The Housing Channels of Monetary Policy*

Daria Finocchiaro† Ettore Savoia ‡ Karl Walentin§
Andreas Westermark¶

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Abstract

Monetary policy influences household portfolios and redistributes wealth through multiple channels. We develop a two-sector New Keynesian heterogeneous agent model, in which housing serves a dual role as both a consumption and investment good and can be used as collateral. Our framework captures key transmission mechanisms—*collateral, housing wealth, cash-flow,* and *housing supply* channels—highlighting housing's crucial role in shaping the response of consumption and residential investment to monetary shocks. We find that monetary policy-induced house price changes account for over half of the transmission to consumption and can induce an asymmetric response to monetary policy shocks.

Keywords: Heterogeneity, Collateral Constraint, Housing, HANK

JEL codes: E40, E50

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†Sveriges Riksbank, CEPR. Email: daria.finocchiaro@riksbank.se.
‡Sveriges Riksbank. Email: ettore.savoia@riksbank.se.
§Uppsala University. Email: karl.walentin@nek.uu.se.
¶Andreas Westermark. Email: andreas.westermark@riksbank.se.

1 Introduction

Monetary policy operates through multiple channels influencing household portfolio decisions and redistributing wealth. The seminal contribution of Kaplan, Moll, and Violante (2018) emphasizes that understanding these transmission mechanisms requires a close examination of household balance sheets. A key insight is that households choices in terms of both liquid and illiquid wealth matter to generate a marginal propensity to consume (MPC) in line with the data. The MPC is a crucial moment to capture indirect - beyond intertemporal substitution - effects of monetary policy. In this paper, we build on this perspective by focusing on the most critical components of household finances: housing as an asset and the associated mortgage debt as a liability.

Our emphasis on housing is motivated by its unique and pivotal role in the economy as it influences and responds to monetary policy through various mechanisms. Housing is one of the most widely held assets, it serves both as a consumption and a lumpy investment good and can function as collateral providing access to credit market. Monetary policy influences mortgagors debt service (*cash-flow channel*), impacts on house prices which affects housing wealth (*housing wealth channel*) and borrowing capacity (*collateral channel*). On the supply side, housing investment is highly volatile and monetary policy induced house price fluctuations can impact on housing production in the longer run (*housing supply channel*).
To incorporate and disentangle the importance of all these channels, we analyze the transmission of monetary policy shocks through the lens of a two-sector, two-asset, incomplete markets model of the U.S. economy, where households can borrow to smooth negative income shocks and purchase a house.[1] Borrowing is tied to the house value and housing investments are illiquid, i.e. subject to transaction costs. Moreover, we explicitly model a housing production sector to better capture how residential investment responds to monetary policy and house price changes. We show that the collateral channel plays a crucial role in the transmission of monetary policy and helps explain the asymmetric response of consumption to interest rate shocks.

Our model is part of the growing literature emphasizing the importance of incorporating full household heterogeneity in New Keynesian frameworks (Kaplan, Moll, and Violante 2018, Bayer and Luetticke 2020, Auclert et al. 2021). Our contribution lies in explicitly modeling illiquid wealth as housing, which we consider crucial for several reasons. First, empirically, housing is by a large margin the dominant illiquid asset in most households' asset portfolio. Being a durable good it is also more affected by interest rates changes than non-durable

1. In the current version of our baseline model, mortgages are one-period contracts but we are working on an extension with long-term debt.

consumption (McKay and Wieland 2021).

Second, accounting for collateral effects implies an additional transmission channel for monetary policy, and for any shock affecting house prices. An expansionary monetary policy shock implies an increase in house prices and thereby an increase in the borrowing capacity of all homeowners. Thus, potentially, a substantial part of the transmission of monetary policy can occur through indirect effects via illiquid assets in the form of housing. In our calibration, we find that monetary policy induced changes in house prices account for more than half of the transmission mechanism to consumption, except in the first quarter of the shock. This differs from the result in Kaplan, Moll, and Violante (2018) where the transmission of a monetary policy shock through illiquid asset prices is only limited.

Third, our model can capture cash-flow effects of monetary policy, i.e. the additional response in consumption to changes in the interest rate of indebted households due to the effect of debt service payments on disposable income. Empirically, these have been shown to be important (see e.g. Fagereng et al. 2020 and Flodén et al. 2020). According to the evidence in Fagereng et al. (2020) this is the primary source of heterogeneity in the consumption response to monetary policy shocks. Flodén et al. (2020) reports that on average indebted households reduce consumption by 0.2–0.6 percentage points more than others in response to a one-percentage-point increase in the policy rate.

We are not the first to acknowledge the significant role of housing in business cycles and the transmission of monetary policy. The closest study to ours is Hedlund et al. (2017) which examines the role of mortgage debt in the transmission and effectiveness of monetary policy within a rich HANK model featuring search frictions in housing markets. We complement their analysis by introducing a construction sector and let housing supply partially respond to house price movements in Walrasian housing markets. Thus, in our model, two components of GDP are directly influenced by housing: consumption and residential investment. The latter is particularly important, as it has historically been one of the most volatile sectors of the economy. Moreover, the impact of asset and mortgage debt distribution on the response of residential investment to shocks remains largely unexplored in the literature. Kinnerud (forthcoming) shows that mortgage refinancing accounts for most of the response of aggregate demand to shocks to the real rate in a life-cycle, endowment economy. Iacoviello (2005) and Iacoviello and Neri (2010) study the interaction between housing, collateralized debt and monetary policy in two-agent, new-Keynesian settings. We differ from these papers in several respects, yet our main conclusion remains the same: housing plays a central role in the transmission of monetary policy.

The rest of the paper is organized as follows. Section 2 presents our model. Sections 3 and 4 report our calibration and main results, while Section 5 concludes.

2 The model

Consider an economy populated by infinitely lived households consuming both non-durable and durable goods, the latter representing housing. They face uninsurable idiosyncratic income risk and can borrow against their homes as collateral. The non-durable good is produced by a perfectly competitive sector that combines intermediate goods from firms operating in monopolistically competitive markets, subject to nominal rigidities. Housing is produced in a perfectly competitive sector combining land (building permits), in fixed supply, and structures, supplied by the final good sector. The government balances its budget every period while nominal rates are set by a monetary authority following a Taylor-type rule. In what follows, we present the model in detail while all technicalities and the algebra are relegated to the Appendix.

2.1 Households

Households consume both non-durable c_{it} goods and housing services, h_{it}. They have a stochastic labor endowment e_{it} and can borrow ($b_{it} \leq 0$) or lend b_{it} from each other using a fraction θ of the current value of their houses as collateral.[2] Their Bellman equation is:

$$V_t(e_{it}, b_{it-1}, h_{it-1}) = \underset{c_{it},h_{it}}{max}\Big\{ \frac{c_{it}^{1-\sigma}}{1-\sigma} - \psi\frac{N_t^{1+\nu}}{1+\nu} + j \ln h_{it} \Big\} + \beta \mathbb{E}_t V_t(e_{it+1}, b_{it}, h_{it})$$

subject to

$$c_{it} + b_{it} + q_t \left(h_{it} - (1-\delta_h)h_{it-1}\right) = z_{it} + b_{it-1}(1+r_t) + d_t - \Phi(h_{it}, h_{it-1}),$$

$$b_{it} + \theta q_t h_{it} \geq 0$$

Where r denotes the real return on bonds, q the real house price and δ_h the depreciation rate of housing.[3] They receive after-tax labor income $z_{it} = (1-\tau_t)w_t N_t e_{it}$, where τ_t is the labor income tax rate, and dividends d_t from the monopolistically competitive firms sector. Households' labor supply, N_t is negotiated at the aggregate level by labor unions as described below. To capture the illiquid nature of housing, it is assumed that housing investments are

2. Iacoviello (2005) considers a similar constraint in a representative household setting:

$$b_{it}(1+r_{t+1}) + \theta q_{t+1} h_{it} \geq 0.$$

We also solve a version of the model where we shut down this channel and assume a fixed borrowing limit.

3. A standard Fisher equation links real and nominal returns, $1 + r_t = \frac{1+i_{t-1}}{1+\pi_t}$ where π denotes inflation and i the nominal interest rate.

subject to a convex adjustment/transaction cost ($\Phi(h_{it}, h_{it-1})$).[4]

2.1.1 Labor unions

For the sake of simplicity, we assume that wages are determined by labor unions. Households provide differentiated labor services and are represented by labor unions who set wages by maximizing the average utility of their members taking as given their consumption decisions:

$$W_t(w_{kt-1}) = \max_{w_{kt}} \int_0^1 {c_{it}}^{-\sigma} w_{kt} n_{kt}(1-\tau_t) e_{it} di - v(n_{kt}) - \frac{\mu_w}{\mu_w - 1} \frac{1}{2k_w} \left[\log(1+\pi^w_{kt})\right]^2 N_t + \beta W_{t+1}(w_{kt})$$

subject to

$$n_{kt} = \left(\frac{w_{kt}}{w_t}\right)^{-\frac{\mu_w}{\mu_w - 1}} N_t$$

where $\pi^w_{kt} = (1+\pi_t)\frac{w_{kt}}{w_{kt-1}} - 1$ denotes wage inflation and we assume that changing nominal wages entails a quadratic cost. From unions' optimality conditions it is possible to derive the following wage Philips curve:

$$\log(1+\pi^w_{kt+1}) = k_w \left[\psi N_t^{1+\nu} - \frac{(1-\tau_t) w_t N_t}{\mu_w} \int e_{it} c_{it}^{-\sigma}\right] + \beta \log(1+\pi^w_{t+1}).$$

2.2 Technology

On the production side, we differentiate between a consumption (non-durable) and a housing sector.

2.2.1 Final-good producers

The final non-durable good is produced aggregating intermediate goods according to

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

where $\mu/(\mu-1) > 1$ measures the elasticity of substitution between different intermediate goods.

Intermediate-good producers

In a monopolistically competitive intermediate good sector, a continuum of firms indexed by j set prices and maximize profits subject to price adjustment costs ψ_t *à la* Rotemberg

4. The functional form is described in the Appendix.

(1982). Labor is the only factor or production and aggregate TFP is denoted by Z_t:

$$y_{jt} = Z_t n_{jt}.$$

From cost minimization we can derive the real marginal cost:

$$mc_t = \frac{w_t}{Z_t}$$

The profit maximization problem faced by the price setters is:

$$\mathbb{E}_0 \underset{\{p_{jt}\}}{Max} \sum_{t=0}^{\infty} \beta^t Y_t \left[\left(\frac{p_{jt}}{P_t} - mc_t \right) \left(\frac{p_{jt}}{P_t} \right)^{\frac{\mu}{1-\mu}} - \frac{\mu}{\mu - 1} \frac{1}{2\kappa} \left(\log \frac{p_{jt}}{p_{jt-1}} \right)^2 \right]$$

given the demand for good j, $y_{it} = \left(\frac{p_{jt}}{P_t} \right)^{\frac{\mu}{1-\mu}} Y_t$. From the optimality conditions of the problem described above, in a symmetric equilibrium, it is possible to derive the following Phillips curve:

$$log(1 + \pi_t) = \kappa \left(mc_t - \frac{1}{\mu} \right) + \frac{Y_{t+1}}{Y_t} \frac{\log(1 + \pi_{t+1})}{1 + r_{t+1}}$$

2.2.2 Housing Sector

Housing is produced by combining land, L, supplied by the government,[5] and structures (the final good), S, according to the following Cobb-Douglas function:

$$Y_h = A_h L^{\alpha_L} S^{1-\alpha_L}$$

where A_h denotes the productivity in the housing sector.[6] The maximization problem solved by construction firms is:

$$\underset{S,L}{Max} \quad q A_h L^{\alpha_L} S^{1-\alpha_L} - p_L L - S$$

where p_L is the real price of land. In aggregate the amount of land is fixed at $\bar{L}$. From the housing sector optimality conditions it follows that

$$Y_h = A_h^{1/\alpha_L} ((1 - \alpha_L) q)^{\frac{1-\alpha_L}{\alpha_L}} \bar{L}$$

That is, the land share in production determines the elasticity of housing supply to prices.

5. The government collects the revenue from the sale of land and permits.

6. Our specification of production function in the construction sector follows Castellanos, Paz-Pardo, and Hannon 2024.

2.3 Fiscal and monetary policy

Monetary policy follows a Taylor rule reacting to inflation and output:

$$i_t = r^* + \phi_\pi \pi_t + \phi_y (Y_t - Y_{ss}) + \epsilon_t^r$$

The fiscal authority finances expenditures, G_t, using issuing one-period nominal debt B_t^g, revenues from the sale of building permits and taxes on labor income:

$$B_t^g = (1 + r_t) B_{t-1}^g + G_t - p_{L,t} \bar{L} - \tau_t w_t N_t$$

There are three possible simple fiscal rules; i) stabilization of debt through taxes, ii) stabilization of debt through government expenditures, or iii) taxes and expenditures constant and debt adjusting to any shocks. The speed of the debt stabilizing rules is regulated through the parameter $\gamma_i, i = \{\tau, G\}$. Our preferred assumption about fiscal behavior is case iii), i.e. that tax rates and government expenditures are unresponsive (constant), in line with the empirical evidence in Bouscasse and Hong (2023). But for the time being we work with the assumption of a period-by-period balanced budget for simplicity.

Re-arranging the government budget constraint, one can solve for the tax rate $\tilde{\tau}_t$ that ensures $B_t^g = \bar{B^g}$:

$$\tilde{\tau}_t = \frac{(B_{t-1}^g (1 + r_t) - \bar{B^g}) + G_t - p_{L,t} \bar{L}}{w_t N_t}$$

If adjustment occurs through taxes, then

$$\tau_t = \gamma_\tau \tilde{\tau}_t + (1 - \gamma_\tau) \bar{\tau}$$

and $\gamma_\tau > 0$ determines the speed of debt convergence. $\gamma_\tau = 1$ implies immediate debt stabilization, i.e. constant government debt. Instead, if $\gamma_\tau = 0$ and $\gamma_G = 0$ (see below) government debt is a random walk.

Analogously to taxes, there is a $\tilde{G}_t$ that implies $B_t^g = \bar{B^g}$:

$$\tilde{G}_t = -(B_{t-1}^g (1 + r_t) - \bar{B^g}) + p_{L,t} \bar{L} + \bar{\tau} w_t N_t$$

Implementation of case ii), debt stabilization through adjustment of government expenditures implies:

$$G_t = \gamma_G \tilde{G}_t + (1 - \gamma_G) \bar{G}$$

The implications of γ_G are analogous to γ_τ: A value of unity implies that government

expenditures fully and immediately adjust to stabilize debt. In contrast, a value of 0 means that government expenditures are invariant to public finances.

2.4 Market clearing

Land is in fixed supply

$$L_t = \bar{L}$$

Government bonds can be bought by both domestic and foreign investors (B_t^*)

$$B_t + B_t^* = B_t^g$$

where $B_t = \int_0^1 b_{it} di$ and we assume an exogenous rule for the supply of funds from abroad. In its simplest form this supply is constant, $B_t^* = \bar{B}^*$.

Taking into account the optimality condition in the construction sector, market clearing in the final good sector requires:

$$Y_t = C_t + q_t Y_{h,t}(1 - \alpha_L) + G_t - B_t^* + (1 + r)B_{t-1}^* + \psi_t + \Phi(H_t, H_{t-1}),$$

and the law of motion of aggregate housing follows:

$$H_t = (1 - \delta_h)H_{t-1} + Y_{ht}.$$

3 Calibration

For a large set of parameters, we adopt values from the existing literature. These are reported in Table 1. The remaining parameters are calibrated jointly within the model to match a set of targeted moments. Table 2 reports the values and the main identifying moments of the internally calibrated parameters. Data sources and values of the targeted moments are documented in Table 3. Our model fits all targeted moments, including the house price elasticity to a monetary policy shock, reasonably well. The targeted elasticity is based on the mid-point of Aastveit and Anundsen 2022 estimate of 3-7% house price response to a 1 percentage point monetary policy shock.

We adopt a discretized version of the earning process in Kaplan, Moll, and Violante (2018), based on the moments in Guvenen et al. (2021), to specify our income dynamics and use data from the 2004 Survey of Consumer Finances (SCF) to calibrate the model regarding the asset holdings. Two important targets in our calibration are housing wealth to GDP and net liquid wealth to GDP computed in the data as liquid assets - debt. Finally, we account

for the fact that the U.S. has a large (net) foreign debt. All the GDP-related ratios in the calibration tables are computed in relationship to annual output. Our chosen land share in production, α_L, implies an elasticity of housing supply roughly equal to 2.

Symbol	Description	Value	Target/Source
Households			
σ	Inverse IES	1	Kaplan, Moll, and Violante 2018
ν	Inverse Frisch elasticity	1	Kaplan, Moll, and Violante 2018
θ	Max LTV	0.90	
e_i	Income process	*See text*	Guvenen et al. 2021
Labor Union			
μ_w	Steady-state markup	1.2	Auclert et al. 2021
κ_w	Slope of wage Phillips curve	0.1	Auclert et al. 2021
Firms			
μ	Steady-state markup	1.2	Auclert et al. 2021
κ	Slope of price Phillips curve	0.1	Auclert et al. 2021
Construction Sector			
α_L	Land share in production	0.33	Garriga and Hedlund 2020
L	Land	1	Normalization
Debt stocks			
$\bar{B}^g$	Government debt to GDP	0.60	FRED
$\bar{B}$	Net Liquid wealth to GDP	-0.41	SCF 2004
B^*	Foreign supply of funds to GDP	1.01	Residually determined: $B^* = \bar{B}^g - \bar{B}$
Policy			
G	Government spending to GDP	25%	
ϕ	Taylor rule coefficient on inflation	1.5	Auclert et al. 2021
ϕ_y	Taylor rule coefficient on output	0	Auclert et al. 2021
π^{ss}	Steady state inflation	0	
Housing adjustment costs			
χ_0	Adjustment cost pivot	0	Simplicity
χ_2	Adjustment cost curvature	2	Quadratic

Table 1: Externally calibrated parameters

Parameter	Explanation	Value	Main identifying moment
β	Discount factor	0.9865	Real interest rate
ψ	Disutility of labor	0.63	Hours worked
j	Utility of housing	0.15135	Housing wealth to GDP
δ_h	Housing stock depreciation	0.00685	Residential investment share
χ_1	Adjustment cost scale	0.013	Median LTV
A_h	Housing sector productivity	0.2	House price elasticity

Table 2: Parameters obtained by internal calibration.

Moment	Source	Data	Model
Real interest rate, annualized	Standard	2.0%	2.0%
Hours worked	Normalization	1.0	1.0
Housing wealth/GDP	SCF 2004	2.18	2.18
Residential investment share	Iacoviello and Neri 2010	0.060	0.060
Median LTV	SCF 2004	0.49	0.48
House price elasticity	Aastveit and Anundsen	5.0	3.8

Table 3: Calibration moments.

4 Results

In this section we report the preliminary results of model. We start by documenting the asset distributions in Figure 1. We note that the amount of liquidity is limited for most households. Housing is more equally distributed than other financial assets. The earnings share of households at the borrowing constraint for liquid assets is 21 percent.

In Figure 2 we document the intertemporal MPC. It is well in line with empirical estimates with a cumulative MPC after 1 year of 32%.

Figure 3 illustrates one of our main results, i.e. the response and decomposition of aggregate consumption to a 25 basis point monetary policy shock. The persistence of the monetary policy shock is set to 0.6. The interesting part is the decomposition of the response, in particular the various indirect effects. A key result in our paper is that there is substantial transmission through the illiquid asset, in contrast to the results in Kaplan, Moll, and Violante (2018). This is clearly visible in the indirect effect on consumption from the change in house prices. This effect is delayed and hump-shaped. Moreover this effect dominates the direct effect and the other indirect effects in the short and medium term (up to around five years). The great majority of the indirect effect through house prices is due to the collateral effect, i.e. how the fall in house prices brings households closer to their borrowing constraint which makes them cut back on consumption. In comparison, taxes play a limited role in the

monetary policy transmission. In the current calibration, wages are so sticky that indirect effects through changes in wages have approximately no role.

In Figure 4 we document how key prices and the tax rate respond to the monetary policy shock. As can be expected from the indirect effect through housing being large in Figure 3, there is a large effect of the monetary policy shock on house prices. On impact, house prices drop by more than one percent, being in line with our target from Aastveit and Anundsen (2022). After a year of suppressed house prices the accumulated reduction in residential investment implies that house prices will rise above their steady state level for some time until the housing stock has recovered and the distribution of liquid assets has been normalized. The wage response is very muted and slightly delayed.

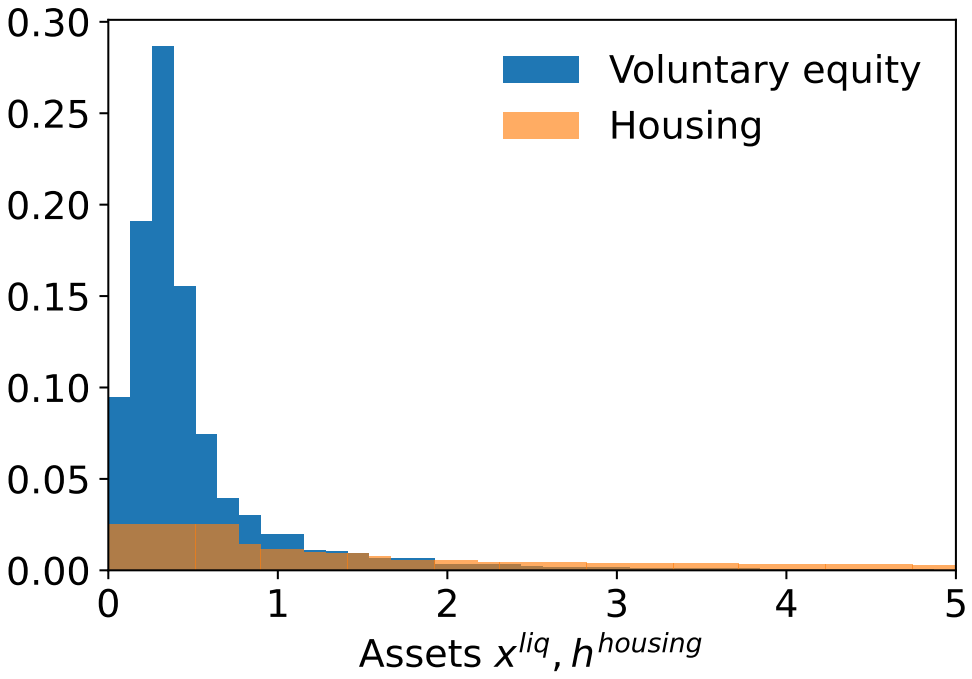


Figure 1: Asset distributions. x^{liq} denotes the voluntary equity (=distance to the borrowing constraint), $x^{liq} = \theta qH + b$.

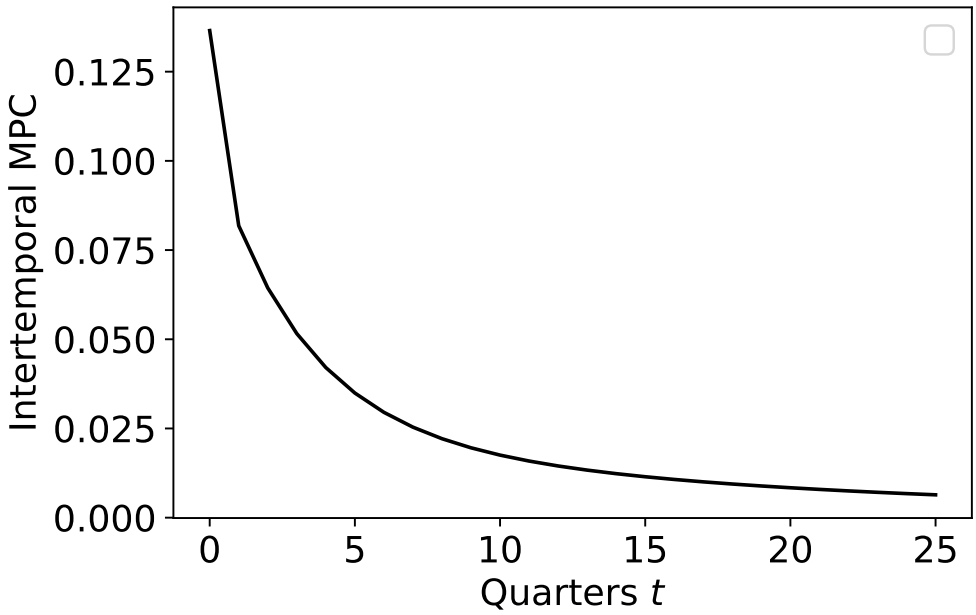


Figure 2: Intertemporal MPC.

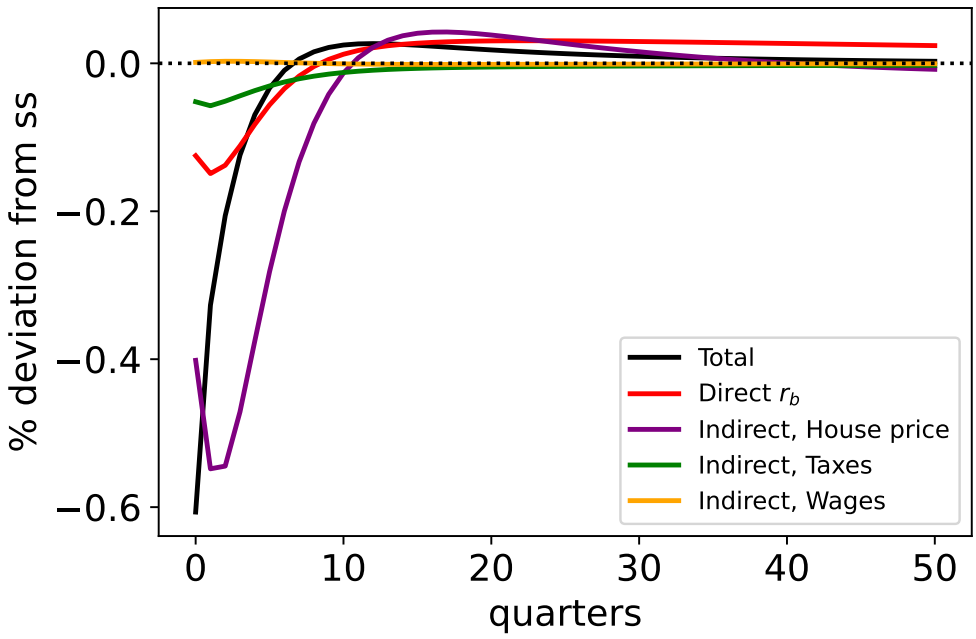


Figure 3: Response of consumption to a 25 bps monetary policy shock.

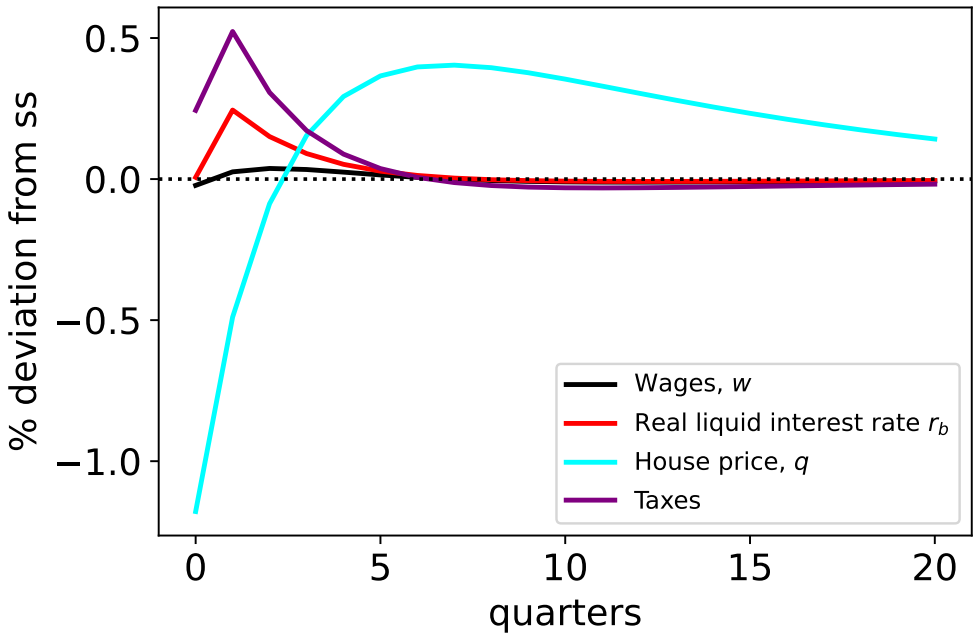


Figure 4: Response of prices to a 25 bps monetary policy shock.

4.1 Extensions

This version of the manuscript is work in progress. Important planned extensions and changes include: i) Long-term loans with an interest rate fixation period beyond one quarter, ii) Fiscal policy that only gradually stabilizes debt in response to shocks and iii) possibly including a simple way of capturing elastic foreign supply of funds, iv) potentially including business capital and business investment in the model.

5 Conclusions

[TBA]

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Appendix

A All Equations

Households with exogenous debt limit

$$U_{c_t} = \beta \mathbb{E}_t U_{c_{t+1}}(1 + r_{t+1}) + \mu_t$$

$$q_t U_{c_t} = U_{h_t} + \beta \mathbb{E}_t U_{c_{t+1}}(q_{t+1}(1 - \delta_h) - \Phi_{2t+1}) - \Phi_{1t} U_{ct}$$

Households with collateral constraint

$$U_{c_t} = \beta \mathbb{E}_t U_{c_{t+1}}(1 + r_{t+1}) + \mu_t$$

$$q_t U_{c_t} = U_{h_t} + \beta \mathbb{E}_t U_{c_{t+1}}(q_{t+1}(1 - \delta_h) - \Phi_{2t+1}) - \Phi_{1t} U_{ct} + \theta \mu_t q_t$$

Unions

$$\log(1 + \pi_t^w) = k_w \left[\psi N_t^{1+\nu} - \frac{(1-\tau) w_t N_t}{\mu_w} \int e_{it} c_{it}^{-\sigma} \right] + \beta \log(1 + \pi_{t+1}^w)$$

Firms

$$log(1 + \pi_t) = \kappa \left(mc_t - \frac{1}{\mu} \right) + \frac{Y_{t+1}}{Y_t} \frac{\log(1 + \pi_{t+1})}{1 + r_{t+1}}$$

$$mc_t = \frac{w_t}{Z_t}$$

Policy

$$i_t = r^* + \phi_\pi \pi_t + \phi_t (Y_t - Y_{ss})$$

$$B_t^g = (1 + r_t) B_{t-1}^g - \tau_t w_t N_t + G_t - \alpha q Y_h$$

Construction Sector

$$Y_h = A_h^{1/\alpha_L} ((1 - \alpha_L) q)^{\frac{1-\alpha_L}{\alpha_L}} \bar{L}$$

$$H_t = (1 - \delta_h) H_{t-1} + Y_{ht}$$

Market Clearing and Aggregation

$$B_t + B_t^g = B_t^*$$

$$Y_t = \int_0^1 c_{it} di + q_t Y_{h,t}(1-\alpha) + G_t + \psi_t + \Phi(H_t, H_{t-1})$$

and the law of motion of aggregate housing follows:

$$H_t = (1-\delta_h) H_{t-1} + Y_{ht}$$

where μ_t denotes the Kuhn-Tucker multiplier on the household's borrowing constraint.

B Housing transaction costs

We adopt the same functional form as used for illiquid asset adjustment costs in Auclert et al. (2021):

$$\phi(h_{it}, h_{it-1}) = \frac{\chi_1}{\chi_2} \left| \frac{q_t h_{it} - q_t h_{it-1}}{q_t h_{it-1} + \chi_0} \right|^{\chi_2} (q_t h_{it-1} + \chi_0)$$

In the text, we follow this notation: $\phi_1 = \frac{\partial \phi(h,h')}{\partial h}$, $\phi_2 = \frac{\partial \phi(h,h')}{\partial h'}$ and $\Phi(H, H') = \int_0^1 \phi(h_i, h_i')\, di$.