 0$, and $\sigma_H c_{H,t} = q_t = \sigma_S c_{S,t}$, to obtain

$$e_{S,t} = \left[\left(\frac{Y}{Y_C} - \frac{1-\tau^D}{1-\lambda}\right)\sigma_S - 1\right]\frac{Y_C}{Y_X}c_{S,t} \tag{B.15}$$

and, thus, $e_{H,t}$.

Flexible prices of nondurables

In this case, from S's labor supply:

$$\phi_S n_{S,t} = \omega_t - \sigma_S c_{S,t}, \tag{B.16}$$

where $\omega_t = 0$ due to the assumption of flexible prices in the nondurables sector and $\sigma_S c_{S,t} = \chi y_{C,t}$. Thus, through $n_t = [1 - \lambda_H(1-\vartheta)]\, n_{S,t}$ (where $\vartheta = \frac{\phi_S}{\phi_H}$) we obtain

$$n_t = y_t = -\frac{\chi}{\zeta}y_{C,t}, \tag{B.17}$$

where $\zeta = \phi_S [1 - \lambda_H(1-\vartheta)]^{-1}$, so that

$$y_{C,t} = -\frac{Y_X}{Y_C\zeta + \chi Y}y_{X,t}. \tag{B.18}$$

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

$$a_y = -\chi^{-1} \frac{(1-\beta\rho_\nu)}{(1-\beta\rho_\nu)(1-\rho_\nu) - \phi_\pi \psi_X},$$
$$a_\pi = \frac{\psi_X}{(1-\beta\rho_\nu)(1-\rho_\nu) - \phi_\pi \psi_X},$$

Thus

$$y_{C,t} = -\frac{(1-\beta\rho_\nu)}{(1-\beta\rho_\nu)(1-\rho_\nu) - \phi_\pi \psi_X} \chi^{-1} \nu_t, \tag{B.19}$$
$$y_{X,t} = \frac{Y_C \zeta + \chi Y}{Y_X} \frac{(1-\beta\rho_\nu)}{(1-\beta\rho_\nu)(1-\rho_\nu) - \phi_\pi \psi_X} \chi^{-1} \nu_t, \tag{B.20}$$

where the response of $y_{C,t}$ ($y_{X,t}$) to ν_t tends to be positive if the shock is persistent enough and where, again, $\sigma_H < \sigma_S$ implies higher reactiveness of $y_{C,t}$ and $y_{X,t}$ in either direction (through the fact that χ is a negative function of $\sigma_S - \sigma_H$). As for agent specific consumption:

$$c_{S,t} = -\frac{(1-\beta\rho_\nu)}{(1-\beta\rho_\nu)(1-\rho_\nu) - \phi_\pi \psi_X} \frac{1}{\sigma_S} \nu_t, \tag{B.21}$$
$$c_{H,t} = -\frac{(1-\beta\rho_\nu)}{(1-\beta\rho_\nu)(1-\rho_\nu) - \phi_\pi \psi_X} \frac{1}{\sigma_H} \nu_t, \tag{B.22}$$

so that the sign of the response follows from that of $y_{C,t}$. Finally, to obtain $e_{S,t}$ and $e_{H,t}$, we turn to the budget constraints, recalling that $d_{C,t} = -\omega_t = 0$, $n_{z,t} = -\frac{\sigma_z}{\phi_z} c_{z,t}$, $d_{X,t} = -(w_t - p_{X,t})$, and $\sigma_H c_{H,t} = q_t = \sigma_S c_{S,t}$:

$$e_{S,t} = \left[\sigma_S \left(\frac{1-\tau^D}{1-\lambda} \frac{Y_X}{Y_C} - \frac{1}{\phi_S} \frac{Y}{Y_C}\right) - 1\right] \frac{Y_C}{Y_X} c_{S,t}, \tag{B.23}$$
$$e_{H,t} = \frac{1}{\lambda} y_{X,t} - \frac{1-\lambda}{\lambda} e_{S,t}. \tag{B.24}$$

C Durables in the 2-state THANK economy

The 2-state THANK model differs from its TANK counterpart with respect to the following Euler equations for durables:

$$Q_t C_{S,t}^{-\sigma_S} = \eta_S X_{S,t}^{-\chi_S} + \beta(1-\delta) E_t \left\{ \varrho_{SS} Q_{t+1} C_{S,t+1}^{-\sigma_S} + \varrho_{SH} Q_{t+1} C_{H,t+1}^{-\sigma_H} \right\}, \tag{C.1}$$
$$Q_t C_{H,t}^{-\sigma_H} = \eta_H X_{H,t}^{-\chi_H} + \beta(1-\delta) E_t \left\{ \varrho_{HH} Q_{t+1} C_{H,t+1}^{-\sigma_H} + \varrho_{HS} Q_{t+1} C_{S,t+1}^{-\sigma_S} \right\}. \tag{C.2}$$

We can take the two Euler equations for durables and write them in compact form as

$$\mathbf{Y}_t = \mathbf{A} E_t \mathbf{Y}_{t+1} + \mathbf{B}\mathbf{X}_t, \tag{C.3}$$

with

$$\mathbf{Y}_t = \begin{bmatrix} Q_t C_{S,t}^{-\sigma_S} \\ Q_t C_{H,t}^{-\sigma_H} \end{bmatrix} \text{ and } \mathbf{X}_t = \begin{bmatrix} X_{S,t}^{-\chi_S} \\ X_{H,t}^{-\chi_H} \end{bmatrix}.$$

where

$$\begin{aligned} \mathbf{A} &= \beta(1-\delta)\begin{bmatrix} \varrho_{SS} & \varrho_{SH} \\ \varrho_{HS} & \varrho_{HH} \end{bmatrix}, \\ \mathbf{B} &= \begin{bmatrix} \eta_S & 0 \\ 0 & \eta_H \end{bmatrix}. \end{aligned}$$

As the two eigenvalues of $\mathbf{A}$, $\beta(1-\delta)$ and $\beta(1-\delta)\left(\varrho_{HH}+\varrho_{SS}-1\right)$, always lie within the unit circle, the system is stationary, and $\mathbf{Y}_t = \sum_{i=0}^{\infty} \mathbf{A}^i \mathbf{B} E_t \mathbf{X}_{t+i}$ by forward iteration. The associated eigenvectors are, instead:

$$\mathbf{E} = \begin{bmatrix} 1 & -\frac{\varrho_{SS}-1}{\varrho_{HH}-1} \\ 1 & 1 \end{bmatrix}.$$

Since we can rewrite $\mathbf{A}$ as $\mathbf{EVE}^{-1}$, where $\mathbf{V} = \beta(1-\delta)\mathtt{diag}\left([1, (\varrho_{HH}+\varrho_{SS}-1)]\right)$, we can rewrite a system of independent equations for $\widetilde{\mathbf{Y}}_t = \mathbf{E}^{-1}\mathbf{Y}_t$, where $\widetilde{\mathbf{Y}}_t = \sum_{i=0}^{\infty} \mathbf{V}^i E_t \widetilde{\mathbf{X}}_{t+i}$ and $\widetilde{\mathbf{X}}_t = \mathbf{E}^{-1}\mathbf{B}\mathbf{X}_t$. Now it is interesting to note that

$$\begin{aligned} \widetilde{\mathbf{Y}}_t &= \mathbf{E}^{-1}\mathbf{Y}_t \\ &= \lambda_S \begin{bmatrix} 1 & \frac{\lambda_H}{\lambda S} \\ -1 & 1 \end{bmatrix} \begin{bmatrix} Q_t C_{S,t}^{-\sigma_S} \\ Q_t C_{H,t}^{-\sigma_H} \end{bmatrix} \\ &= Q_t \begin{bmatrix} \lambda_S C_{S,t}^{-\sigma_S} + \lambda_H C_{H,t}^{-\sigma_H} \\ \lambda_S (C_{H,t}^{-\sigma_H} - C_{S,t}^{-\sigma_S}) \end{bmatrix}, \end{aligned}$$

$$
\begin{aligned}
E_t\widetilde{\mathbf{X}}_{t+i} &= \mathbf{E}^{-1}\mathbf{B}E_t\mathbf{X}_{t+i} \\
&= \lambda_S \begin{bmatrix} 1 & \frac{\lambda_H}{\lambda S} \\ -1 & 1 \end{bmatrix} \begin{bmatrix} \eta_S X_{S,t}^{-\chi_S} \\ \eta_H X_{H,t}^{-\chi_H} \end{bmatrix} \\
&= \lambda_S \begin{bmatrix} \eta_S X_{S,t}^{-\chi_S} + \frac{\lambda_H}{\lambda S}\eta_H X_{H,t}^{-\chi_H} \\ -\eta_S X_{S,t}^{-\chi_S} + \eta_H X_{H,t}^{-\chi_H} \end{bmatrix} \\
&= \begin{bmatrix} \lambda_S\eta_S X_{S,t}^{-\chi_S} + \lambda_H\eta_H X_{H,t}^{-\chi_H} \\ \lambda_S\left(\eta_H X_{H,t}^{-\chi_H} - \eta_S X_{S,t}^{-\chi_S}\right) \end{bmatrix}
\end{aligned}
$$

Thus, we can write down the following independent equations:

$$
\begin{aligned}
Q_t\left(\lambda_S C_{S,t}^{-\sigma_S} + \lambda_H C_{H,t}^{-\sigma_H}\right) &= \sum_{i=0}^{\infty}\left[\beta(1-\delta)\right]^i\left\{\lambda_S\eta_S X_{S,t}^{-\chi_S} + \lambda_S\eta_H X_{H,t}^{-\chi_H}\right\}, \\
Q_t\left(-C_{S,t}^{-\sigma_S} + C_{H,t}^{-\sigma_H}\right) &= \sum_{i=0}^{\infty}\left[\beta(1-\delta)\left(\varrho_{HH}+\varrho_{SS}-1\right)\right]^i\left\{-\eta_S X_{S,t}^{-\chi_S} + \eta_H X_{H,t}^{-\chi_H}\right\}.
\end{aligned}
$$

D 3-state THANK economy

D.1 Transition probabilities in the steady state

Let us consider the transition probabilities across three states/islands $[S, H, K]$ and assume those are governed by the following transition probabilities

$$
\mathbf{P} = \begin{bmatrix} \varrho_{SS} & \varrho_{SH} & \varrho_{SK} \\ \varrho_{HS} & \varrho_{HH} & \varrho_{HK} \\ \varrho_{KS} & \varrho_{KH} & \varrho_{KK} \end{bmatrix}. \tag{D.1}
$$

Denote with $\boldsymbol{\lambda} = [\lambda_S, \lambda_H, \lambda_K]$ the share of population within each of the states/islands. The stationary distribution is found by solving the system of equations $\boldsymbol{\lambda}\boldsymbol{P} = \boldsymbol{\lambda}$:

$$
\boldsymbol{\lambda} = \begin{bmatrix} \frac{\varrho_{KH}\varrho_{HS}+\varrho_{KS}\varrho_{HS}+\varrho_{HK}\varrho_{KS}}{\varrho_{KH}\varrho_{HS}+\varrho_{KS}\varrho_{HS}+\varrho_{HS}\varrho_{SK}+\varrho_{SH}\varrho_{KH}+\varrho_{SK}\varrho_{KH}+\varrho_{SH}\varrho_{KS}+\varrho_{HK}\varrho_{KS}+\varrho_{HK}\varrho_{SH}+\varrho_{HK}\varrho_{SK}} \\ \frac{\varrho_{SH}\varrho_{KH}+\varrho_{SK}\varrho_{KH}+\varrho_{SH}\varrho_{KS}}{\varrho_{KH}\varrho_{HS}+\varrho_{KS}\varrho_{HS}+\varrho_{HS}\varrho_{SK}+\varrho_{SH}\varrho_{KH}+\varrho_{SK}\varrho_{KH}+\varrho_{SH}\varrho_{KS}+\varrho_{HK}\varrho_{KS}+\varrho_{HK}\varrho_{SH}+\varrho_{HK}\varrho_{SK}} \\ \frac{\varrho_{HS}\varrho_{SK}+\varrho_{HK}\varrho_{SH}+\varrho_{HK}\varrho_{SK}}{\varrho_{KH}\varrho_{HS}+\varrho_{KS}\varrho_{HS}+\varrho_{HS}\varrho_{SK}+\varrho_{SH}\varrho_{KH}+\varrho_{SK}\varrho_{KH}+\varrho_{SH}\varrho_{KS}+\varrho_{HK}\varrho_{KS}+\varrho_{HK}\varrho_{SH}+\varrho_{HK}\varrho_{SK}} \end{bmatrix} \tag{D.2}
$$

D.2 Problem, log-linear economy, and key derivations

D.2.1 Utility maximization

The head of family's optimization problem reads as

$$\max_{C_{S,t},C_{H,t},C_{K,t},X_{S,t},X_{H,t},N_{S,t},N_{H,t},N_{K,t},\Omega_{S,t},Z_{S,t},Z_{H,t}} E_t\left\{\sum_{i=0}^{\infty}\beta^i\left[\lambda_S\left(\frac{C_{S,t+i}^{1-\sigma_S}}{1-\sigma_S}+\eta_S\frac{X_{S,t+i}^{1-\chi_S}}{1-\chi_S}-\varpi_S\frac{N_{S,t+i}^{1+\phi_S}}{1+\phi_S}\right)\right.\right.$$
$$+\lambda_H\left(\frac{C_{H,t+i}^{1-\sigma_H}}{1-\sigma_H}+\eta_H\frac{X_{H,t+i}^{1-\chi_H}}{1-\chi_H}-\varpi_H\frac{N_{H,t+i}^{1+\phi_H}}{1+\phi_H}\right)$$
$$\left.\left.+\lambda_K\left(\frac{C_{K,t+i}^{1-\sigma_K}}{1-\sigma_K}-\varpi_K\frac{N_{K,t+i}^{1+\phi_K}}{1+\phi_K}\right)\right]\right\}$$

s.t.

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

The main novelty brought by this setup, compared to the 2-state THANK model, is represented by the Euler equations for durables on islands S, H, and K, respectively:

$$
\begin{aligned}
C_{S,t}^{-\sigma_S} Q_t &= \eta_S X_{S,t}^{-\chi_S} + \varrho_{SS} \beta (1-\delta) E_t \left\{ \varrho_{SS} C_{S,t+1}^{-\sigma_S} Q_{t+1} + \varrho_{SH} \beta C_{H,t+1}^{-\sigma_S} Q_{t+1} + \varrho_{SK} \Psi_{t+1} \right\}, \\
C_{H,t}^{-\sigma_H} Q_t &= \eta_H X_{H,t}^{-\chi_H} + E_t \left\{ \varrho_{HS} C_{S,t+1}^{-\sigma_S} Q_{t+1} + \varrho_{HH} \beta C_{H,t+1}^{-\sigma_S} Q_{t+1} + \varrho_{HK} \Psi_{t+1} \right\}, \\
\Psi_t &= \eta_K X_{K,t}^{-\chi_K} + E_t \left\{ \varrho_{KS} C_{S,t+1}^{-\sigma_S} Q_{t+1} + \varrho_{KH} \beta C_{H,t+1}^{-\sigma_S} Q_{t+1} + \varrho_{KK} \Psi_{t+1} \right\},
\end{aligned}
$$

where Ψ_t is the multiplier applying to the liquidity constraint. As in the case of the 2-state THANK, the analytics in Section 5 rely on the fact that a quasi-constant stock of durables (in the face of monetary policy shocks) implies $C_{S,t}^{-\sigma_S} Q_t$, $C_{H,t}^{-\sigma_H} Q_t$, Ψ_t to be constant too, through the Euler equations above.

D.2.2 Log-linear economy

From now on, we impose deep parameters—aside of transition probabilities, the relative size of the two sectors, and the degree of sectoral price stickiness—to be homogeneous. In order to log-linearize, we set $\eta \equiv C_z^{-\sigma} / X_z^{-\chi}$, for $z \in \{H, S, K\}$, so that

$$
\Psi = \left[1 - \varrho_{KK} (1-\delta)\right]^{-1} \left[1 + (\varrho_{KS} + \varrho_{KH}) \beta (1-\delta)\right] C_z^{-\sigma}.
$$

Based on this, the log-linearized economy is structured as follows.

Island S:

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

$q_t - \sigma c_{S,t} = -\eta\chi x_{S,t}$

$+\beta(1-\delta)[\varrho_{SS}(E_t q_{t+1} - \sigma E_t c_{S,t+1}) + \varrho_{SH}(E_t q_{t+1} - \sigma E_t c_{H,t+1})] + \frac{\varrho_{SK}(1-\delta)[\eta + (\varrho_{KS}+\varrho_{KH})\beta(1-\delta)]}{1-\varrho_{KK}(1-\delta)} E_t \psi_{t+1}$

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

$c_{S,t} + \frac{Y_X}{Y_C} e_{S,t} = \frac{Y}{Y_C}(\omega_t + n_{S,t}) + \frac{1-\tau_K^D - \tau_H^D}{\lambda_S} d_{C,t} + \frac{1-\tau_K^D-\tau_H^D}{\lambda_S}\frac{Y_X}{Y_C} d_{X,t}$

$e_{S,t} = q_t + \frac{1}{\delta} x_{S,t} - \frac{1-\delta}{\delta}[\varrho_{SS}\lambda_S x_{S,t-1} + \varrho_{HS}\lambda_H x_{H,t-1} + \varrho_{KS}\lambda_K x_{K,t-1}]$

Island H:

$q_t - \sigma c_{H,t} = -\eta\chi x_{H,t}$

$+\beta(1-\delta)[\varrho_{HS}(E_t q_{t+1} - \sigma E_t c_{S,t+1}) + \varrho_{HH}(E_t q_{t+1} - \sigma E_t c_{H,t+1})] + \frac{\varrho_{HK}(1-\delta)[\eta + (\varrho_{KS}+\varrho_{KH})\beta(1-\delta)]}{1-\varrho_{KK}(1-\delta)} E_t \psi_{t+1}$

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

$c_{H,t} + \frac{Y_X}{Y_C} e_{H,t} = \frac{Y}{Y_C}(\omega_t + n_{H,t}) + \frac{\tau_H^D}{\lambda_H} d_{C,t} + \frac{\tau_H^D}{\lambda_H}\frac{Y_X}{Y_C} d_{X,t}$

$e_{H,t} = q_t + \frac{1}{\delta} x_{H,t} - \frac{1-\delta}{\delta}[\varrho_{HH}\lambda_H x_{H,t-1} + \varrho_{SH}\lambda_S x_{S,t-1} + \varrho_{KH}\lambda_K x_{K,t-1}]$

Island K:

$\psi_t = -\frac{\eta\chi[1-\varrho_{KK}(1-\delta)]}{[\eta + (\varrho_{KS}+\varrho_{KH})\beta(1-\delta)]} x_{K,t}$

$+\frac{\beta(1-\delta)[1-\varrho_{KK}(1-\delta)]}{[\eta+(\varrho_{KS}+\varrho_{KH})\beta(1-\delta)]}[\varrho_{KS}(E_t q_{t+1} - \sigma E_t c_{S,t+1}) + \varrho_{KH}(E_t q_{t+1} - \sigma E_t c_{H,t+1})] + \varrho_{KK}(1-\delta) E_t \psi_{t+1}$

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

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

$x_{K,t} = (1-\delta)\widetilde{x}_{K,t-1}$

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:

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

$y_{C,t} = c_t = \lambda_H c_{H,t} + \lambda_K c_{K,t} + \lambda_S c_{S,t}$

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

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

D.3 Sectoral dynamics in the benchmark economy

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

$$\pi_t = \frac{1}{\phi_\pi} E_t \pi_{t+1} - \frac{1}{\phi_\pi} \nu_t, \tag{D.3}$$

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

$$\pi_t = -\frac{1}{\phi_\pi} E_t \sum_{s=0}^{\infty} \left(\frac{1}{\phi_\pi}\right)^s v_{t+s} = \frac{1}{\rho_\nu - \phi_\pi} \varepsilon_t^\nu, \tag{D.4}$$

Thus, from the NKPC:

$$\omega_t = \frac{1}{\psi\, (\rho_\nu - \phi_\pi)} \varepsilon_t^\nu. \tag{D.5}$$

Take now H's and S's budget constraints, and aggregate them, considering that *i*) $c_{H,t} = c_{S,t} = q_t = 0$ (by virtue of quasi-constancy of the shadow values of durables), so that $\omega_t = w_t - p_{X,t}$ and $d_{C,t} = d_{X,t} = -\omega_t$; *ii*) $n_{S,t} = n_{H,t} = \frac{1}{\phi}\omega_t$. Thus, multiply both sides of the constraint by $1/(1-\lambda_K)$ to obtain

$$y_{X,t} = \frac{Y}{(1-\lambda_K)\, Y_X} \left(\frac{\lambda_S + \lambda_H}{\phi} + \tau_K^D \right) \omega_t. \tag{D.6}$$

Take now K's budget constraint, and combine it with $c_{K,t} = \frac{1}{\lambda_K} y_{C,t}$, $n_{K,t} = \frac{1}{\lambda_K} n_t - \frac{\lambda_S}{\lambda_K} n_{S,t} - \frac{\lambda_H}{\lambda_K} n_{H,t}$ and $n_{S,t} = n_{H,t} = \frac{1}{\phi}\omega_t$:

$$y_{C,t} = \frac{Y}{Y_C} \left(\lambda_K - \tau_K^D - \frac{\lambda_S + \lambda_H}{\phi} \right) \omega_t + \frac{Y}{Y_C} y_t. \tag{D.7}$$

Consider y_t from the definition of aggregate hours, and then combine this with the labor supply schedule in each state (recall that $n_{K,t} = \frac{1}{\phi}\omega_t - \frac{\sigma}{\phi}c_{K,t}$):

$$y_t = \frac{1}{\phi}\omega_t - \frac{\sigma}{\phi}y_{C,t}.$$

Thus, combining the latter with (D.7):

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

Together with (D.6), the latter allows us to obtain (18) in the main text.

D.4 Amplification under asymmetric price stickiness

Figure D.1 shows that aggregate conditional volatility increases in the fiscal transfer, both in polarized settings with one sector at a time featuring pure price flexibility (Panels (a) and (b)), and in the economy with mild asymmetry in sectoral price stickiness (where, specifically, durables have relatively more flexible prices; see Panel (c), where we impose $\theta_X = 0.4$ and $\theta_C = 0.6$).[23] Unsurprisingly, average volatility is an order of magnitude greater when durables have sticky prices, for their inherently higher volatility is amplified by price stickiness. However, in the opposite situation, or even when nondurables have just stickier prices, we register a much higher percentage increases in aggregate volatility over the support for the fiscal transfer.

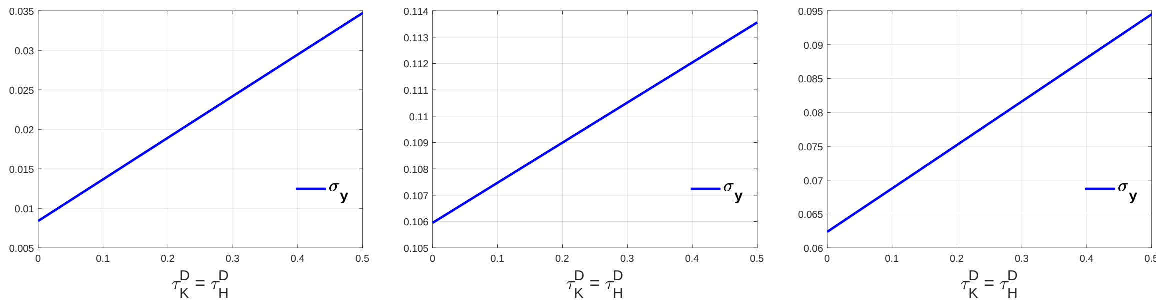
To provide some analytical intuition for these facts, we abstract from ω_t and q_t being endogenous to fiscal transfers (unlike the case of symmetric price stickiness), while focusing on factor loadings that involve τ_K^D. This allows us to interpret how fiscal redistribution exerts a first-order impact on sectoral and aggregate responsiveness.[24] Based on this strategy, it is possible express real GDP as the sum of two components, the second of which depends on the average real marginal cost in the economy, $rmc_t \equiv \frac{Y_C}{Y}\omega_t + \frac{Y_X}{Y}(w_t - p_{X,t})$:

$$y_t = \mathfrak{F}(\omega_t, q_t) + \left(\frac{1}{1-\lambda_K} - \frac{\phi Y_C}{\phi Y_C + \sigma Y}\right)\tau_K^D rmc_t, \tag{D.8}$$

[23] We take this setting as reflecting the main standpoint when it comes to calibrating multi-sector economies with nominal price rigidity and involving the durable-nondurable dichotomy. See, e.g., Bils and Klenow (2004) and Nakamura and Steinsson (2008). In fact, as we will show in the remainder of this section, our analysis retains a fair degree of generality, with respect to alternative calibrations of sectoral price rigidity.

[24] For illustrative purposes, Appendix D.5 documents a comparative-statics analysis of how fiscal transfers and the elasticity of labor supply shape *sectoral* amplification/attenuation in economies with asymmetric price stickiness, where one sector at a time features purely flexible prices. In this case, it is possible to characterize the elasticity of K's nondurable consumption to aggregate nondurable consumption—and, thus, the behavior of the conditional volatility of both durables and nondurables—in the vein of Bilbiie (2020).

Figure D.1: Volatility and fiscal redistribution: asymmetric stickiness



(a) Sticky Nondurables (b) Sticky Durables (c) Mild Asymmetry

Notes. A period in the model corresponds to a quarter. Panel (a): $\theta_X = 0$, $\theta_C = 0.6$; Panel (b): $\theta_X = 0.6$, $\theta_C = 0$; Panel (c): $\theta_X = 0.4$, $\theta_C = 0.6$. Other parameter values: $\sigma = 1$, $\phi = 1$, $Y_C = \alpha = 0.75$, $Y_X = 1 - Y_C$, $\beta = 0.97$, $\delta = 0.025$, $\phi_\pi = 1.5$, $\lambda_S = 2/3$, $\lambda_K = 1/9$, $\lambda_H = 2/9$ (which, in light of the restrictions to the transition probability matrix, require $\varrho_{SS} = 0.9634$, $\varrho_{SH} = 1 - \varrho_{SS}$, $\varrho_{SK} = 0$, $\varrho_{HH} = 0.8901$, $\varrho_{HS} = \varrho_{HK} = (1 - \varrho_{HH})/2$, $\varrho_{KK} = 0.8901$, $\varrho_{KH} = 1 - \varrho_{KK}$ and $\varrho_{KS} = 0$).

where $\mathfrak{F}(\omega_t, q_t)$ is a function of the real wage in units of nondurables and the relative price, and where factor loadings do not feature fiscal transfers. Focusing on the factor loading applying to the average real marginal cost, instead, allows us to infer that fiscal transfers amplify the overall monetary response. This is not just true regardless of how large the production sector of durables is, but also of how "sticky" it is. In fact, as $\frac{1}{1-\lambda_K} > \frac{\phi Y_C}{\phi Y_C + \sigma Y}$ is always verified (unless, again, limit situations are considered, in line with Proposition 4), fiscal redistribution amplifies a given change in the average real marginal cost, and more so as durables' inherent illiquidity, as captured by λ_K, increases.

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

$$y_{X,t} = \frac{Y}{Y_X(1-\lambda_K)}\left(\frac{\lambda_S + \lambda_H}{\varphi} + \tau_K^D\right)\omega_t - \left(\frac{\tau_K^D}{1-\lambda_K} + \frac{(\varphi Y_C + \sigma Y)(1-\lambda_K) - \varphi\sigma\lambda_K Y_X}{Y_X\varphi\sigma(1-\lambda_K)}\right)q_t. \tag{D.10}$$

To explain why aggregate volatility is more sensitive to τ^D when nondurables have stickier prices, instead, it is useful to derive (D.9) and (D.10), so to express $y_{C,t}$ and $y_{X,t}$ as functions of the real wage (in units of nondurables) and the relative price of durables.[25] For illustrative purposes, we focus on the two polar cases in which one sector at a time features purely flexible prices. Starting with nondurables, $\omega_t = 0$ when $\theta_C = 0$, so that raising transfers amplifies

[25] Notice how (19) and (20) respectively obtain as special cases, under symmetric price stickiness, by imposing $q_t = 0$.

the passthrough of q_t on $y_{C,t}$, while attenuating it with respect to $y_{X,t}$. When durables have flexible prices, instead, we need to recall that $q_t = \omega_t$. In this case, it is immediate to see that increasing τ^D necessarily amplifies the passthrough of ω_t on $y_{X,t}$—which is inherently more volatile—while attenuating it with respect to $y_{C,t}$. As a result, when durables have more flexible prices—so that aggregate volatility is on average lower, all else equal—aggregate production displays higher sensitivity to profit redistribution.

D.5 Sectoral amplification under asymmetric price stickiness

It is instructive to discuss some comparative statics exercises in the two economies where sectoral price stickiness is nil in one sector at a time. To this end, much like the analysis of Bilbiie (2020), it is possible to characterize the elasticity of K's nondurable consumption to aggregate nondurable consumption, whenever price stickiness is asymmetric between sectors:

$$c_{K,t} = \frac{\mu_K}{\lambda_K} y_{C,t}. \tag{D.11}$$

In order to derive μ_K, we start from aggregating the labor supply schedules of households in each of the three states to obtain the aggregate wage schedule:

$$\phi n_t = \omega_t - \sigma c_t. \tag{D.12}$$

Let us now consider the case of *flexible prices for durables*. Combine K's labor supply with her budget constraint, using $d_{j,t} = -w_{j,t}$ and recalling that $\omega_{X,t} = 0$, to obtain

$$\omega_t = \frac{\left(\phi + \sigma \frac{Y}{Y_C}\right) \lambda_K}{\lambda_K + \phi \left(\lambda_K - \tau_K^D\right)} \frac{Y_C}{Y} c_{K,t}. \tag{D.13}$$

Plugging this into the the aggregate wage equation, and relying on $y_t = n_t$:

$$\phi y_t = \frac{\left(\phi + \sigma \frac{Y}{Y_C}\right) \lambda_K}{\lambda_K + \phi \left(\lambda_K - \tau_K^D\right)} \frac{Y_C}{Y} c_{K,t} - \sigma c_t. \tag{D.14}$$

This equation is the key to deriving K's consumption as a function of total nondurable production.[26] Recall again that $w_t - p_{X,t} = 0$. Thus, by appealing to K's labor supply and

[26] At this stage, it is possible to prove the equivalence with the multiplier in Bilbiie (2020), by simply setting

$\sigma_H c_{H,t} = q_t = \sigma_S c_{S,t}$, we can show again that $n_{H,t} = n_{S,t} = 0$, so that $n_t = \lambda_K n_{K,t}$. In light of this:

$$c_{K,t} = \frac{\left[\lambda_K + \phi\left(\lambda_K - \tau_K^D\right)\right]\left[\lambda_K Y + \phi\left(\lambda_K Y - \tau_K^D Y_C\right)\right]}{\left(\phi + \sigma \frac{Y}{Y_C}\right)\left[\lambda_K Y + \phi\left(\lambda_K Y - \tau_K^D Y_C\right)\right]\frac{Y_C}{Y} - \phi\left[\lambda_K + \phi\left(\lambda_K - \tau_K^D\right)\right]\left[\lambda_K Y_C - \sigma\left(\lambda_K Y - \tau_K^D Y_C\right)\right]} \cdot \frac{\sigma}{\lambda_K} y_{C,t} \tag{D.15}$$

As for the case of *flexible prices for nondurables*, recall that $\omega_t = d_{C,t} = 0$. Thus, K's labor supply implies $n_{K,t} = -\frac{\sigma}{\phi} c_{K,t}$. Combining this and $q_t = \sigma c_{S,t}$ with her budget constraint:

$$\left(1 + \frac{\sigma}{\phi}\frac{Y}{Y_C}\right) c_{K,t} = \frac{\tau_K^D}{\lambda_K}\frac{Y_X}{Y_C}\sigma c_{S,t}, \tag{D.16}$$

In turn, using $c_{S,t} = \frac{1}{\lambda_H + \lambda_S} c_t - \frac{\lambda_K}{\lambda_H + \lambda_S} c_{K,t}$ and $c_t = y_{C,t}$,, we can prove that

$$c_{K,t} = \frac{\tau_K^D \sigma \phi Y_X}{\phi Y_C\left(\lambda_H + \lambda_S\right) + \sigma Y\left(\lambda_H + \lambda_S\right) + \tau_K^D \sigma \phi Y_X}\frac{1}{\lambda_K} y_{C,t}. \tag{D.17}$$

The role of fiscal transfers and labor supply Starting from S's bond Euler (which is the only one holding in equilibrium), we may characterize the behavior of aggregate nondurable consumption:

$$y_{C,t} = \frac{\lambda_K\left(\varrho_{SS} + \varrho_{SH}\right)\left(1 - \mu_K\right) + \varrho_{SK}\mu_K\left(\lambda_H + \lambda_S\right)}{\left(1 - \mu_K\right)\lambda_K} E_t y_{C,t+1} - \frac{1 - \lambda_K}{\sigma\left(1 - \mu_K\right)}\left(r_t - E_t \pi_{C,t+1}\right). \tag{D.18}$$

Notably, $\mu_K < (>) \lambda_K$ ensures discounting (compounding) of news about the future while attenuating (amplifying) the elasticity of $y_{C,t}$ to the real interest rate.[27] Therefore, the (intratemporal) HtM channel is *complemented* by the (intertemporal) self-insurance channel: bad (good) news about future nondurable production reduce (boost) today's demand for nondurables, implying less (more) need for self-insurance against the K state. Thus, given that $y_{X,t}$ and $y_{C,t}$ display close-to-perfect negative correlation when either sector features purely flexible prices, the volatilities of the two sectoral productions are also characterized by the same determinants. In light of this, we can simply focus on the behavior of μ_K.

$Y_C = Y$.

[27]According to the same conditions, procyclical (countercyclical) nondurable consumption inequality emerges.

Starting from the scenario featuring flexible prices of durable goods, $c_{K,t}$ is meant to react more than one-to-one to changes in nondurable production under relatively low fiscal redistribution and large λ_K. Assume a monetary tightening, which causes a contraction in $y_{C,t}$ and ω_t, with S and H substituting nondurables for durables, given that the latter become relatively cheaper. Recall that, under $\theta_X = 0$ and $\theta_C > 0$, $d_{X,t} = 0$, so that K's income equals $\frac{Y}{Y_C}(n_{K,t} + \omega_t) + \frac{\tau_K^D}{\lambda_K} d_{C,t}$. Notice how raising ϕ attenuates the increase in $n_{K,t}$, thus acting as a further drag on K's labor income. At the same time, as $d_{C,t} = -\omega_t$, dividends accruing from the nondurables sector necessarily expand—attenuating the impact of the contractionary monetary stance on $c_{K,t}$—and more so as τ_K^D increases and/or λ_K drops, all else equal, as in this case K progressively internalizes the positive effect from fiscal redistribution. This effect counteracts the negative impulse on aggregate nondurable consumption.

Turning to the scenario with nondurable goods featuring flexible prices, $\mu_K > \lambda_K$ tends to hold more easily under relatively large fiscal redistribution and/or under a relatively small λ_K. As nondurable goods become relatively cheaper, a monetary tightening now induces S and H to substitute durables for nondurables. Recall also that K's income equals $\frac{Y}{Y_C} n_{K,t} + \frac{\tau_K^D}{\lambda_K} \frac{Y_X}{Y_C} d_{X,t}$. As $d_{X,t} = -(w_t - p_{X,t}) = q_t$, dividends from the durable sector expand, thus supporting K's purchase of nondurables. Thus, increasing τ_K^D and/or reducing λ_K enhances such expansion. As for ϕ, instead, raising it amounts to limit the drop in K's labor supply, making it increasingly inelastic and attenuating the drag on $c_{K,t}$.