HOW SHOULD MONETARY POLICY RESPOND TO HOUSING INFLATION?

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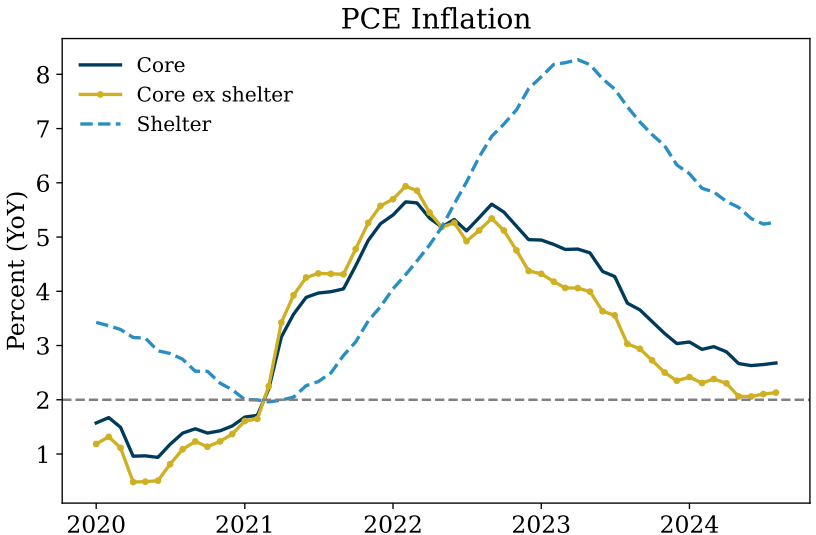
Price of Shelter Driving Current Inflation



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 ⇒ larger response in demand
    - More inelastic supply ⇒ larger change in inputs to meet demand

- Rents are highly sticky (e.g. 12-month contracts)
- Housing supply essentially fixed in the short run

→ Monetary policy should respond aggressively to a rise in housing demand

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

Rationing Mechanisms

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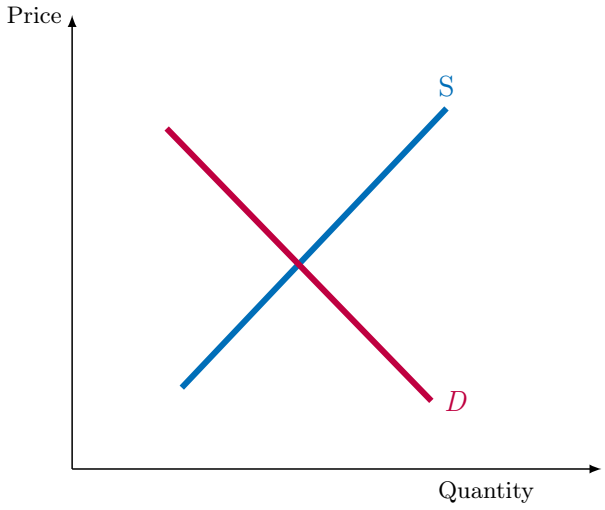

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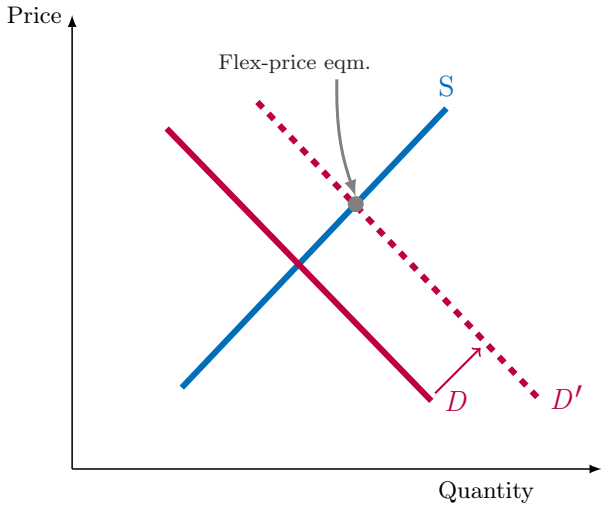

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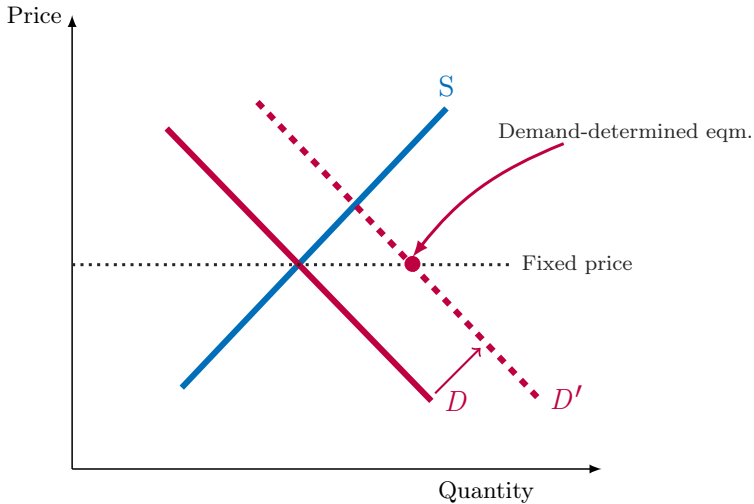

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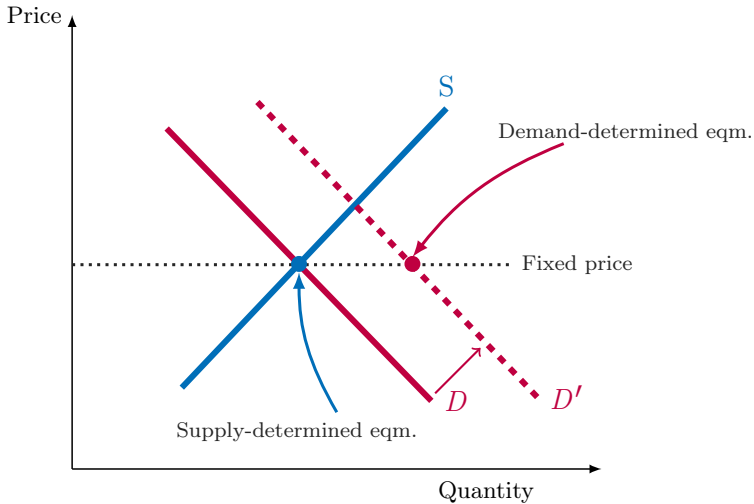

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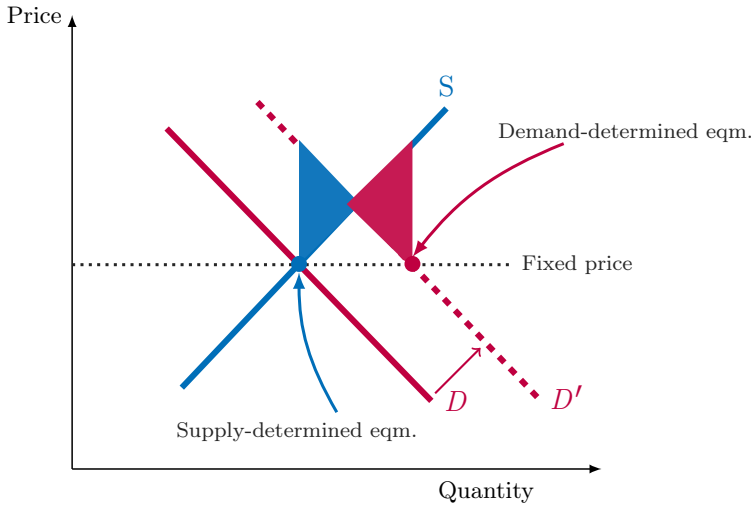

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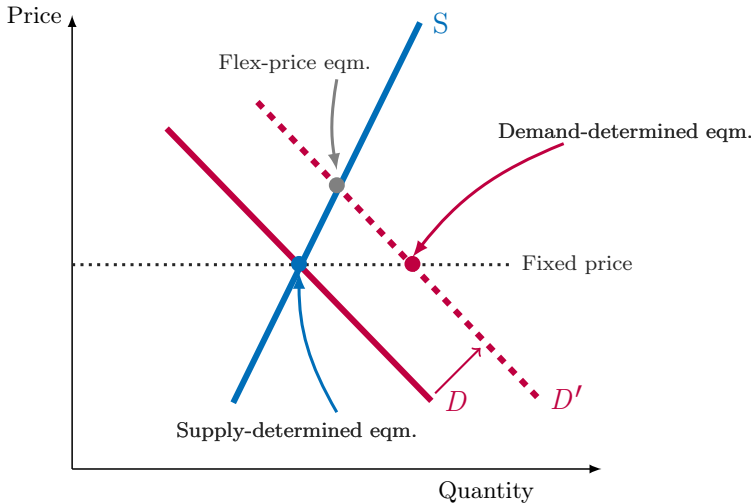

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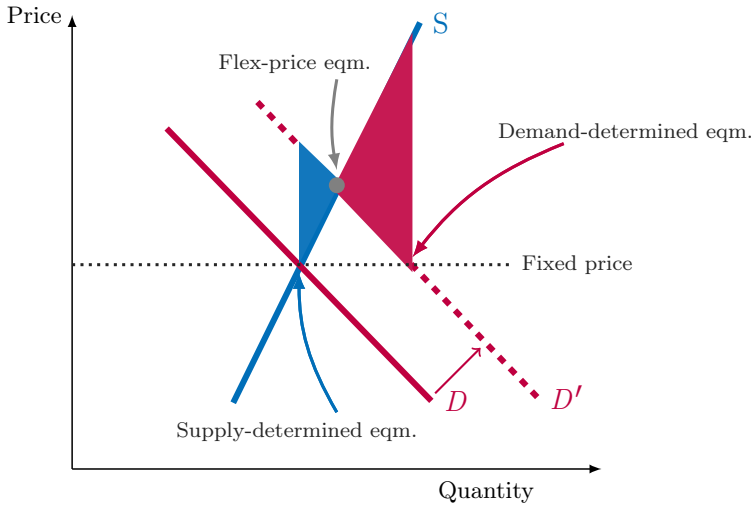

Roadmap

1. Static model:
   - Prices of goods and rents fixed:
     - ☐ Goods: output is demand-determined
     - ☐ Housing: disequilibrium resolved via search

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

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

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

$h = sf(\Theta)$ (search for housing)

Market tightness

finding probability $f' < 0$

- Search split across HH members

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- Rationing: meet demand at $P = \bar{P}$

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Landlords

- Inelastically supply $\bar{h}$

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

$$c = \frac{m}{\varphi} \qquad \frac{\omega}{h} = \frac{1}{c}\left(\frac{\overline{R}}{\overline{P}}\right) + \frac{\rho}{f(\Theta)}. \qquad \frac{W}{\overline{P}} = c,$$

Equilibrium Characterization

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

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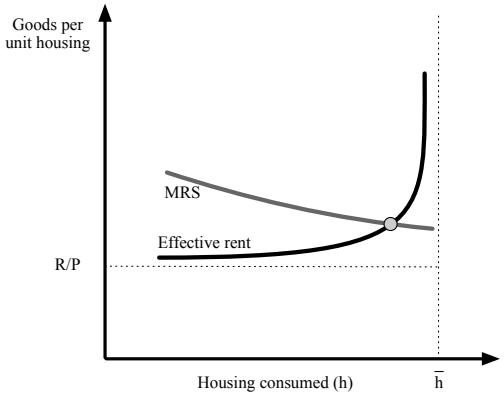
$$\underbrace{\frac{\omega c}{h}}_{MRS} = \underbrace{\frac{\overline{R}}{\overline{P}} + \frac{c}{f\left(g^{-1}\left(\frac{h}{\overline{h}}\right)\right)}}_{\text{Effective rent}}$$



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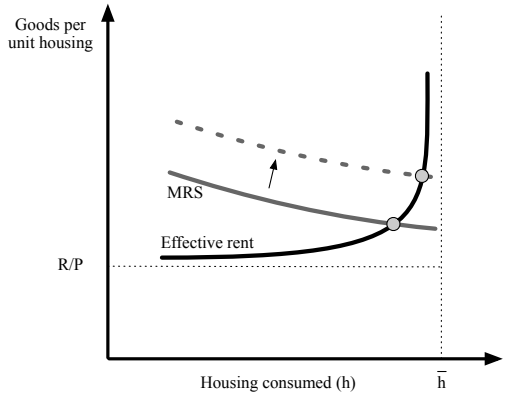

Constrained efficient allocation

- Planner directly chooses allocation subject to technology and search frictions

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

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- Optimality

$$c = z$$

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

- 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

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

subject to

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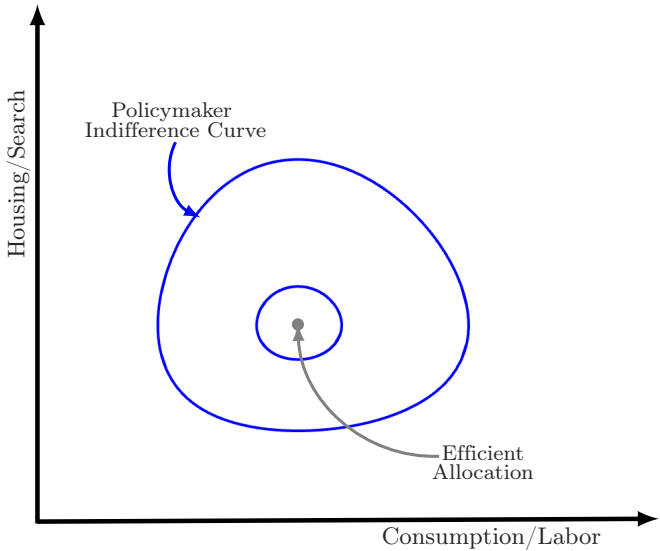
Targeting rule

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

$\Rightarrow$ If housing market is tight, then goods market is slack

Tradeoffs for Monetary Policy



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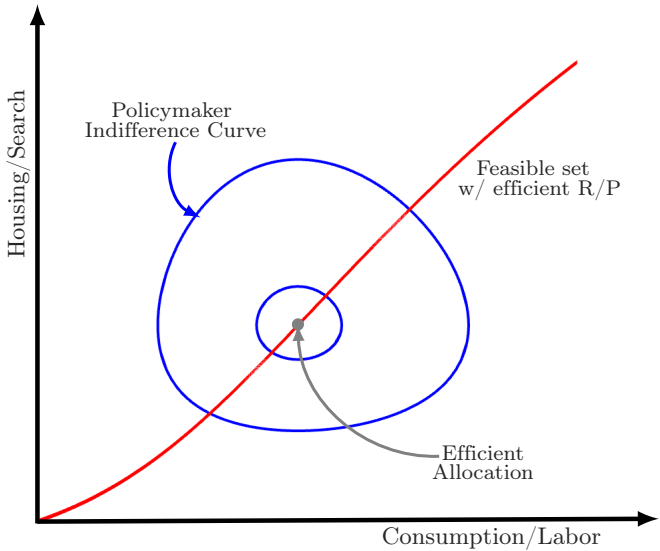

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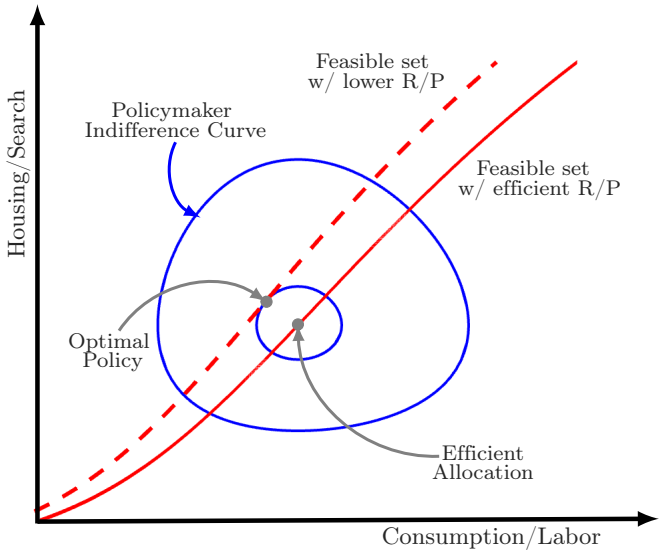

Taking Stock

- 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:
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- Next: dynamic model & quantitative analysis

Dynamic Model

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- 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 HH = matching function elasticity (Hosios)
2. $\chi = 0$ (rents fully determined by Nash bargaining)
3. No price dispersion across intermediate goods
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$\Rightarrow \chi > 0$ is only reason to depart from $\pi^{\text{goods}} = 0$

Calibration and Main Experiment

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- Calibrate steady-state to 2019
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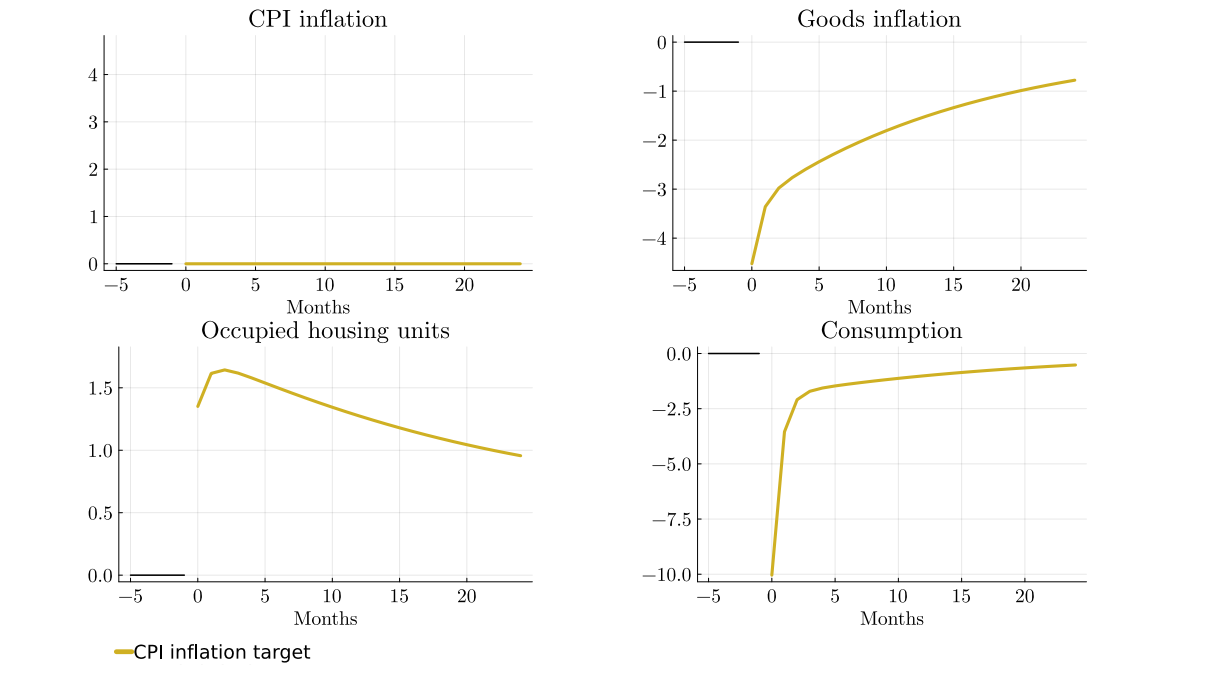
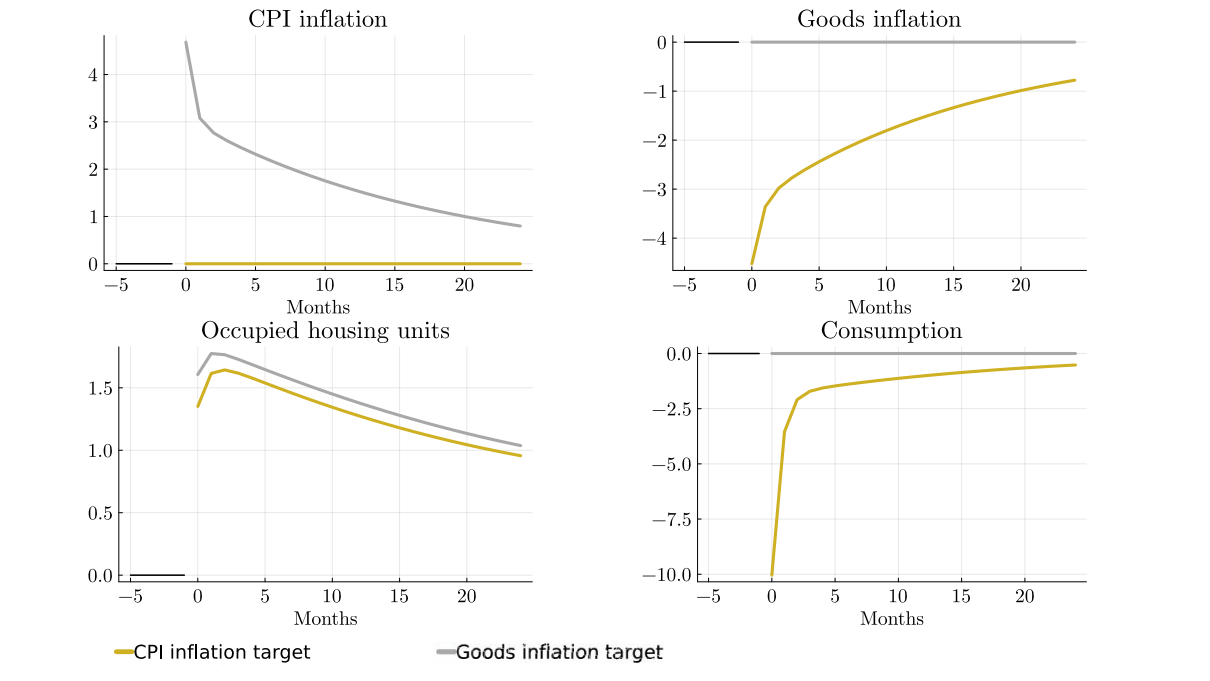
- Calibrate steady-state to 2019
  - Match size of housing, renter mobility, vacancy rate, spending on real estate
- Permanent increase in ω_t to match rise in housing share from 15% to 18%
  - Change in demand for space, e.g., WFH (e.g., Mondragon-Wieland, 2022)
  - Rigidity (χ) to match pass-through 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
4
3
2
1
0
−5
0
5
10
15
20
Months
Goods inflation
0
−1
−2
−3
−4
−5
0
5
10
15
20
Months
Occupied housing units
1.5
1.0
0.5
0.0
−5
0
5
10
15
20
Months
Consumption
0.0
−2.5
−5.0
−7.5
−10.0
−5
0
5
10
15
20
Months
CPI inflation target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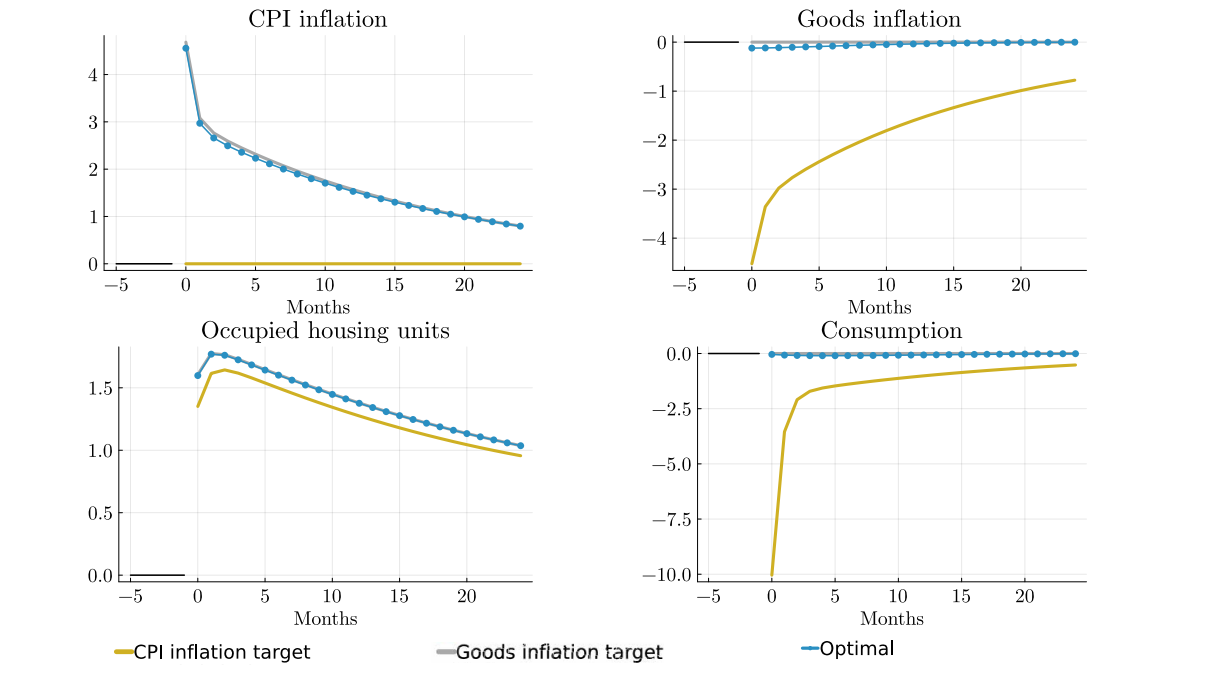
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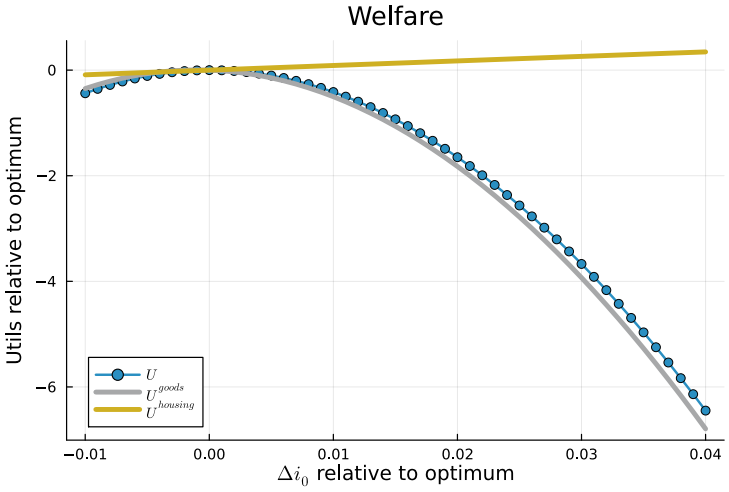
Optimal

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

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

subject to

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

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

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

Environment

- Preferences

$$\sum_{t=0}^{\infty} \beta^t \left\{ \log c_t + \omega_t \log \left(h^o + h_{t+1} \right) - \psi \left(\ell_t + s_t \right) \right\},$$

- Search

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

$$\Theta_t \equiv s_t / [\bar{h} - (1-\delta) h_t]$$

- Production of goods

$$c_t = \left(\int_0^1 y_{jt}^{\frac{\eta-1}{\eta}} \, dj \right)^{\frac{\eta}{\eta-1}}$$

$$y_{jt} = z \ell_{jt} \qquad \forall$$

Price setting

- Intermediate goods producers face Calvo friction
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    or
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- Rents for new and renegotiated leases adjust gradually:
  - R_t^* = Nash bargaining rent
  - $\bar{R}_t$ = average outstanding rent
  - Actual rent $\quad R_t = \chi \bar{R}_t + (1 - \chi) R_t^*$

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  - Given target for h, $\quad R/P \uparrow \Rightarrow f(\Theta) \uparrow \Rightarrow \Theta \downarrow \Rightarrow s \downarrow$
  - Empirical target: share of output devoted to brokers' commissions (1.2% × 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
  - Average rents become more inertial even with $\chi = 0$

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- δ estimated from American Community Survey → "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

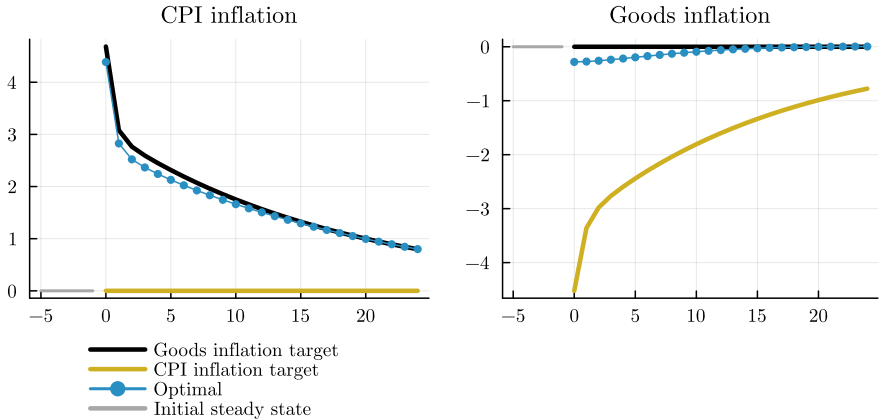
Definition

Given fixed prices $\left\{\bar{P}, \bar{R}\right\}$ 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



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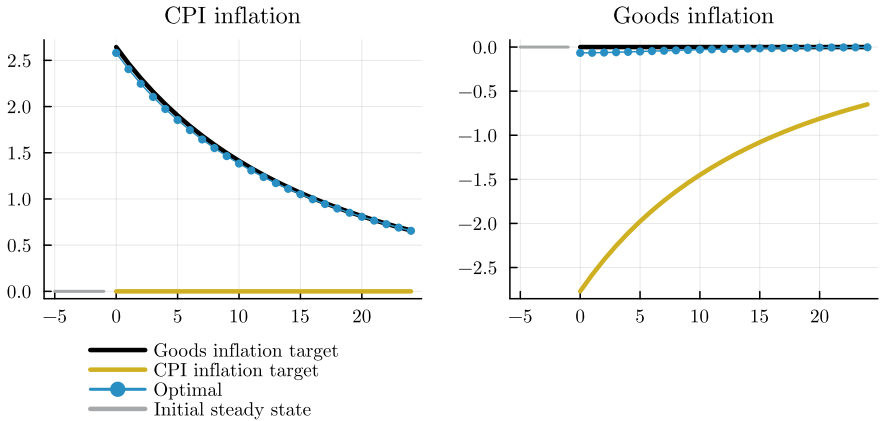
Without inelastic housing demand ($h^o = 0$)



Note: real estate sector is now 4.3% of PCE

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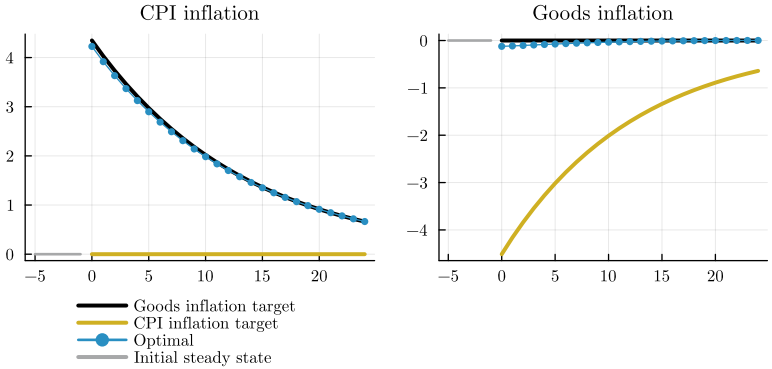
Using equal stickiness in both sectors



- 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.

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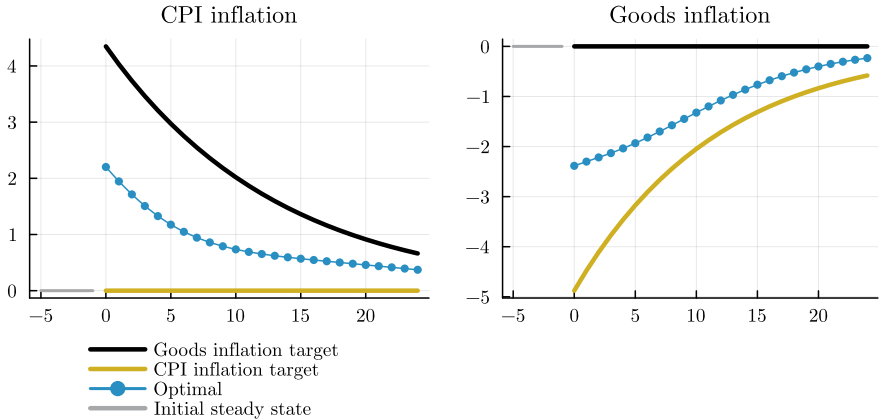
Using median price duration of 3.4 months



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

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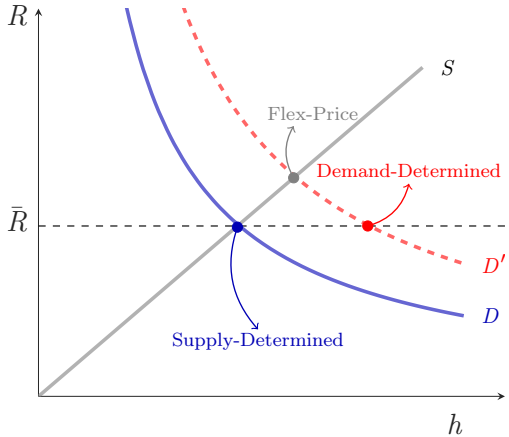
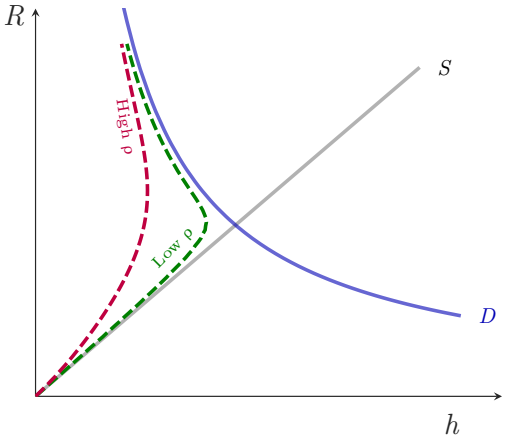
Short-Side Rule and Search Equilibrium

(a) Supply vs. Demand Determined Eqm.



(b) Search Equilibrium



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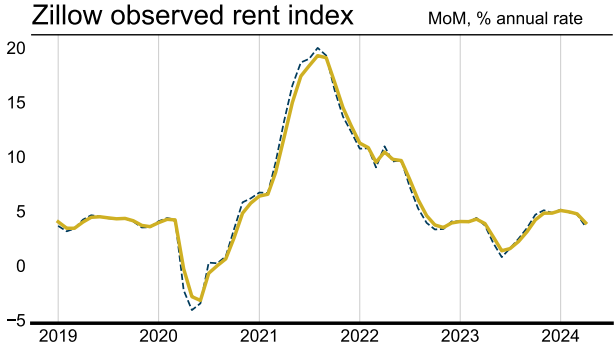
Estimating χ

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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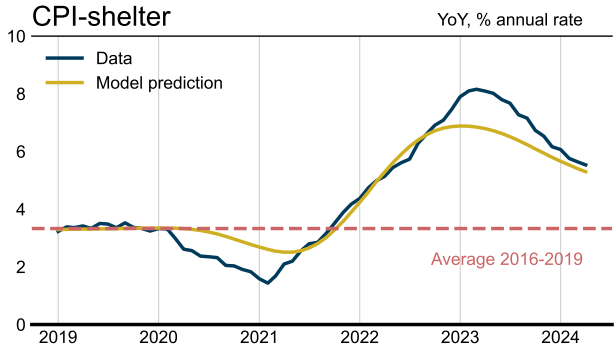
Estimating χ



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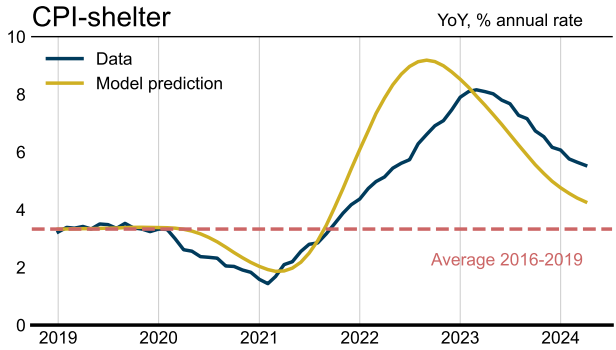
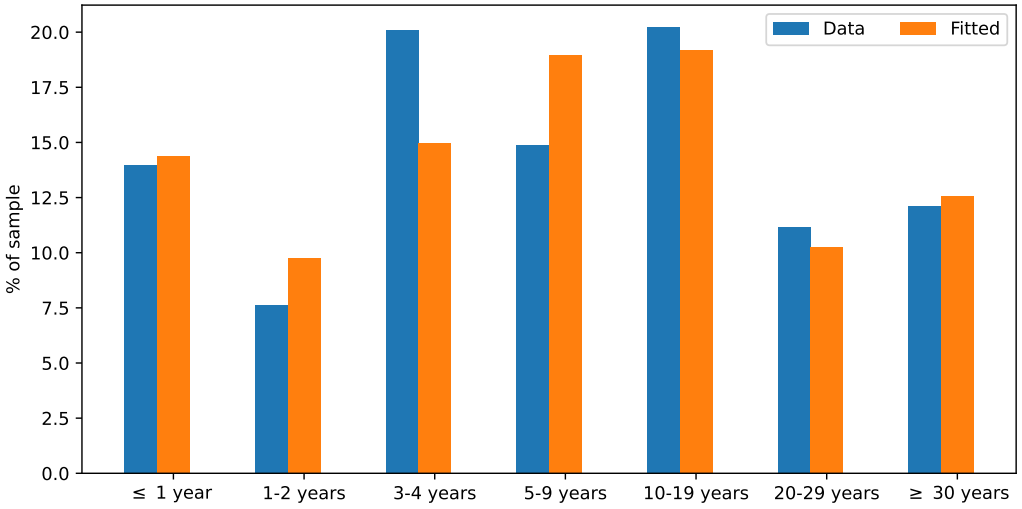
Estimating χ

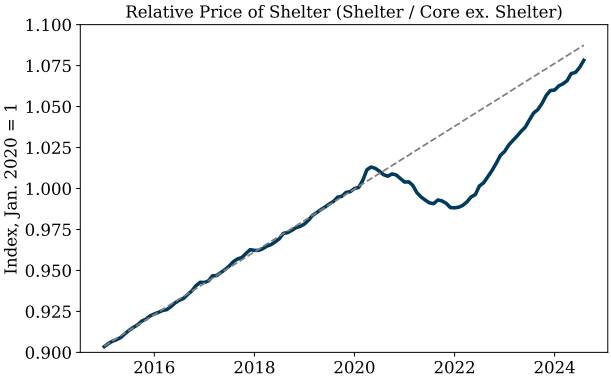


Counterfactual with $\chi = 0$

How long have you lived here? (ACS)

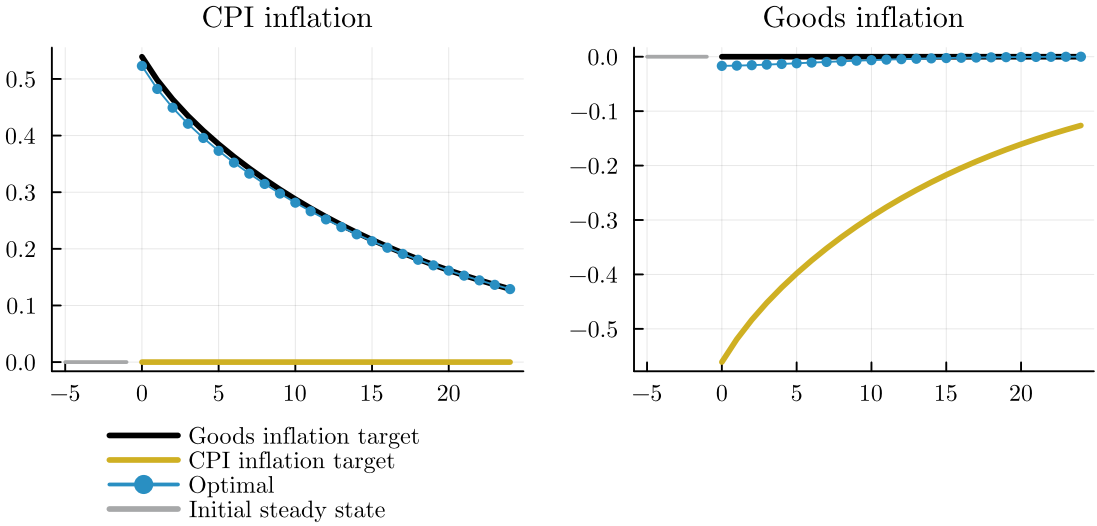


Rents need to catchup

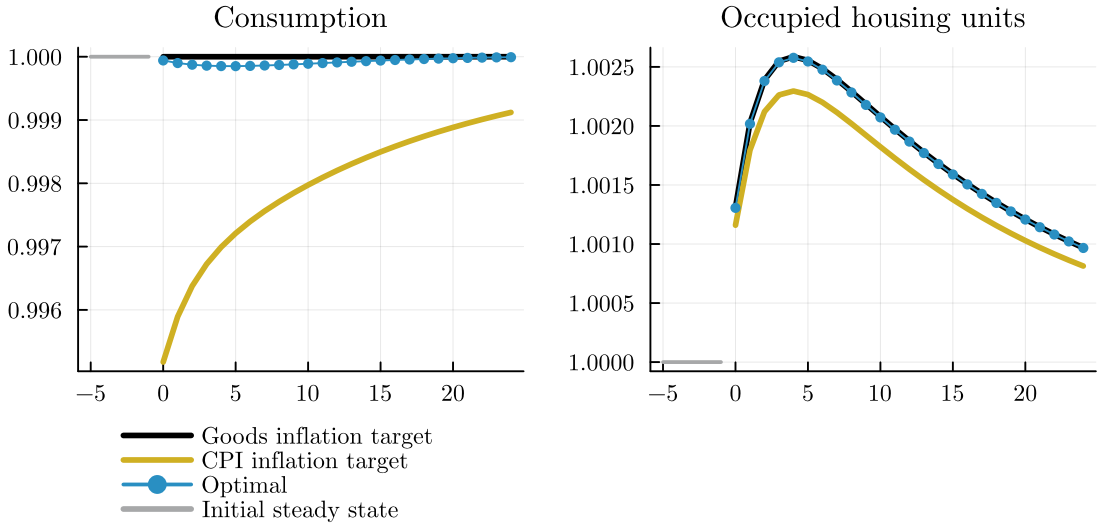


- Relative price of shelter fell below trend in ’21 & ’22
- A period of "catchup" ensues
- Simulate a 5% deflation of real outstanding rents
- Affects allocation due to $\chi > 0$

Rents need to catchup



Rents need to catchup



Rents need to catchup