

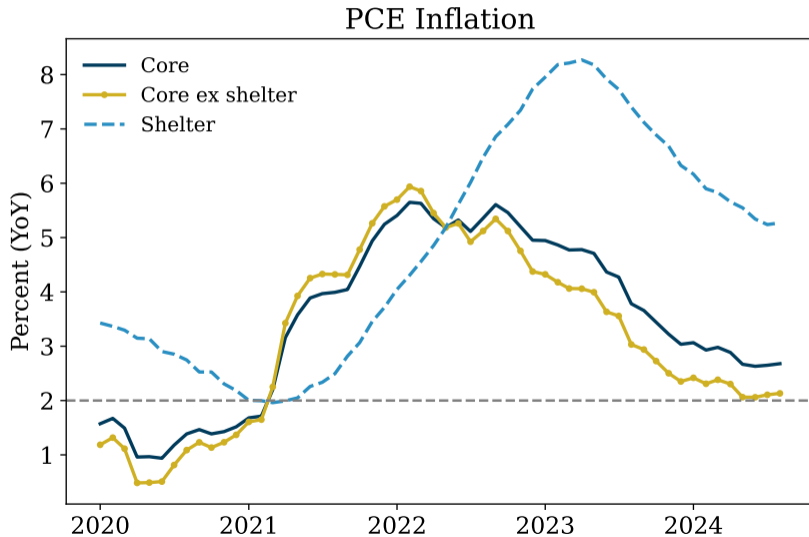
HOW SHOULD MONETARY POLICY RESPOND TO HOUSING INFLATION?

Javier Bianchi, Alisdair McKay, Neil Mehrotra

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The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

Price of Shelter Driving Current Inflation



New Keynesian Theory: Shelter Inflation is very Costly

- Larger welfare costs of π in sectors with more **sticky prices** and more **inelastic supply**
Aoki (2001), Woodford (2003, ch. 6), Benigno (2004), Eusepi-Hobijn-Tambalotti (2011)
 - Equilibrium is demand determined: producers have to supply at posted price
 - Higher **stickiness** \Rightarrow larger response in demand
 - More **inelastic supply** \Rightarrow larger change in inputs to meet demand
 - Rents are highly sticky (e.g. 12-month contracts)
 - Housing supply essentially fixed in the short run
- \rightarrow Monetary policy should respond aggressively to a rise in housing demand

Our View: Standard NK Model Unsuitable for Housing

- Implausible that supply of housing adjusts in the short-run to satisfy demand

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 - Without congestion costs: **zero-weight** on housing inflation
 - With search friction: **tradeoff** between congestion and output gap

Quantitatively: optimal to ignore housing inflation

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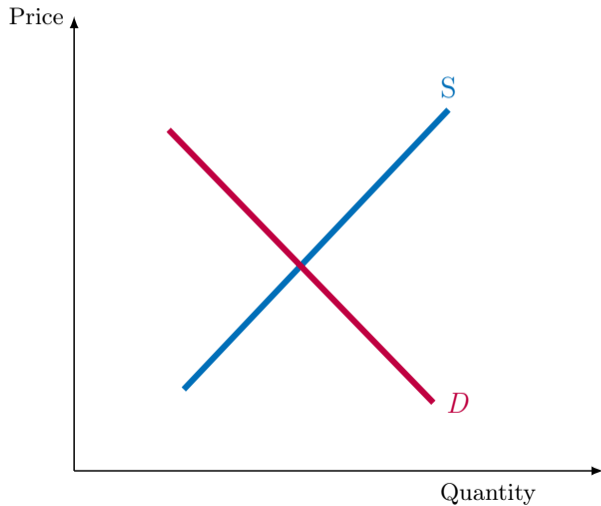
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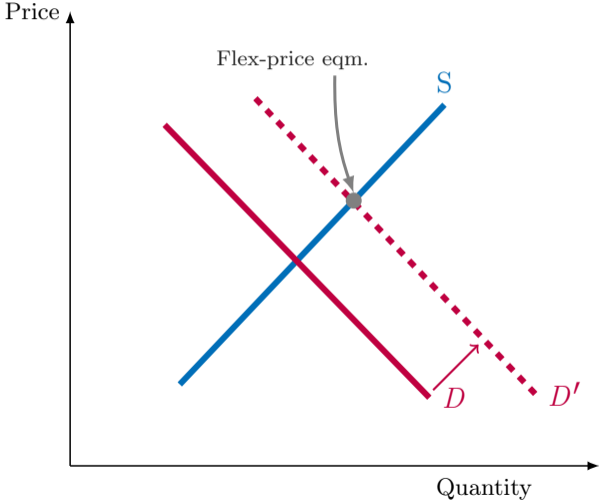
- Broader point— 3 considerations: (i) degree of stickiness; (ii) supply elasticity; (iii) **rationing mechanism**

Rationing Mechanisms

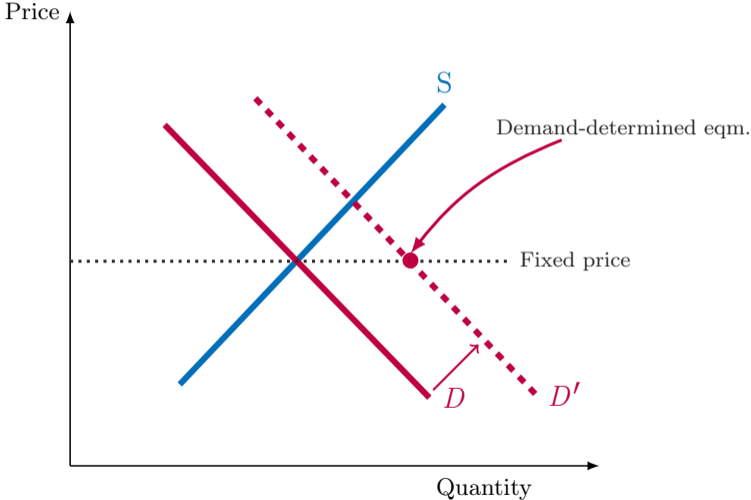
Rationing Mechanisms



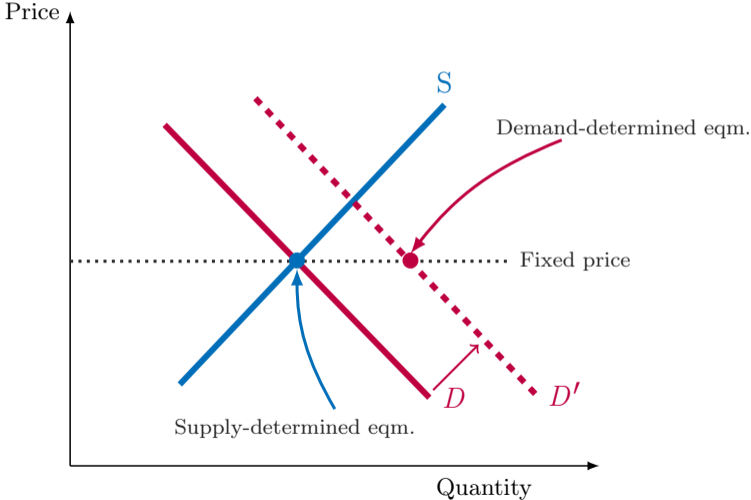
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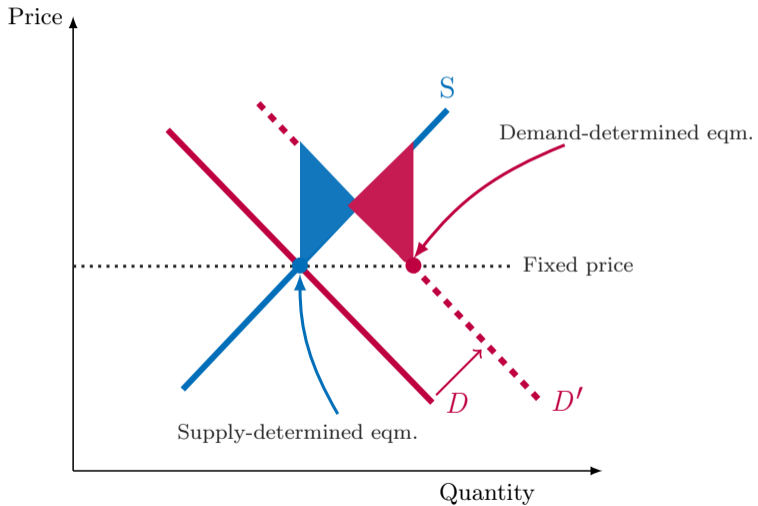
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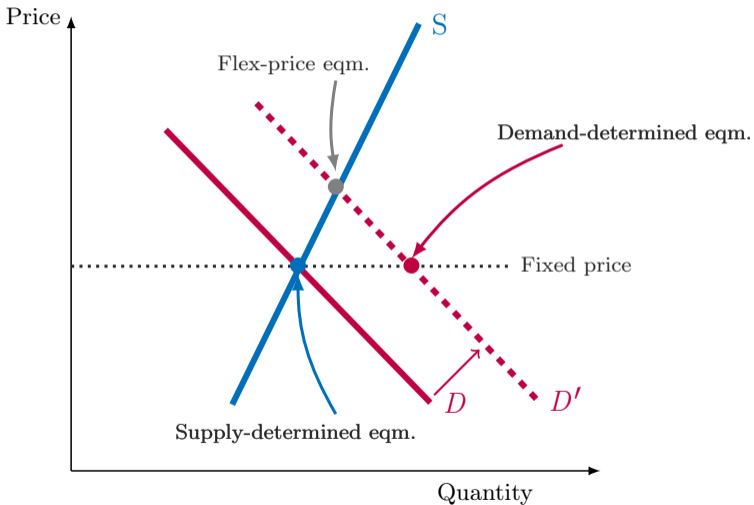
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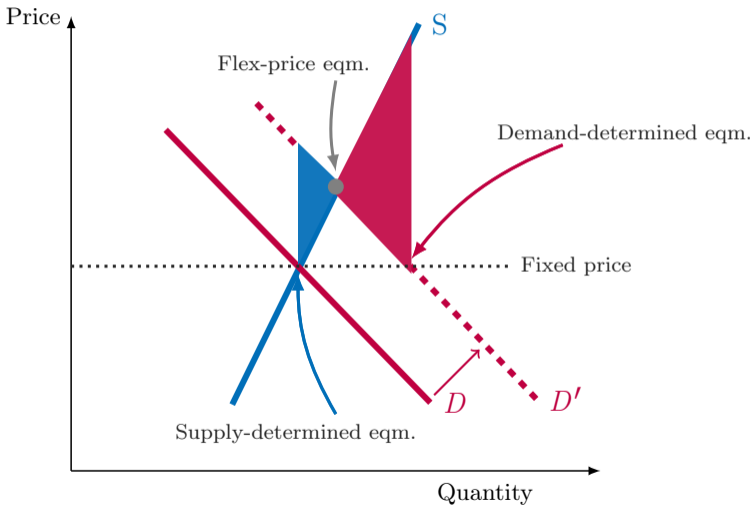
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Rationing Mechanisms



Rationing Mechanisms



Roadmap

1. Static model:

– Prices of goods and rents fixed:

□ Goods: output is demand-determined

□ Housing: disequilibrium resolved via search

mimics supply-determined
if excessive demand



2. Dynamic quantitative model:

– Staggered pricing for goods and rentals

– Compare optimal policy, CPI and goods-price targeting

STATIC MODEL

Households

$$\{\log(c) + \omega \log(h) + \varphi \log(m) - (\ell + \rho s)\}$$

Households

$$\max_{c, h, s, l, m} \{ \log(c) + \omega \log(h) + \varphi \log(m) - (\ell + \rho s) \}$$

$$\text{s.t. } Rh + Pc + Pm = W\ell + d + T$$

$$h = sf(\Theta) \quad (\text{search for housing})$$

Market tightness

finding probability $f' < 0$

- Search split across HH members

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Firms

- Produce goods, $y = z\ell$
- Rationing: meet demand at $P = \bar{P}$

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Landlords

- Inelastically supply \bar{h}

$$\text{Total profits } d = z\ell - W\ell + Rg(\Theta)\bar{h}$$

g prob. of landlord finding tenant

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Government $M = T$

› Definition of fixed-price equilibrium

Equilibrium Characterization

$$c = \frac{m}{\varphi}$$

$$\frac{\omega}{h} = \frac{1}{c} \left(\frac{\bar{R}}{\bar{P}} \right) + \frac{\rho}{f(\Theta)}.$$

$$\frac{W}{\bar{P}} = c,$$

Equilibrium Characterization

$$c = \frac{m}{\varphi} = \frac{M}{\bar{P}\varphi}$$

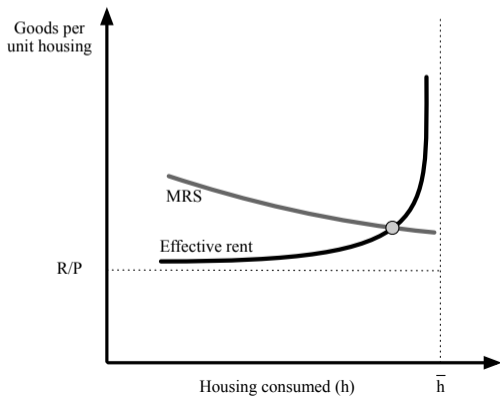
$$\frac{\omega}{h} = \frac{1}{c} \left(\frac{\bar{R}}{\bar{P}} \right) + \frac{\rho}{f(\Theta)}$$

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$$sf(\Theta) = \bar{h}g(\Theta)$$

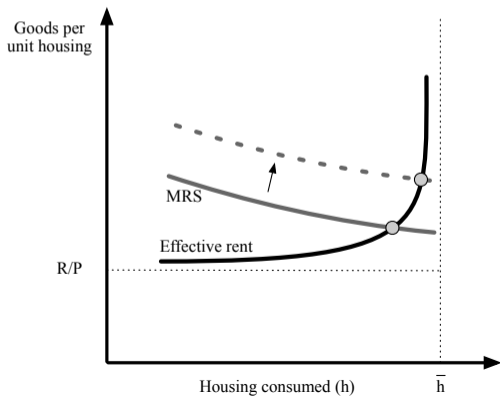
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$$\underbrace{\frac{\omega c}{h}}_{MRS} = \underbrace{\frac{\bar{R}}{\bar{P}} + \frac{c}{f\left(g^{-1}\left(\frac{h}{\bar{h}}\right)\right)}}_{\text{Effective rent}}$$



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Constrained efficient allocation

- Planner directly chooses allocation subject to technology and search frictions

$$\max_{c,s} \left\{ \log(c) + \omega \log \left(sf \left(\frac{s}{\bar{h}} \right) \right) - \left(\frac{c}{z} + \rho s \right) \right\} \quad (\text{Ignoring money for welfare})$$

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- Optimality

$$c = z$$

$$\frac{\omega}{h} [f(\Theta) + f'(\Theta)\Theta] = \rho$$

- Flex-price outcome is not necessarily constrained efficient (Hosios, 1990)

- Excess search if $\frac{\bar{R}}{\bar{P}} < -\frac{\omega c}{h} \frac{f'(\Theta)\Theta}{f(\Theta)}$

Optimal monetary policy

$$\max_{c, s, M} \left\{ \log(c) + \omega \log(sf(s/\bar{h})) - \left(\frac{c}{z} + \rho s \right) \right\}$$

subject to

$$\frac{\omega}{sf(s/\bar{h})} = \left(\frac{1}{c} \right) \frac{\bar{R}}{\bar{P}} + \frac{\rho}{f(s/\bar{h})}$$

$$c = \left(\frac{1}{\varphi} \right) \frac{M}{\bar{P}}$$

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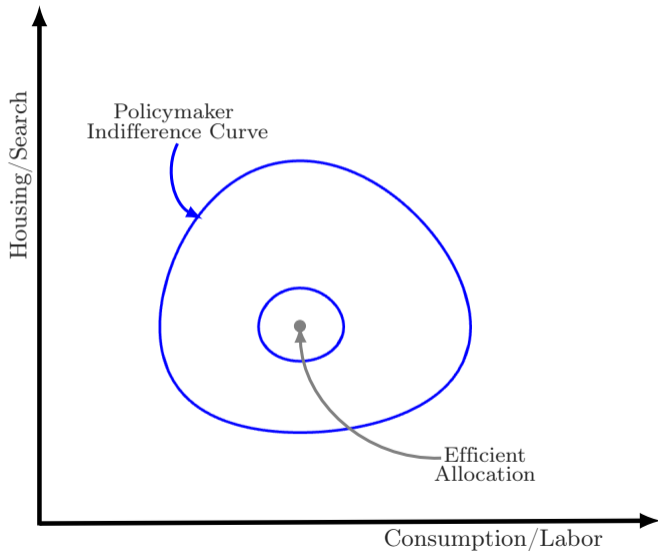
$$\frac{\omega}{sf(s/\bar{h})} = \left(\frac{1}{c} \right) \frac{\bar{R}}{\bar{P}} + \frac{\rho}{f(s/\bar{h})}$$

Targeting rule

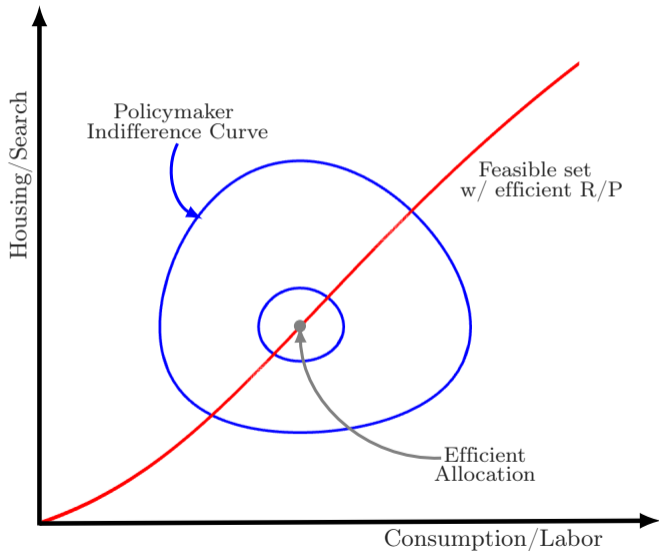
$$\underbrace{1 - \frac{\omega}{h} (f(\Theta) + f'(\Theta)\Theta)}_{\text{Housing congestion}} = [\text{term} < 0] \times \underbrace{(c - z)}_{\text{Output gap}}$$

⇒ If housing market is tight, then goods market is slack

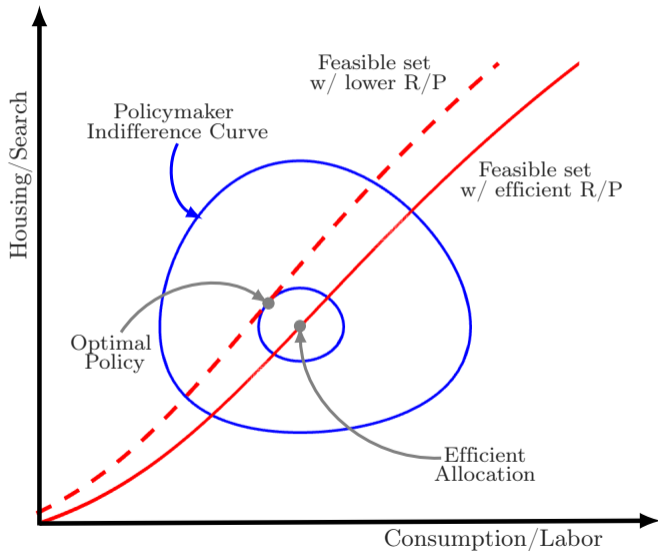
Tradeoffs for Monetary Policy



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Tradeoffs for Monetary Policy



Taking Stock

- Two-sector model with two different rationing mechanisms
- Monetary policy faces a tradeoff between output gap and housing congestion
- In the paper, simple extension with housing production
 - Equilibrium with search mimics “short-side” rule:
 - If excess demand, quantity closer to supply-determined eqm. [▸ Details](#)

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- Two-sector model with two different rationing mechanisms
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- Next: dynamic model & quantitative analysis

Dynamic Model

- Goods sector same as NK model
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Dynamic Model

- Goods sector same as NK model
 - Intermediate good producers with staggered pricing a la Calvo
- Long-term rental market for housing
 - Exogenous separations (prob. δ) and renegotiation (prob. ξ)
 - Law of motion for rental units

$$h_{t+1} = (1 - \delta)h_t + f(\Theta_t)s_t$$

- Rental rate is a weighted average of outstanding and Nash-bargained rents

$$R_t = \chi \bar{R}_t + (1 - \chi)R_t^{Nash}$$

Nominal Rigidities and Policy Tradeoffs

Result


The decentralized equilibrium coincides with the constrained efficient allocation if

1. Bargaining power $\theta = \eta$ (Hosios)
2. $\chi = 0$ (rents fully determined by Nash bargaining)
3. No price dispersion across intermediate goods
4. No output gap in goods

Nominal Rigidities and Policy Tradeoffs

Result


The decentralized equilibrium coincides with the constrained efficient allocation if

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 $\Rightarrow \chi > 0$ is only reason to depart from $\pi^{\text{goods}} = 0$

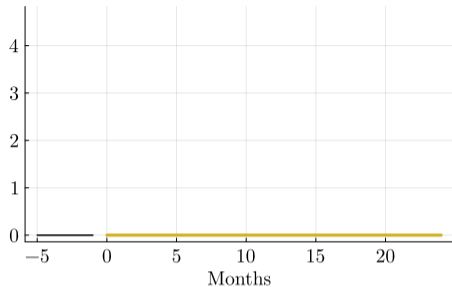
Calibration and Main Experiment

- Monthly model, standard parameters for goods sector
- Calibrate steady-state to 2019
 - Match size of housing, renter mobility, vacancy rate, spending on real estate

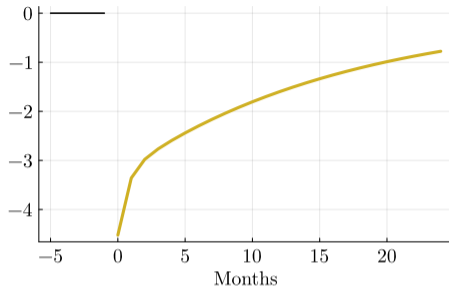
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- Permanent increase in ω_t to match rise in housing share from 15% to 18%
 - Change in demand for space, e.g., WFH (e.g., Mondragon-Wieland, 2022)
 - Rigidity (χ) to match pass-through from new rents (Zillow) to CPI shelter
- Three policies: (1) $\pi^{\text{cpi}} = 0$; (2) $\pi^{\text{goods}} = 0$; (3) Optimal policy
- Computation: non-linear perfect foresight

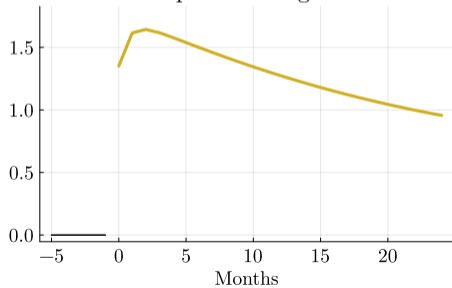
CPI inflation



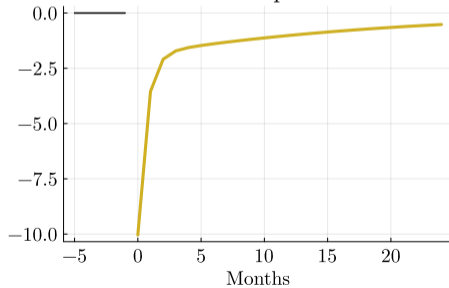
Goods inflation



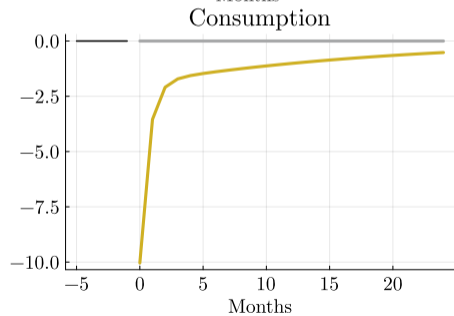
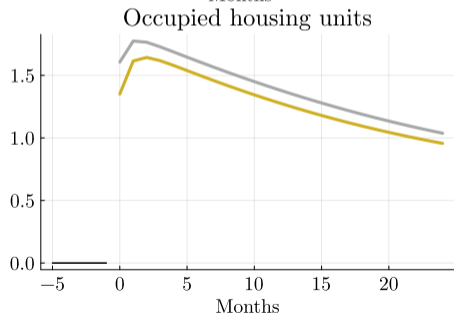
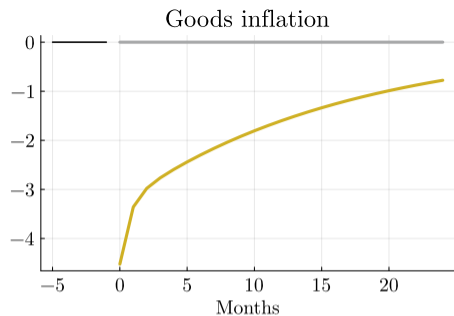
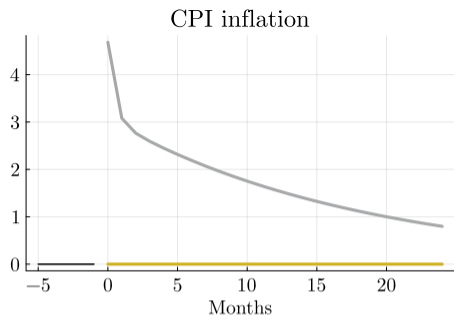
Occupied housing units



Consumption

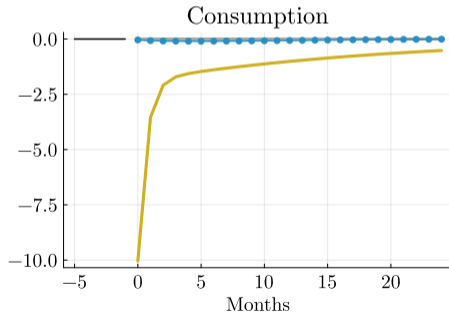
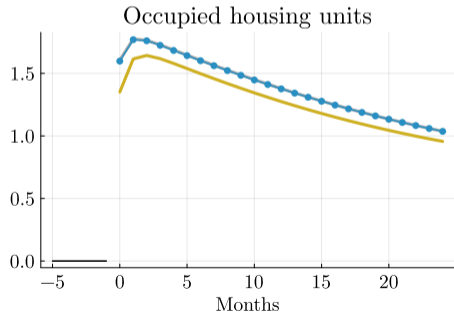
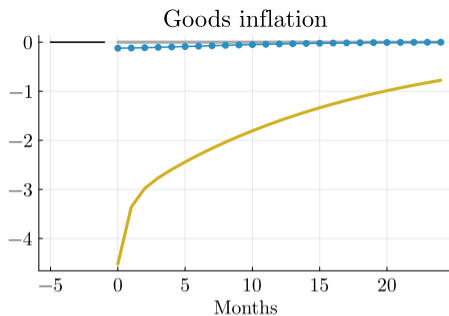
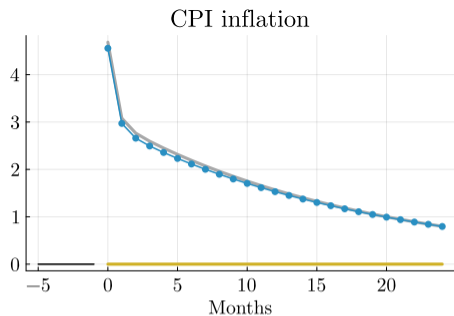


— CPI inflation target



— CPI inflation target

— Goods inflation target

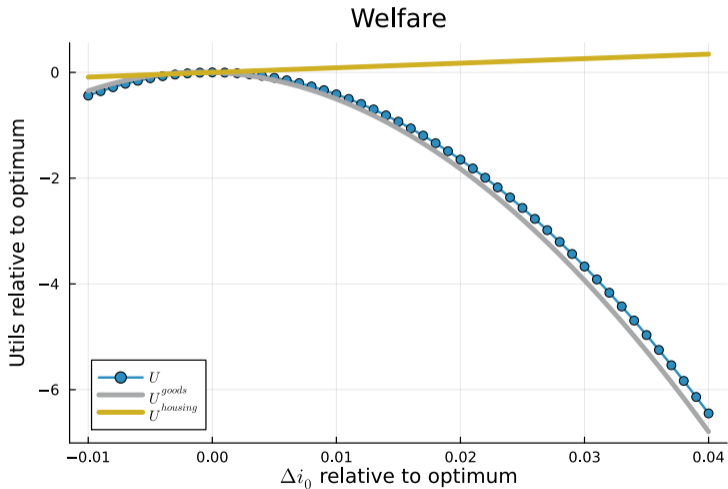


— CPI inflation target

— Goods inflation target

— Optimal

Why ignoring housing inflation is optimal?



Additional Results in the Paper

- Shelter inflation due to catch-up effects ▶ Figure
- Without price dispersion between goods ▶ Figure
- Without inelastic housing demand ($h^o = 0$) ▶ Figure
- With equal stickiness in both sectors ▶ Figure
- With median price duration of 3.4 months ▶ Figure

Conclusion

- Welfare costs of inflation depend on rationing mechanism
- Our model with demand rationing in housing: optimal policy is to ignore housing π

EXTRA SLIDES

Household Problem

$$H_t(h, X, B) = \max_{\substack{c, h', X', \\ s, \ell, B'}} \left\{ (1 - \omega_t) \log c + \omega_t \log (h^o + h') - \psi(1 - \omega_t) (\ell + s) + \beta H_{t+1} (h', X', B') \right\}$$

subject to

$$P_t c_t + \frac{B'}{1 + i_t} + X' = B + W_t \ell_t + P_t d_t,$$

$$h' = (1 - \delta)h + f(\Theta_t)s,$$

$$X' = (1 - \delta)(1 - \xi)X + R_t [\xi(1 - \delta)h + f(\Theta_t)s],$$

Calibration: scope for misallocation

- Thought experiment: suppose no resources used in housing sector, then no misallocation

Calibration: scope for misallocation

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- Use tenant bargaining power to target search effort

$$f(\Theta) \left(\frac{\omega}{h} - \frac{1}{c} \frac{R}{P} \right) = 1$$

- Given target for h , $R/P \uparrow \Rightarrow f(\Theta) \uparrow \Rightarrow \Theta \downarrow \Rightarrow s \downarrow$

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- Given target for h , $R/P \uparrow \Rightarrow f(\Theta) \uparrow \Rightarrow \Theta \downarrow \Rightarrow s \downarrow$
- Empirical target: share of output devoted to brokers' commissions ($1.2\% \times \text{PCE}$)
- **Conservative:** nominal rigidities in rents can distort the whole real estate sector
- Resources used in real estate are small relative to housing budget share (15%)

Calibrating δ and ξ

- δ and ξ play a role in that they affect estimation of χ
 - Lower values induce longer periods of fixed rents within a match
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- δ and ξ play a role in that they affect estimation of χ
 - Lower values induce longer periods of fixed rents within a match
 - Average rents become more inertial even with $\chi = 0$
- ξ set so leases turnover after one year (on average)
- δ estimated from American Community Survey \rightarrow “how long have you lived here?”
 - Assume two types: low- and high- δ
 - Find 29% have high- $\delta = 0.035$, remainder have low- $\delta = 0.005$

Competitive equilibrium

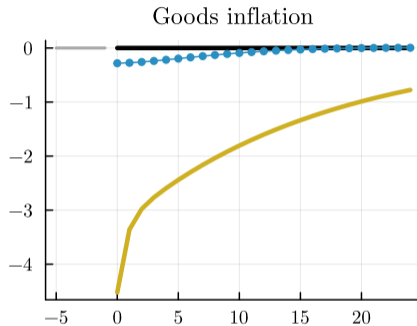
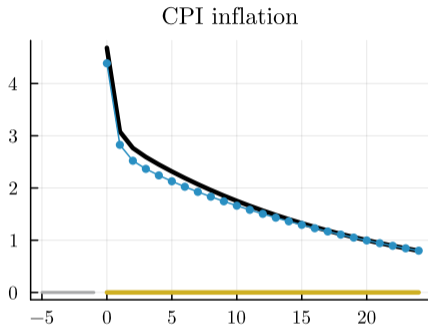
Definition

Given fixed prices $\{\bar{P}, \bar{R}\}$ and a government policy $\{M, T\}$, a **competitive equilibrium** in this economy is given by $\{c, h, s, l, W, \Theta, d, m\}$ such that:

1. Household optimality conditions
2. Search process $h = f(\Theta)s \Leftrightarrow h = g(\Theta)\bar{h}$
3. Goods and labor market clearing: $\ell = c/z$
4. Definitions of $m = M/P$, Θ , and d

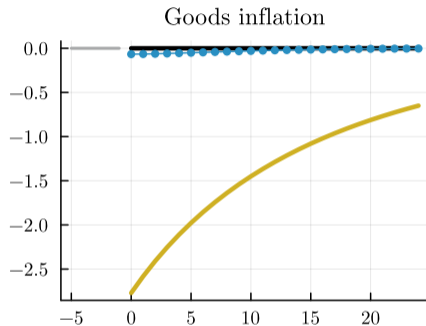
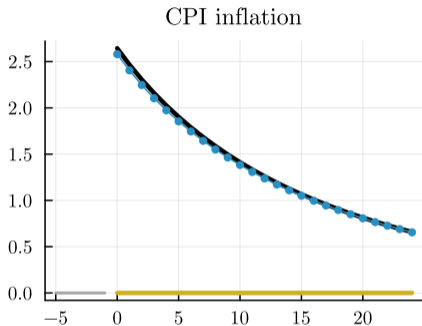
► Return

Without price dispersion within goods



- Goods inflation target
- CPI inflation target
- Optimal
- Initial steady state

Without inelastic housing demand ($h^o = 0$)

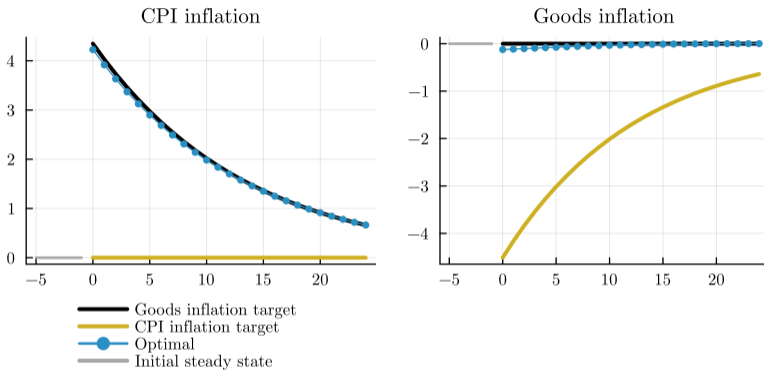


- Goods inflation target
- CPI inflation target
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Note: real estate sector is now 4.3% of PCE

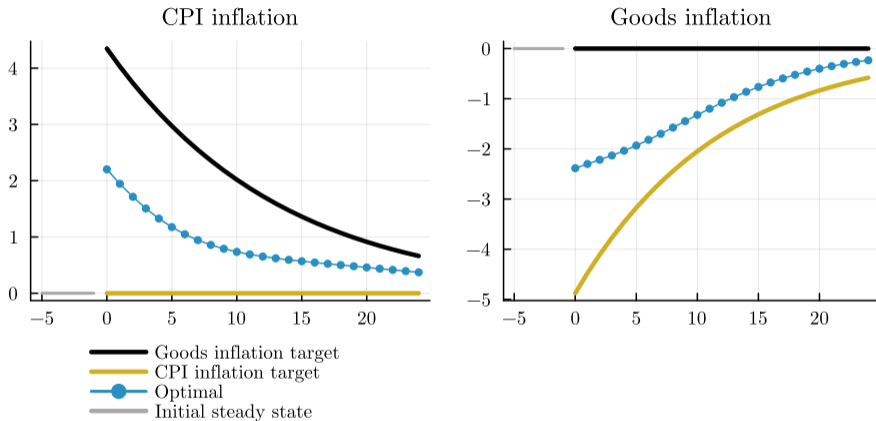
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Using equal stickiness in both sectors



- When a rent is renegotiated, it is set to the Nash bargained rent.
 - We set $\chi = 1$ so all new leases are set to the average outstanding rent.
 - We set the frequency of renegotiation to match the frequency of price changes in goods.
- ▶ Return to main slide

Using median price duration of 3.4 months

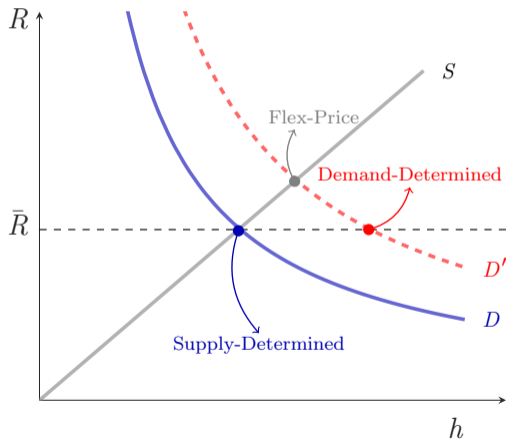


Note: 3.4 month median duration corresponds to all price changes including sales and product substitutions

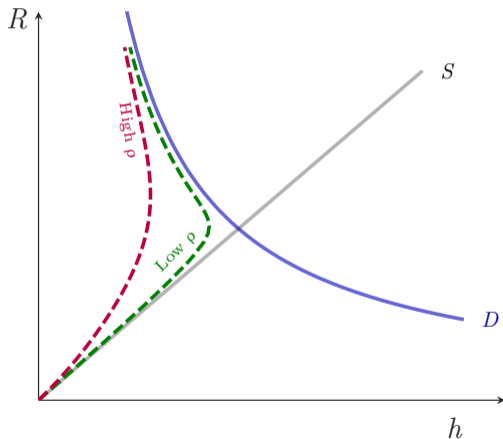
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Short-Side Rule and Search Equilibrium

(a) Supply vs. Demand Determined Eqm.



(b) Search Equilibrium



Estimating χ

State space model:

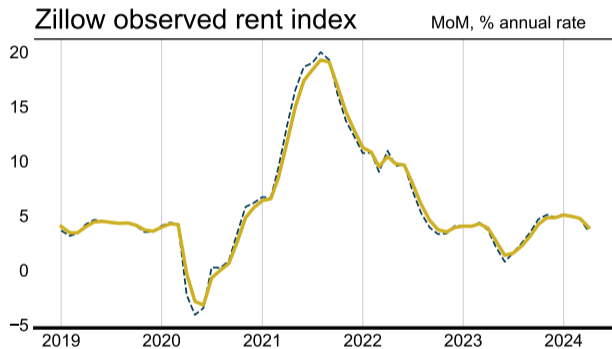
- CPI-shelter = average rent (Δ 6m)
- Zillow rent = Nash rent
- BLS NTR = typical new rent

- All series observed with measurement error
- Estimate by ML
- $\chi = 0.66$

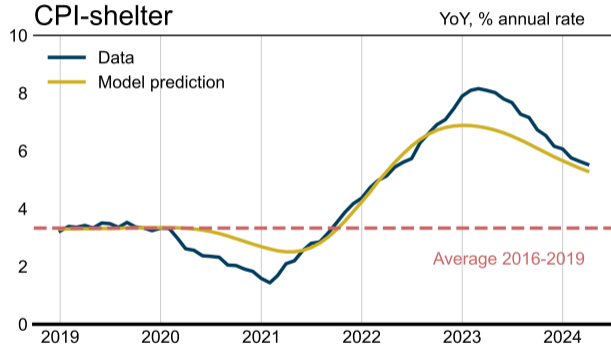
Estimating χ

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- Zillow rent = Nash rent
- BLS NTR = typical new rent
- All series observed with measurement error
- Estimate by ML
- $\chi = 0.66$



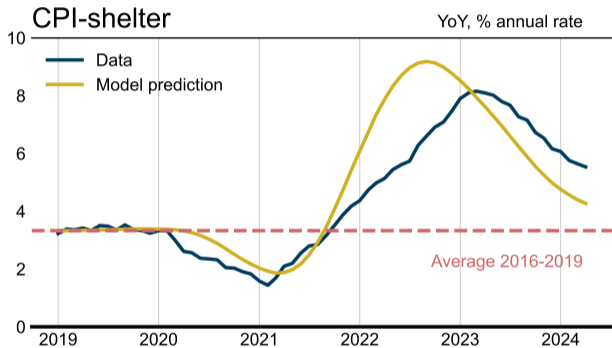
Estimating χ



State space model:

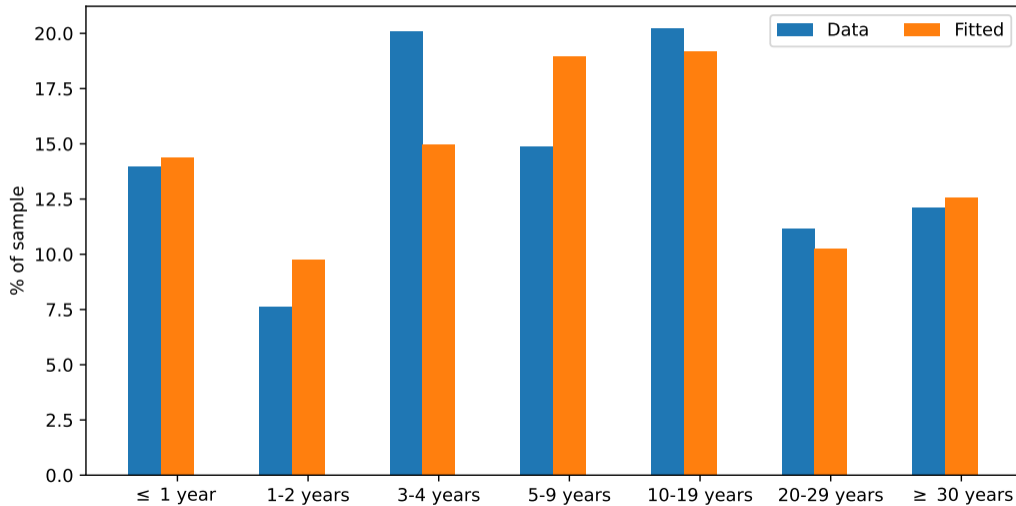
- CPI-shelter = average rent (Δ 6m)
- Zillow rent = Nash rent
- BLS NTR = typical new rent
- All series observed with measurement error
- Estimate by ML
- $\chi = 0.66$

Estimating χ

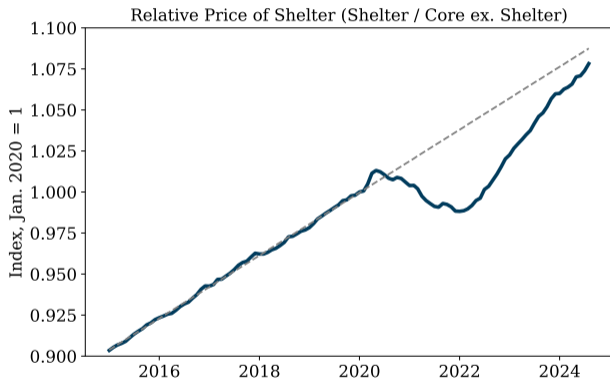


Counterfactual with $\chi = 0$

How long have you lived here? (ACS)



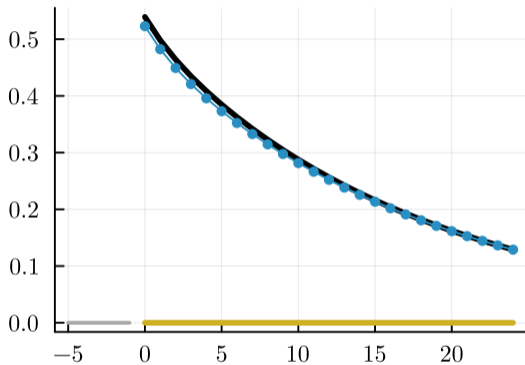
Rents need to catchup



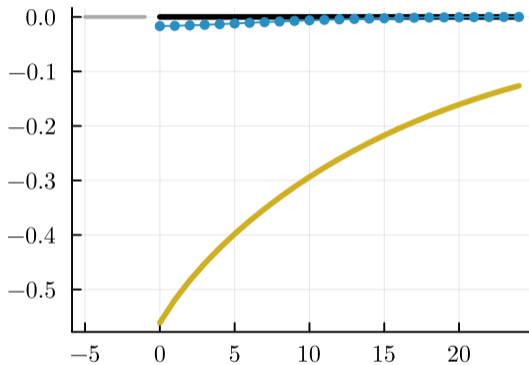
- Relative price of shelter fell below trend in '21 & '22
- A period of "catchup" ensues
- Simulate a 5% deflation of real outstanding rents
- Affects allocation due to $\chi > 0$

Rents need to catchup

CPI inflation



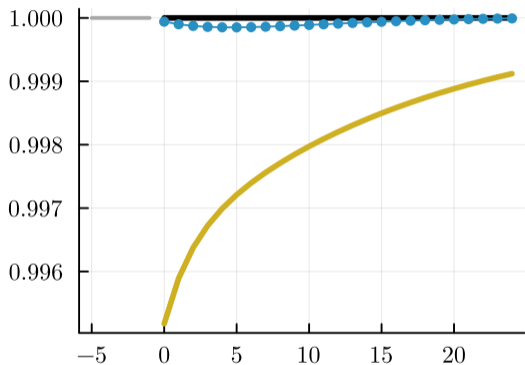
Goods inflation



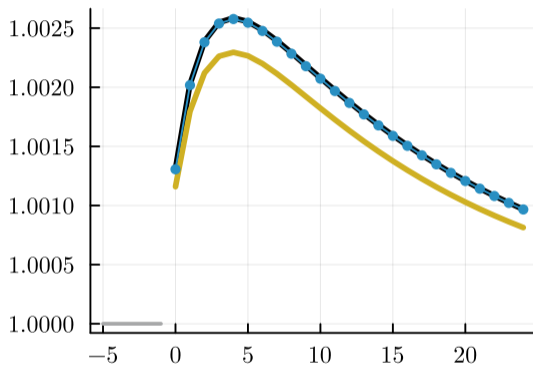
- Goods inflation target
- CPI inflation target
- Optimal
- Initial steady state

Rents need to catchup

Consumption



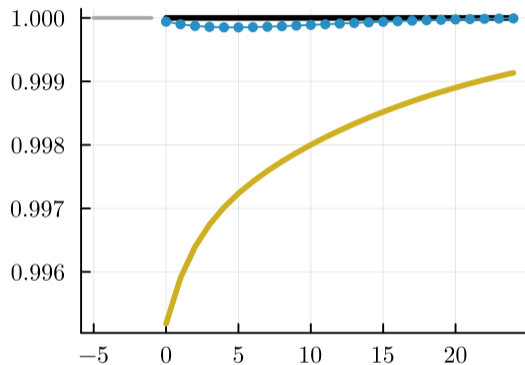
Occupied housing units



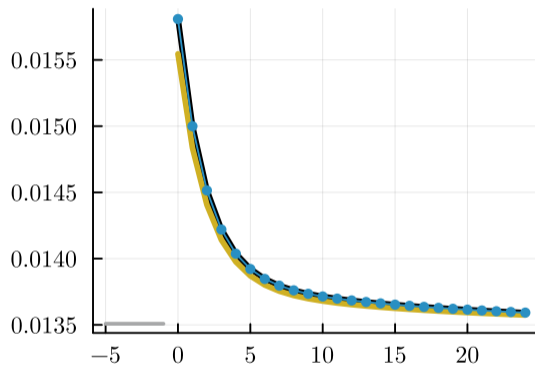
- Goods inflation target
- CPI inflation target
- Optimal
- Initial steady state

Rents need to catchup

Labor effort



Search effort



- Goods inflation target
- CPI inflation target
- Optimal
- Initial steady state