

HOW SHOULD MONETARY POLICY RESPOND TO HOUSING INFLATION?

Javier Bianchi, Alisdair McKay and Neil Mehrotra

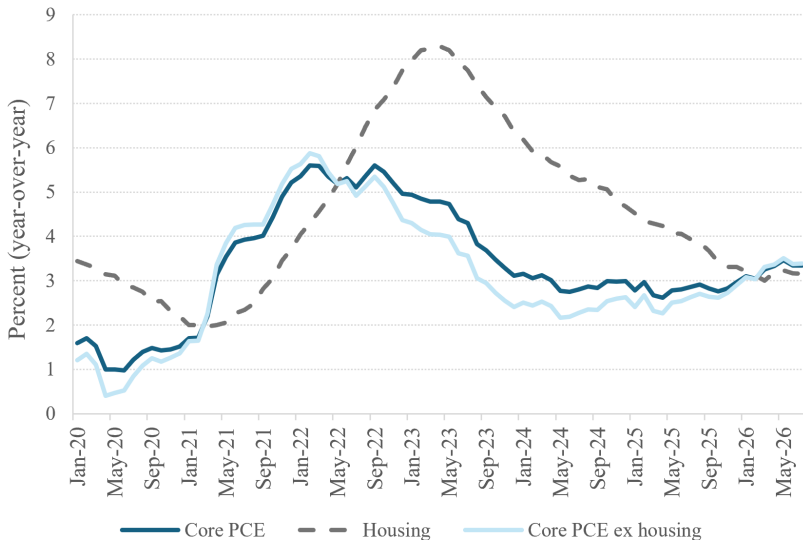
Federal Reserve Bank of Minneapolis

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Inflation: Drivers and Dynamics

September 24-25, 2026

Shelter Inflation Has Kept Inflation High



Optimal Monetary Policy in Multi-Sector Models

- Larger welfare costs of π in sectors with more rigid prices and less elastic supply

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 - Equilibrium is demand determined: producers have to supply at posted price
 - More rigid $\Rightarrow$ larger response in demand
 - Less elastic supply $\Rightarrow$ larger change in inputs to meet demand

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 - **Equilibrium is demand determined**: producers have to supply at posted price
 - More **rigid** $\Rightarrow$ larger response in demand
 - Less **elastic supply** $\Rightarrow$ larger change in inputs to meet demand
- Rents are sticky & housing supply is highly inelastic

$\Rightarrow$ Monetary policy should respond aggressively to shelter inflation

Our View: Standard NK Model Unsuitable for Housing

- Implausible that supply of housing adjusts in the short-run to satisfy demand
 - Move away from demand-determined rationing assumption

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 - Optimal monetary policy and role of supply elasticity

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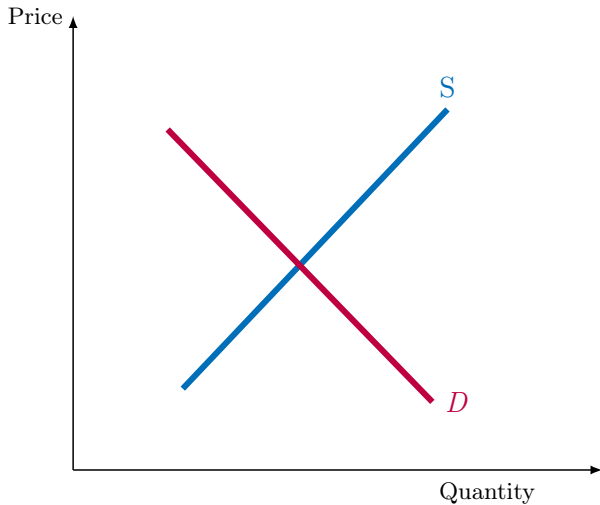
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 - Tradeoff between congestion and employment losses
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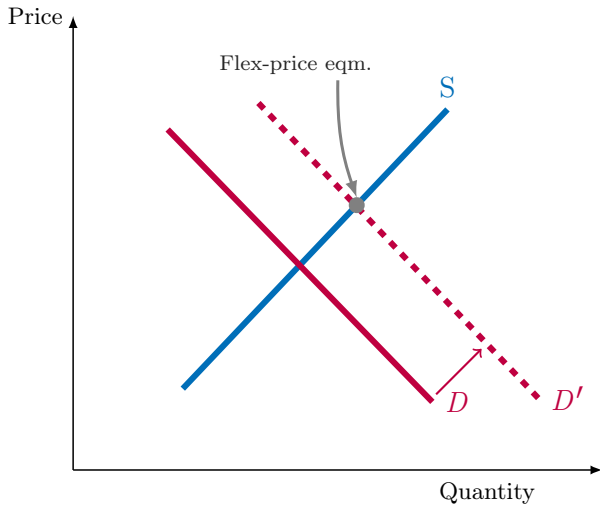
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 - Quantitatively: optimal to ignore housing inflation
- Broader point— 3 considerations: (i) price rigidity; (ii) supply elasticity; (iii) rationing mechanism

Rationing Mechanisms

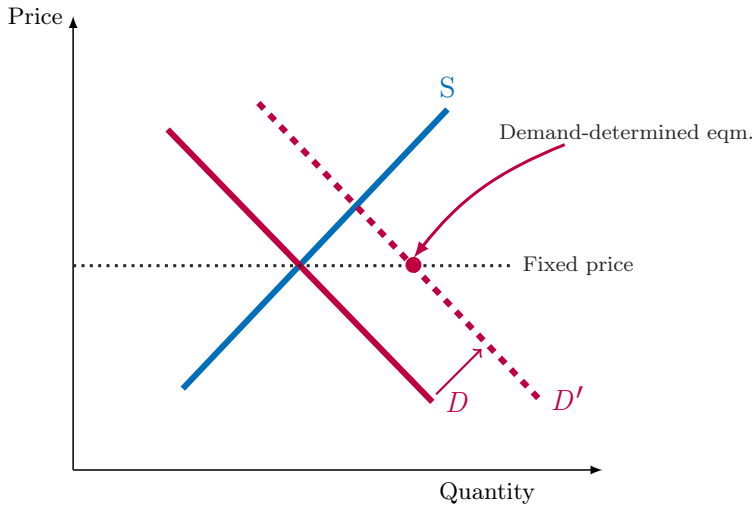
Rationing Mechanisms



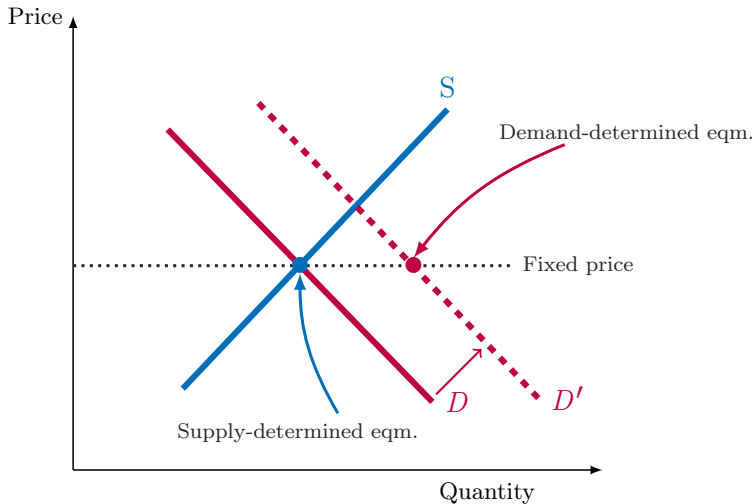
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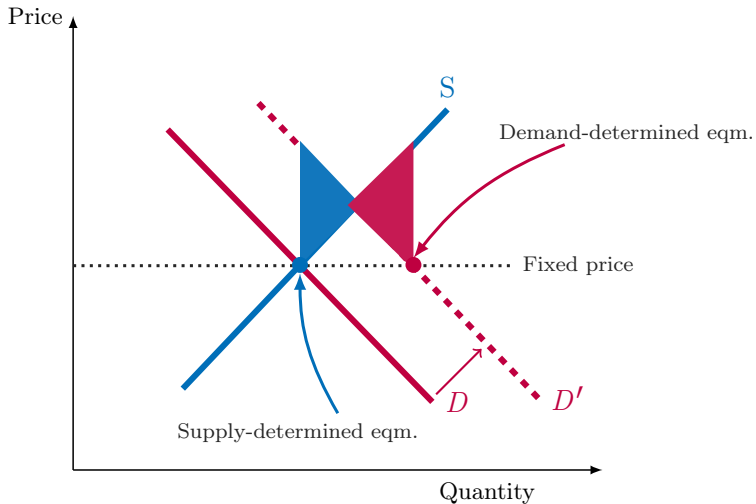
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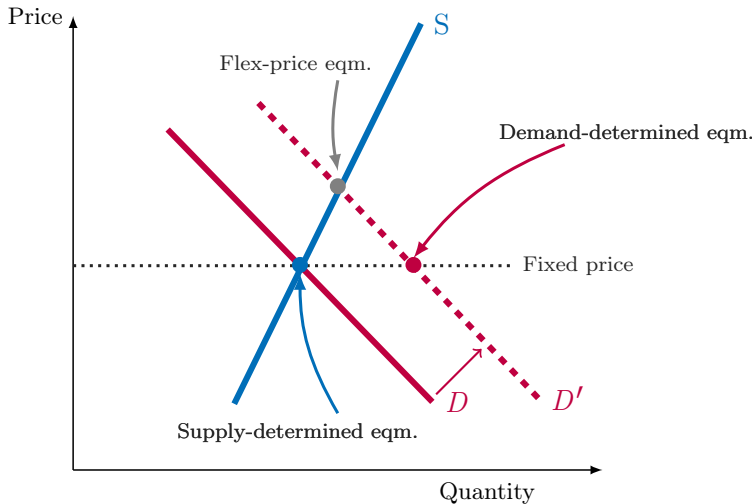
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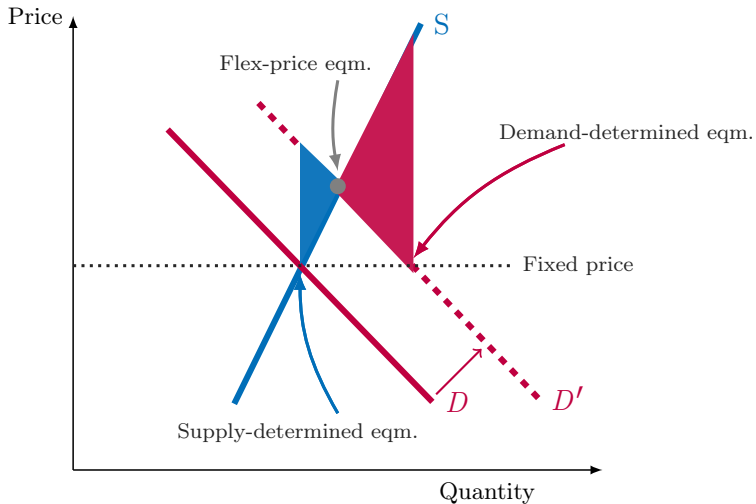
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Rationing Mechanisms



Rationing Mechanisms



Roadmap

1. **Static model:** (Barro and Grossman, 1971; Michaillat and Saez, 2015)
 - Prices of goods and rents fixed:
 - ☐ Search frictions in goods, housing, labor markets
 - ☐ Disequilibrium in all markets resolved via search

Roadmap

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 - Prices of goods and rents fixed:
 - ☐ Search frictions in goods, housing, labor markets
 - ☐ Disequilibrium in all markets resolved via search
2. **Dynamic quantitative model:**
 - Staggered pricing for goods and rentals
 - Compare optimal policy, CPI targeting, and goods-price targeting

Outline for Presentation

1. Static model

- **Fixed price equilibrium**
- Optimal monetary policy

2. Quantitative model

- Dynamic model and calibration
- Results

- Rep. household with preferences:

$$U = \log(c) + \omega \log(h) + \log(m) - (\rho_s s_c + \rho_h s_h)$$

- c = consumption goods
- h = housing services
- m = real money balances
- s = search effort
- ρ_i = cost of search

- Rep. household with preferences:

$$U = \log(c) + \omega \log(h) + \log(m) - (\rho_s s_c + \rho_h s_h)$$

- Nominal budget constraint:

$$Rh + Pc + M \leq W\ell + d + T$$

- R = nominal rent
- P = price of goods
- M = money holdings
- W = nominal wage
- d = nominal dividends
- T = tax or transfer

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- Search for goods and housing:

$$c \leq f_c(\theta_c) s_c$$

$$h \leq f_h(\theta_h) s_h$$

- θ_i = market tightness

Household Optimality Conditions

- Consumption goods:

$$f_c(\theta_c) \left(\frac{1}{c} - \lambda \right) = \rho_c$$

- Labor supply:

$$f_h(\theta_h) \left(\frac{\omega}{h} - \lambda r \right) = \rho_h$$

- Money demand:

$$\frac{1}{m} = \lambda$$

Firms and Landlords

- Firms produce consumption: $y = A\ell^\alpha$
- Firms hire by posting vacancies: $e = \ell + \rho_\ell v \leq f_\ell(\theta_\ell) v$
- Standard FOC for hiring:

$$Pg_c(\theta_c) A \alpha \ell^{\alpha-1} = \left(1 + \frac{\rho_\ell}{f_\ell(\theta_\ell) - \rho_\ell}\right) W$$

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- Landlords freely list housing $\bar{h}$ and fixed rent $R = \bar{R}$
- Market tightness: $\theta_h = s_h / \bar{h}$
- Housing utilization rate: $h = g_h(\theta_h) \bar{h}$

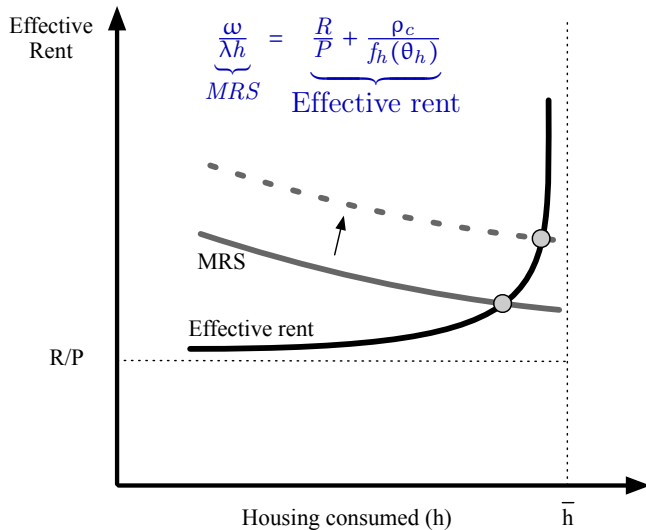
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- Market tightness: $\theta_h = s_h / \bar{h}$
- Housing utilization rate: $h = g_h(\theta_h) \bar{h}$
- Total profits: $d = Pg_c(\theta_c) A \ell^\alpha - W(\ell + \rho_\ell v) + Rg_h(\theta_h) \bar{h}$

Equilibrium in the Housing Market



Competitive Equilibrium

Definition (Fixed-price competitive equilibrium). Given fixed prices $P, W, R > 0$ and money supply $M > 0$, an interior fixed-price competitive equilibrium is a vector $\theta = (\theta_c, \theta_\ell, \theta_h)$ such that, at the allocation implied:

- household optimality conditions hold with $m = M/P$;
- firm optimality condition holds

Proposition (Monetary expansion and market tightness). An increase in the money supply raises tightness in *all three markets*:

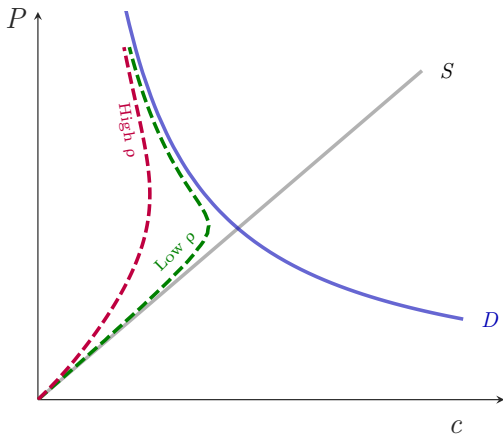
$$\frac{d\theta_j}{dM} > 0, \quad j \in \{c, \ell, h\}.$$

Short-Side Rule

- Define notional supply and demand as search frictions vanish
- Hold effective wages (wage + labor search costs) fixed:

$$c_d = \frac{M}{P}$$

$$c_s = A \left(\frac{PA\alpha}{\tilde{W}} \right)^{\alpha/(1-\alpha)}$$



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Constrained-Efficient Allocation

Planner's problem: The planner chooses quantities and search effort:

$$\max_{c, s_c, \ell, v, h, s_h} U = \log c + \omega \log h - \rho_c s_c - \rho_h s_h$$

subject to:

$$c \leq \mathcal{M}_c(s_c, A\ell^\alpha)$$

$$\ell + \rho_\ell v \leq \mathcal{M}_\ell(v, 1)$$

$$h \leq \mathcal{M}_h(s_h, \bar{h})$$

Matching elasticity: For $j \in \{c, \ell, h\}$, define the elasticity of matches with respect to the searching side's input:

$$\eta_j(\theta_j) \equiv \frac{\partial \log \mathcal{M}_j}{\partial \log s_j} = 1 + \frac{f'_j(\theta_j)\theta_j}{f_j(\theta_j)}$$

Constrained-Efficient Allocation

There exist a set of prices that implement the constrained efficient allocation:

$$\begin{aligned}\lambda^* &= \frac{1 - \eta_c(\theta_c^*)}{c^*} \\ r^* &= \frac{[1 - \eta_h(\theta_h^*)]\omega}{h^*\lambda^*} \\ w^* &= [1 - \eta_\ell(\theta_\ell^*)] \alpha g_c(\theta_c^*) \frac{y^*}{\ell^*}\end{aligned}$$

Under fixed prices, constrained-efficient allocation is implemented by setting:

$$M^* = \frac{P}{\lambda^*}$$

Optimal Monetary Policy

Define welfare in terms of market tightness $\boldsymbol{\theta} \equiv (\theta_c, \theta_\ell, \theta_h)$:

$$U(\boldsymbol{\theta}) = \log c(\boldsymbol{\theta}) + \omega \log h(\boldsymbol{\theta}) - [\rho_c s_c(\boldsymbol{\theta}) + \rho_h s_h(\boldsymbol{\theta})].$$

The central bank chooses the money supply to solve:

$$\max_{M>0} U(\boldsymbol{\theta}(M))$$

- One policy instrument, M , affects tightness in all three markets.
- In general, monetary policy cannot simultaneously implement efficiency in the goods, labor, and housing markets.

Optimal Monetary Policy: Targeting Rule

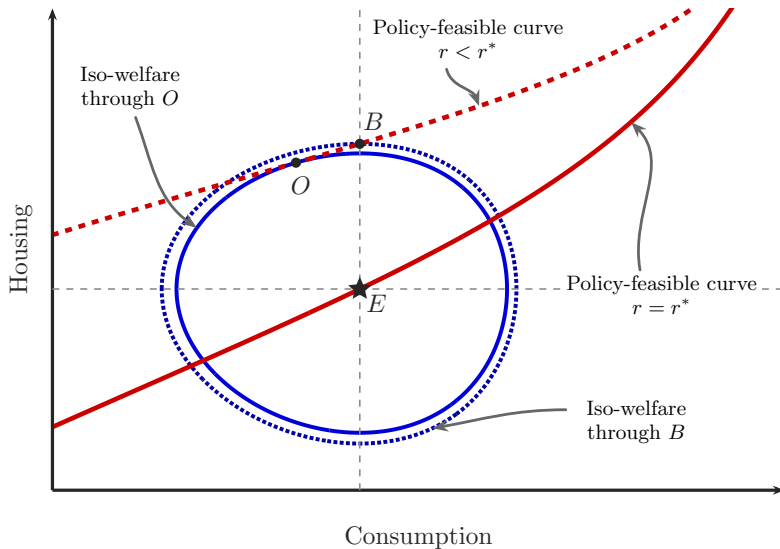
Define the response of market tightness to monetary policy:

$$\varepsilon_M^j \equiv \frac{d \log \theta_j}{d \log M} > 0, \quad j \in \{c, \ell, h\}.$$

The first-order condition for optimal monetary policy is

$$\underbrace{\left[1 - \frac{1 - \eta_c(\theta_c)}{c\lambda}\right] c \varepsilon_M^c}_{\text{Goods market}} + \underbrace{\left[w - (1 - \eta_\ell(\theta_\ell))\alpha g_c(\theta_c)\frac{y}{\ell}\right] e \varepsilon_M^\ell}_{\text{Labor market}} + \underbrace{\left[r - \frac{(1 - \eta_h(\theta_h))\omega}{h\lambda}\right] h \varepsilon_M^h}_{\text{Housing market}} = 0.$$

Tradeoffs for Monetary Policy



Optimal Policy and Goods Supply Elasticity

Proposition (Optimal monetary policy) Let

$$A(\alpha) \equiv \frac{y^*}{(\ell^*)^\alpha},$$

so efficient output is fixed at y^* for every α , and let $M(r, \alpha)$ solve the monetary policy problem, with $w = w^*$. Then

$$\left. \frac{\partial M}{\partial r} \right|_{r=r^*} > 0, \quad \left. \frac{\partial^2 M}{\partial r \partial \alpha} \right|_{r=r^*} < 0.$$

- A fall in r below r^* calls for a **monetary contraction**.
- A higher α (more elastic goods supply) implies a **smaller contraction**.

Demand-Determined Output: Optimal Policy

Proposition (Optimal monetary policy with demand-determined output) Let

$$A(\alpha) \equiv (y^*)^\alpha \alpha^{-\alpha/(1+\sigma)},$$

which holds efficient output at y^* for every α , and let $M^D(r, \alpha)$ denote optimal policy in the demand-determined economy. Then

$$\left. \frac{\partial M^D}{\partial r} \right|_{r=r^*} > 0, \quad \left. \frac{\partial^2 M^D}{\partial r \partial \alpha} \right|_{r=r^*} > 0.$$

- A fall in r below r^* calls for a **monetary contraction**.
- A higher α implies a **larger contraction**—the opposite of Proposition 4 under search rationing.

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Environment

- Preferences:

$$\sum_{t=0}^{\infty} \beta^t \left\{ \log c_t + \omega_t \log (h^o + h_t) - \rho_c s_{c,t} - \rho_h s_{h,t} \right\},$$

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- Goods search

$$c_t = f_c(\theta_{c,t}) s_{c,t}$$

$$\theta_{c,t} \equiv s_{c,t} / A \ell_t$$

- Housing search:

$$h_t = (1 - \delta_h) h_{t-1} + f_h(\theta_{h,t}) s_{h,t}$$

$$\theta_{h,t} \equiv s_{h,t} / [1 - (1 - \delta_h) h_{t-1}]$$

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- Labor matches:

$$e_t = (1 - \delta_\ell) e_{t-1} + f_\ell(\theta_{\ell,t}) v_t$$

$$\theta_{\ell,t} \equiv v_t / [1 - (1 - \delta_\ell) \ell_{t-1}]$$

Price Setting

- “Efficient price” P_t^* induces constrained-efficient search effort
- Nominal rigidity: transaction price moves towards P_t^* slowly

$$P_t = \chi_c P_{t-1} + (1 - \chi_c) P_t^*$$

$$\Pi_t \equiv \frac{P_t}{P_{t-1}} = \frac{\chi_c}{1 - (1 - \chi_c) p_t^*},$$

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- Nominal rigidity: transaction price moves towards P_t^* **slowly**

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$$\Pi_t \equiv \frac{P_t}{P_{t-1}} = \frac{\chi_c}{1 - (1 - \chi_c) p_t^*},$$

- Similar frictions in nominal wages and rents.
- Rents are also sticky within a match
 - Fixed in nominal terms until separate or renegotiate with probability ξ per period
 - Irrelevant for allocation but matters for measurement of CPI

Monetary Policy Alternatives

We consider three policies

1. Goods inflation targeting $\pi = \Pi - 1 = 0$

2. CPI inflation targeting $\pi^{\text{CPI}} = 0$

CPI measures shelter costs based on rent currently paid

3. Optimal policy

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3. Optimal policy

- Optimal nonlinear perfect-foresight transition path
- Stack transition paths in x ($nT \times 1$)
- $f(x) = 0$ $(n-1)T$ private-sector equilibrium conditions
- Solve $\max_x U(x)$ s.t. $f(x) = 0$ using Newton's method

Calibration

- Monthly time period; use 2019 as reference year
- Search frictions: match “unemployment” rates
 - Labor: unemployment rate = 4.9%
 - Housing: rental vacancy rate = 6.6%
 - Goods: inventory-sales ratio = 1.5 (inventories / monthly sales)
inventory holding cost = 37% per year Nahmias and Olsen (2015)
 $\Rightarrow \frac{1.5}{12} \times 0.37 = 4.6\%$

Calibration

- Nominal rigidities:
 - Traditional calibration strategy: price durations, prices reset once per year
 - Calvo model with reset prob. $1 - \phi$: $\frac{d \log \Pi_t}{d \log p_t^R} \approx \frac{1 - \phi}{\phi}$
 - Our model: $\frac{d \log \Pi_t}{d \log p_t^*} \approx \frac{1 - \chi_c}{\chi_c}$
 - Set $\chi = 1/12$ in all markets

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 - Set $\chi = 1/12$ in all markets
- $\delta_\ell = 4.5\%$ based on measured worker flows [Elsby et al \(2015\)](#)
- $\xi = 0.0594$ based on frequency of rent change on continuing tenants [Gallin et al \(2024\)](#)
- Matching function from Michaillat-Saez: $\mathcal{M}(s, y) = (s^{-\gamma} + y^{-\gamma})^{-1/\gamma}$ with $\gamma = 1$

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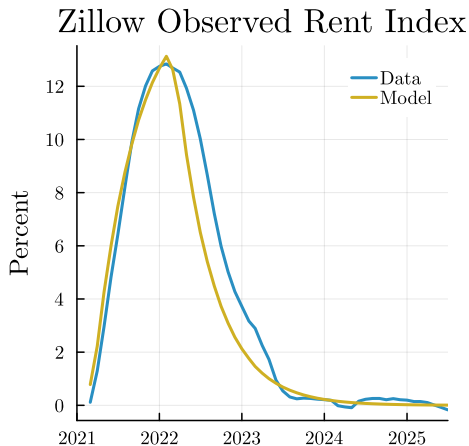
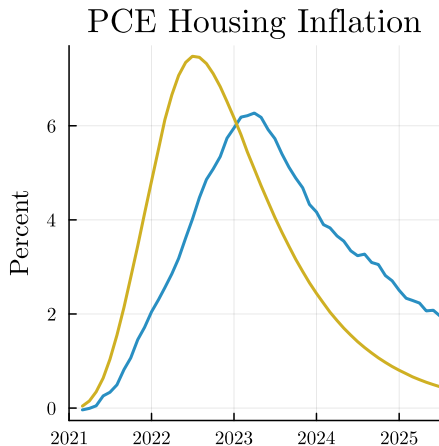
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2. **Quantitative model**

- Dynamic model and calibration
- **Results**

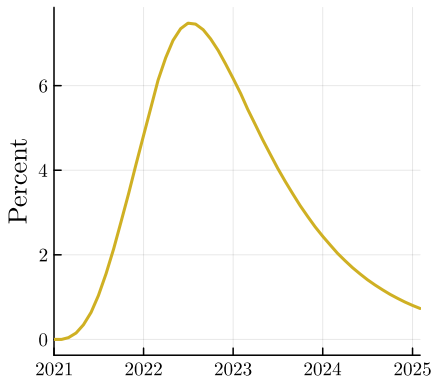
Housing Demand Shock

- Permanent shock to $\omega_t = 0.15 \rightarrow 0.17$ in March 2021

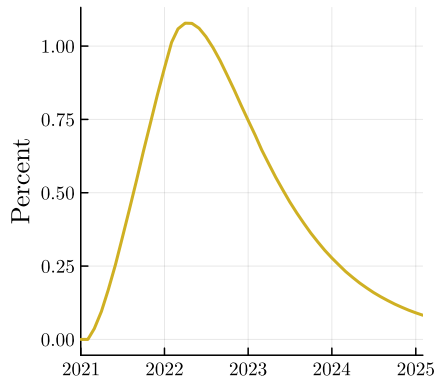


Monetary Policy Alternatives

Housing Inflation



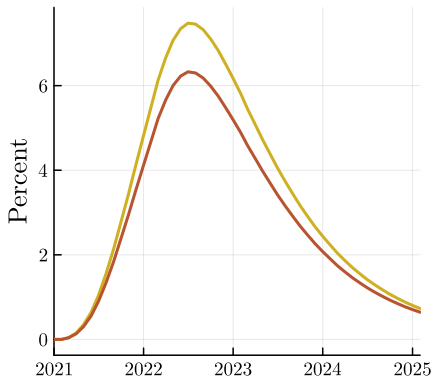
CPI Inflation



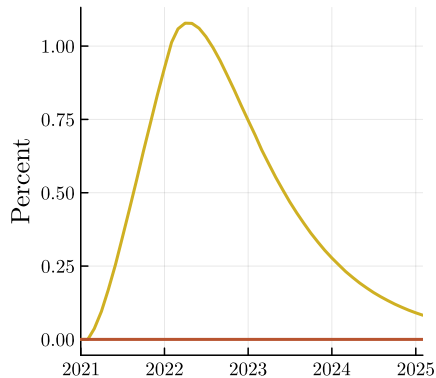
— Goods inflation target — CPI inflation target — Optimal

Monetary Policy Alternatives

Housing Inflation



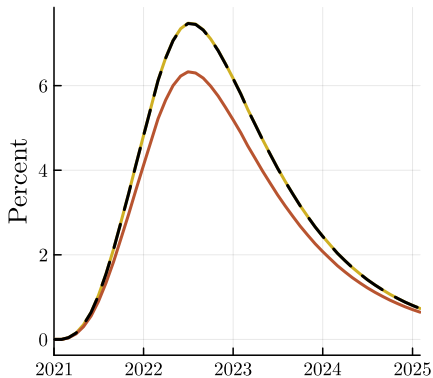
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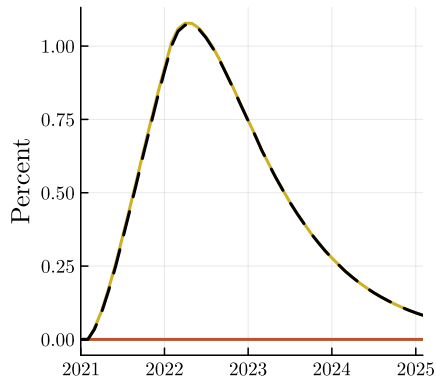
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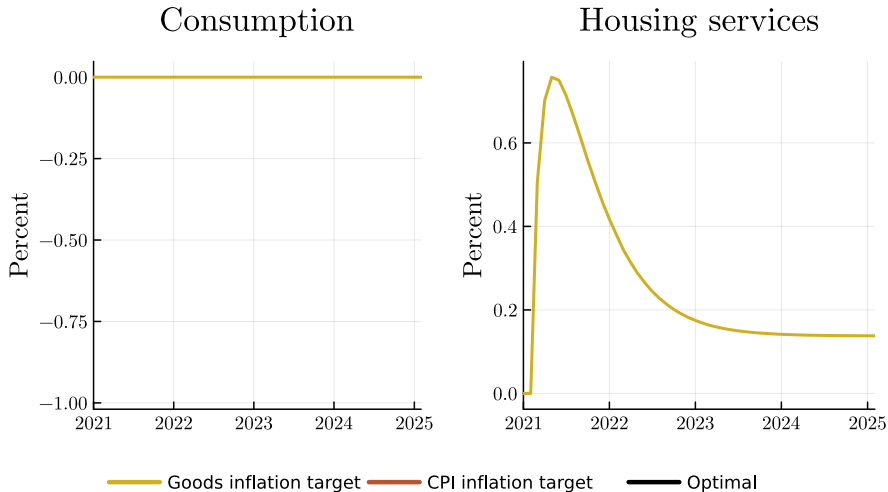


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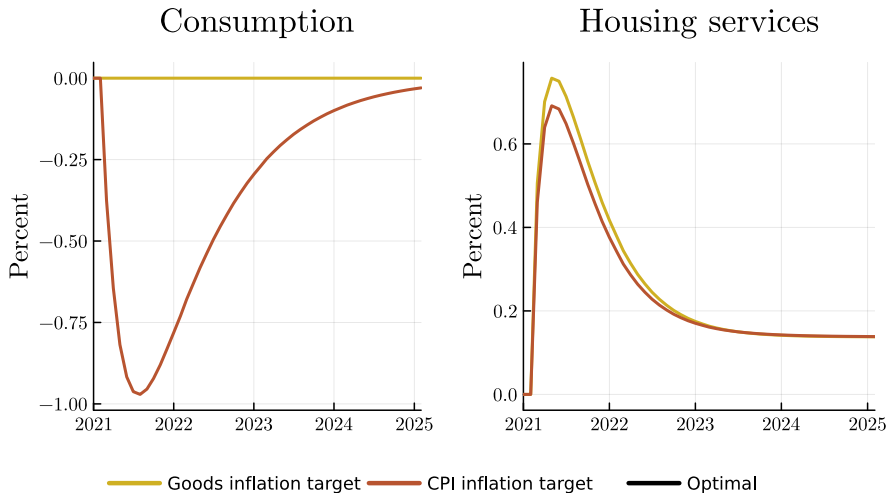


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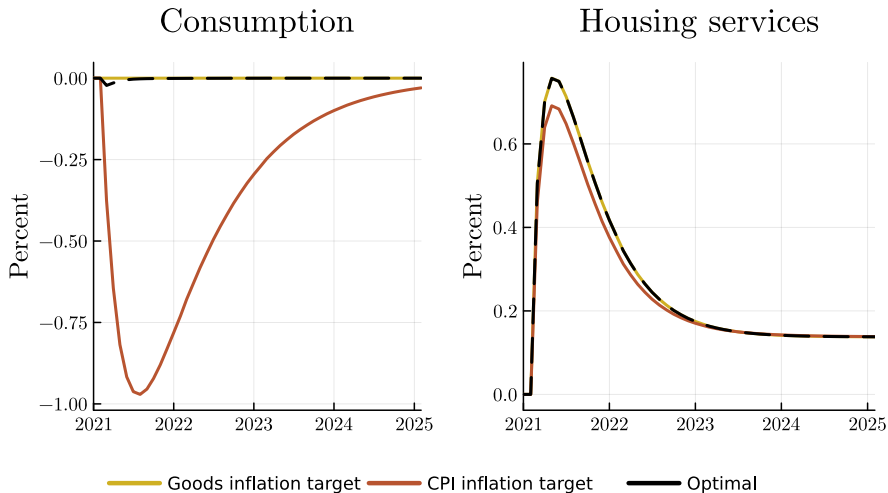
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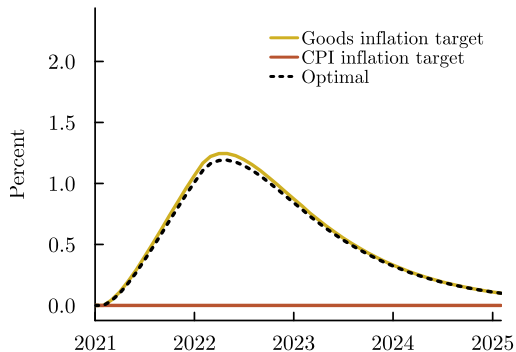


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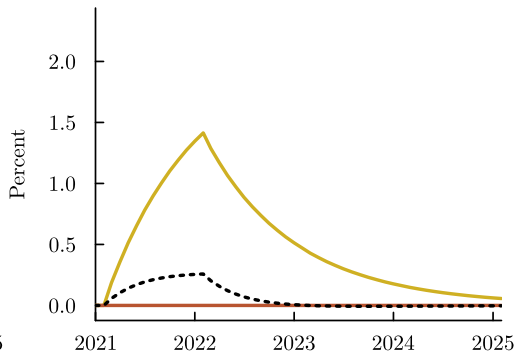


Symmetric Case

Baseline

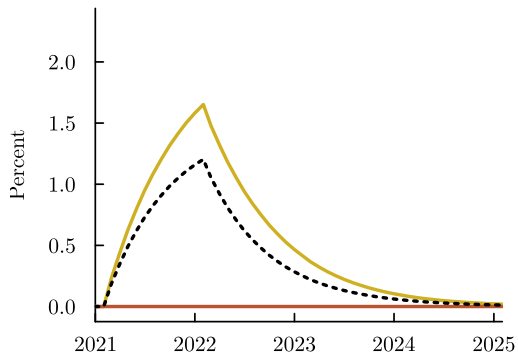


Symmetric

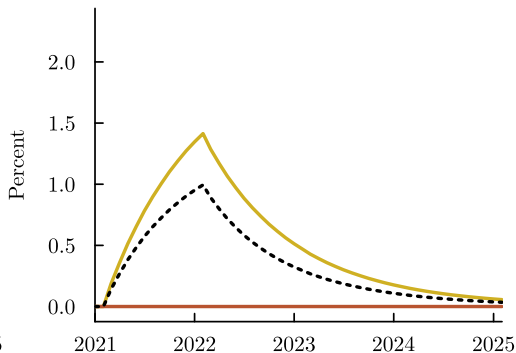


Key Elements: Immobile Homeowners, Elastic Supply

Inelastic homeowners ($h^o > 0$)

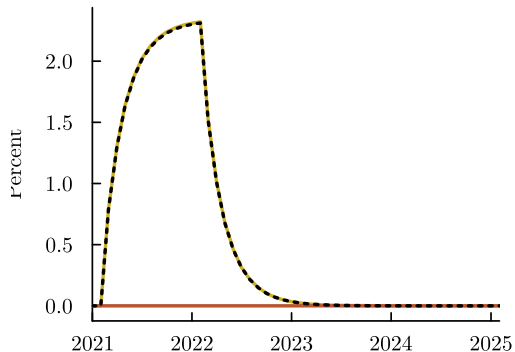


Sticky wages ($\chi_\ell > 0$)

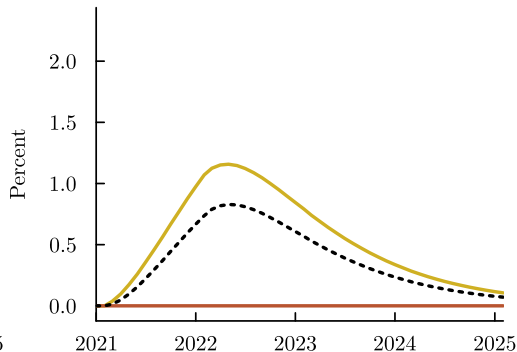


Additional Elements: Persistent Matches

Persistent housing matches ($\delta_h < 1$)



Fixed rent within lease ($\delta_h < 1, \xi < 1$)



Conclusion

- Welfare costs of π are closely related to the rationing mechanism that resolves disequilibrium
- We take the view that the standard NK mechanism is implausible for housing services
- In a model with rationing via search frictions, it is optimal to ignore housing inflation
- Relevance: what measure of π should we target?

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ECB: “We recognise that the inclusion of costs related to owner-occupied housing in the HICP would better represent the inflation rate that is relevant for households. The European Statistical System is investigating how these costs could be included in the inflation measure.”

Additional Slides

Calibration

Parameter	Target	Value
β	Steady-state interest rate	$1.02^{-1/12}$
ω	Housing expenditure share	0.18
$h^o/(h + h^o)$	ACS housing turnover	0.71
δ_h	ACS housing turnover	0.035
δ_ℓ	Monthly job separation	0.045
ρ_c	Goods vacancy / inventories	0.0023
ρ_ℓ	Unemployment rate	0.205
ρ_h	Rental vacancy rate	0.173
ξ	70% unchanged rents over 6 months	0.06
$\chi_c = \chi_\ell = \chi_h$	Price adjustment frequency	0.92

Extended Model with Housing Production

- Houses produced out of labor and a fixed factor (land)

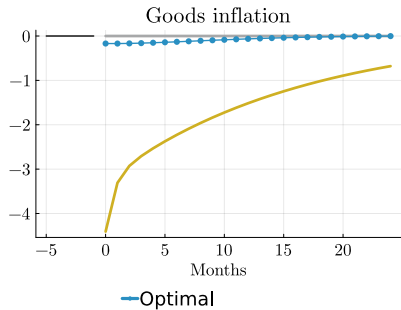
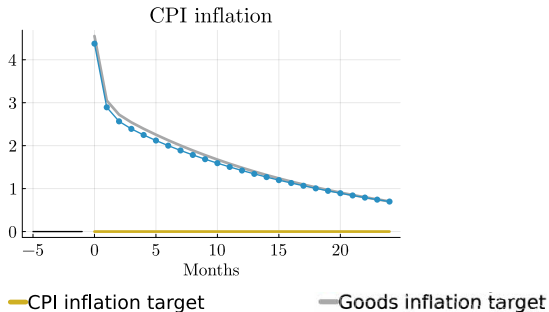
$$I_t = z_h m_t^{\tilde{\Phi}}$$

- Supply of housing units:

$$\bar{h}_t = (1 - \kappa)\bar{h}_{t-1} + I_t - \kappa h^o$$

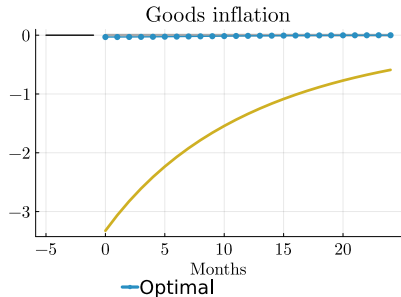
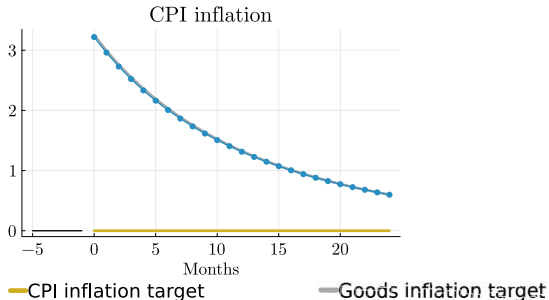
- Housing supply elasticity calibrated to Baum-Snow and Han (2024) estimate of 0.35
- Free entry: value of a vacant unit = construction cost
 - Important to distinguish rigidities in rents from rigidities in construction costs

Extended Model with Housing Production



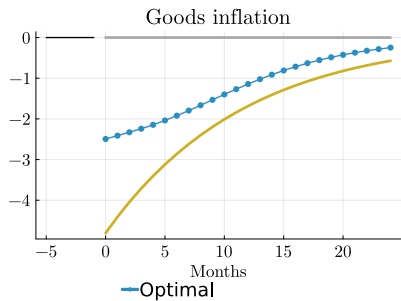
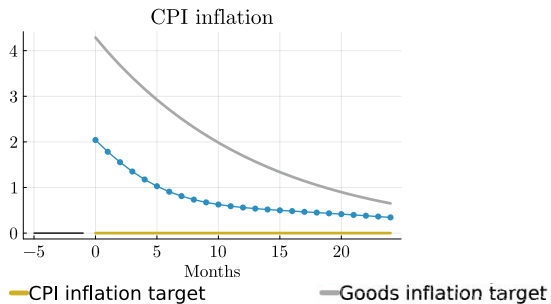
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Without Inelastic Housing Demand ($h^o = 0$)



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With More Flexible Goods Prices



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