Mortgages and Monetary Policy

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Motivation and questions

- House is a large long-term *real* asset; mortgage is a large long-term *nominal* liability
  - Nominal payments for $20-30$ yrs; $15-22\%$ of net income (US, UK), 29% (GER, FRA)
  - Mortgage debt: 30-110% of annual GDP (developed countries, 2009)
- Nominal frictions usually lead to real effects of monetary policy
- What are the real effects in the presence of mortgages? Who gains, who looses? ARM vs FRM?

Methodology and preview of findings

- Model: homeowners (3rd & 4th quintile of wealth dist.); capital owners (5th quintile); incomplete markets; Taylor rule; absence of standard nom. frictions
  - Monetary policy affects real mortgage payments
  - Two channels: price effect (new debt), wealth effects (old debt)
- The two effects reinforce each other under ARM, offset each other under FRM $\rightarrow$ mon. policy has stronger effects under ARM
- More persistent changes in monetary policy have larger impact
- Upper bounds due to no refinancing, no choice b/w ARM and FRM

Outline of the talk

(1) Numerical examples of the price effect in "partial equilibrium"

(2) An explanation

(3) Overview of the model ("general equilibrium")

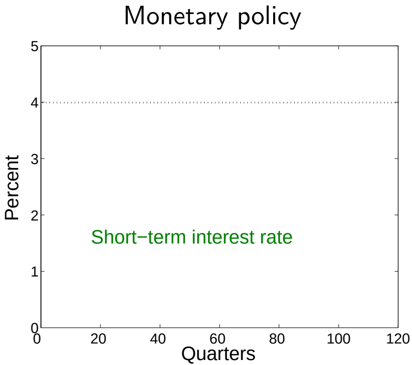
(4) Some quantitative findings

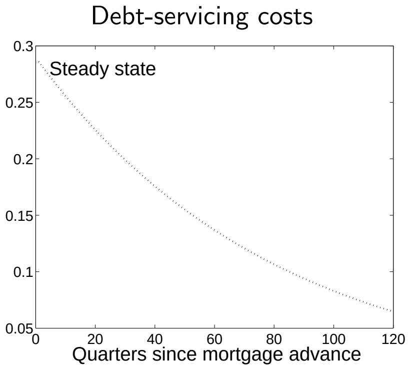
... much more in the paper!

Mon. policy and real mortgage payments

over the life of a new mortgage loan

Constant short-term interest rate



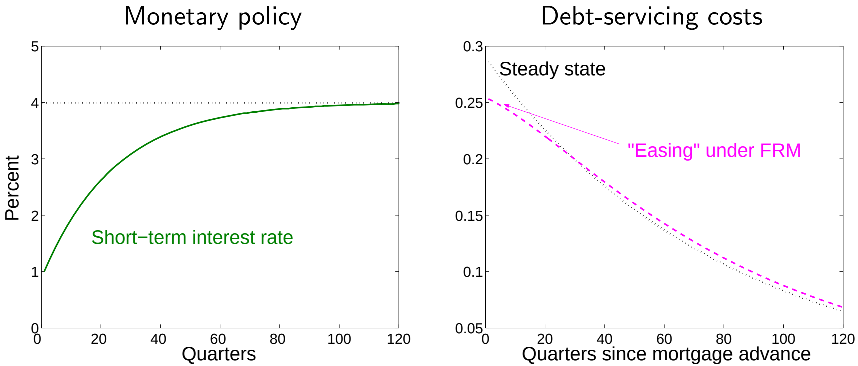


Constant real interest rate $r = 1\%$; constant real income w

Mortgage (30 yrs) $=$ 4x annual income

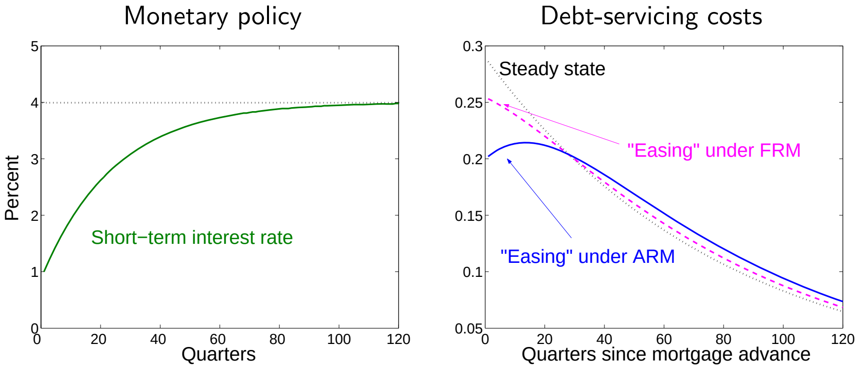
Debt servicing costs $= \widetilde{m}_t / w$

Mean-reverting decline in the short rate



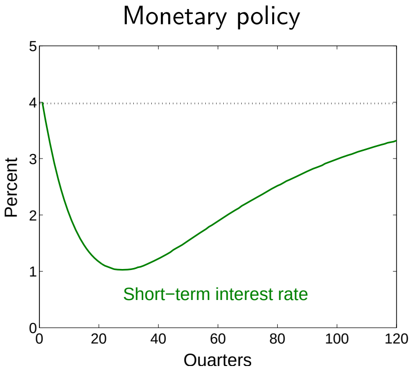
Concave utility fn ⇒ you prefer payments under easing

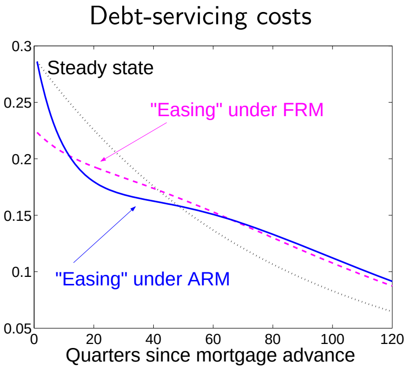
Mean-reverting decline in the short rate



Even better if contracts are ARM

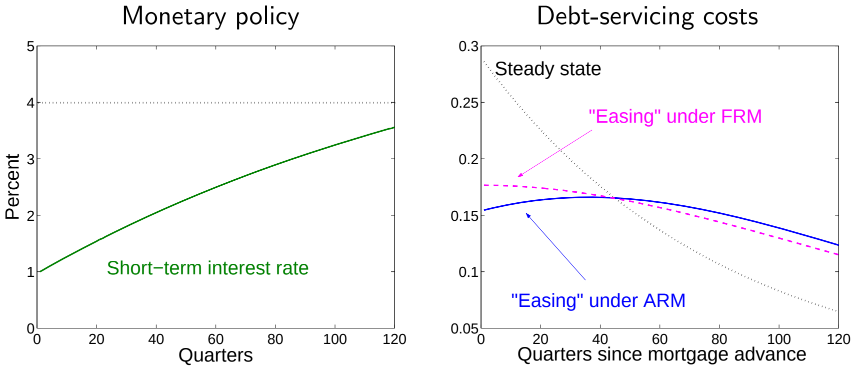
Hump-shaped decline in the short rate





Effect not always bigger under ARM!

Highly persistent mean-reverting decline



Effect gets bigger with persistence; FRM gets closer to ARM

Price and wealth effects

2-period mortgage

$t = 1, 2, 3$

$$\frac{l}{p_1} = \theta h, \qquad m_2 = (i_2^M + \gamma) l, \qquad m_3 = (i_3^M + 1)(1 - \gamma) l$$

Fully-amortizing mortgage: $i_2^M + \gamma = (i_2^M + 1)(1 - \gamma)$

No arbitrage pricing of mortgages

ARM: $i_2^M = i_1, \quad i_3^M = i_2$

No arbitrage pricing of mortgages

ARM: $i_2^M = i_1, \quad i_3^M = i_2$

FRM: $i_2^M = i_3^M = i^F$

$$1 = Q_1^{(1)}(i^F + \gamma) + Q_1^{(2)}(1-\gamma)(i^F + 1)$$

$$Q_1^{(1)} = (1 + i_1)^{-1}$$

$$Q_1^{(2)} = [(1 + i_1)(1 + i_2)]^{-1}$$

No arbitrage pricing of mortgages

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Fisher: $(1 + i_t)(1 + \pi_{t+1})^{-1} = (1 + r) = (\mu^*)^{-1}$

Price effect (new debt)

Cost of a new mortgage to the household

$$\tau_H^{FRM} = -\theta \left\{ 1 - \left[\mu_{12} \frac{i^F + \gamma}{1 + \pi_2} + \mu_{12}\mu_{23} \frac{(i^F + 1)(1 - \gamma)}{(1 + \pi_2)(1 + \pi_3)} \right] \right\}$$

$$\tau_H^{ARM} = -\theta \left\{ 1 - \left[\mu_{12} \frac{i_1 + \gamma}{1 + \pi_2} + \mu_{12}\mu_{23} \frac{(i_2 + 1)(1 - \gamma)}{(1 + \pi_2)(1 + \pi_3)} \right] \right\}$$

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Notice: $i_1 \uparrow \Rightarrow$ marginal mortg. payments in $t = 2 \uparrow \Rightarrow \tau_H \uparrow$

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No real effects if:

(i) $\theta = 0$ (ii) $\mu_{t,t+1} = \mu^*$ (iii) $\gamma = 1$ (iv) indexation

Wealth effects (outstanding debt)

- $t = 1$:

$$\widetilde{m}_1 = \frac{(i_1^M + \gamma_1)}{(1 + \pi_1)} \widetilde{l}_0 \qquad i_1^M \text{ determined in } t = 0$$

- $t = 2$

$$\text{FRM:} \qquad \widetilde{m}_2 = \frac{(i_0^F + \gamma_2)}{(1 + \pi_2)(1 + \pi_1)} (1 - \gamma_1) \widetilde{l}_0$$

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ARM: $$\widetilde{m}_2 = \frac{(i_1 + \gamma_2)}{(1 + \pi_2)(1 + \pi_1)} (1 - \gamma_1) \widetilde{l}_0$$

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Notice: $i_1 \uparrow \Rightarrow \widetilde{m}_2 \downarrow$ under FRM, $\widetilde{m}_2 \uparrow$ under ARM

Quantitative model

Main features

- Infinite horizon
- Multi-period mortgages ($\approx$ 30 yrs)
- General equilibrium (r, w, i endogenous)
    - capital owner
    - competitive factor markets, elastic labor supply
    - Taylor rule
- Calibrated to the US (long-run averages)

Environment

- Competitive producers: $A_t f(K_t, N_t) = \zeta(C_t, X_{Kt}, X_{St})$
- Competitive homebuilders: $X_{Lt} = 1$; $g(X_{St}, X_{Lt}) = X_{Ht}$
- Two agent types: *homeowners* and *capital owners*; log preferences, same β, measures $2/3$ and $1/3$; repre. agent of each type; interact in factor, mortgage, unsecured loan markets
- Taylor rule
- Either FRM or ARM
- No financial intermediaries

Monetary policy shocks as a 'level' factor

Monetary policy shocks as a 'level' factor

Taylor rule: $\quad i_t = (i - \overline{\pi} + \overline{\pi}_t) + \nu_\pi(\pi_t - \overline{\pi}_t) \qquad \nu_\pi > 1$

$$\overline{\pi}_{t+1} = (1-\rho_\pi)\overline{\pi} + \rho_\pi \overline{\pi}_t + \epsilon_{\pi,t+1} \qquad \rho_\pi \to 1$$

$+$ Fisher eqn $\Rightarrow$ $\displaystyle i_t \approx \underbrace{\sum_{j=0}^{\infty}\left(\frac{1}{\nu_\pi}\right)^j E_t r_{t+1+j}}_{\text{slope factor}} + \underbrace{\overline{\pi}_t}_{\text{level factor}}$

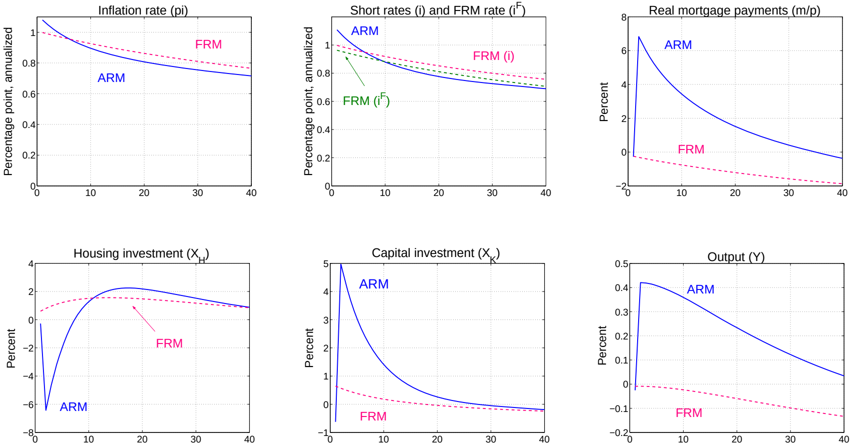
$$\pi_t \approx \frac{1}{\nu_\pi}\sum_{j=0}^{\infty}\left(\frac{1}{\nu_\pi}\right)^j E_t r_{t+1+j} + \overline{\pi}_t$$

where $\quad r_t = MPK$

Selected findings

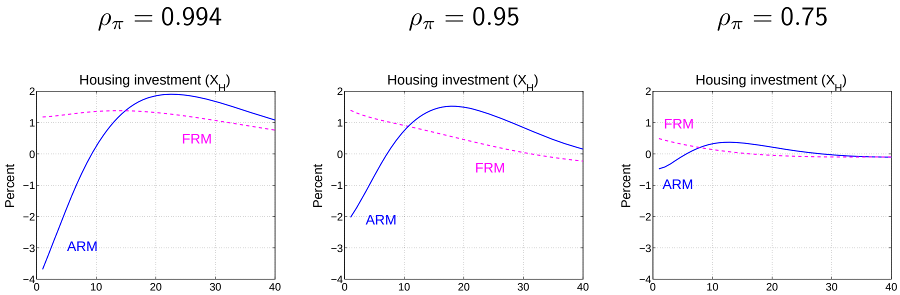
Responses to 1 percentage point (annual) increase in $\overline{\pi}_t$

Effects larger under ARM than FRM



Calibration

Effects larger when the shock is more persistent



Responses to a TFP shock

Cyclical properties

Concluding remarks

- Policy implications
  - Real effects of monetary policy larger in ARM countries (UK) than FRM countries (US)
  - Persistence matters: keeping low longer has bigger impact
- Some open issues
  - Housing construction or house prices?
  - Can monetary policy substitute for an "optimal debt contract"?

    ... what should optimal mon. policy be in the Eurozone?

Calibration

Symbol	Model	Data	Description
Targeted in calibration:			
K	7.06	7.06	Capital stock
H	5.28	5.28	Housing stock
X_K	0.156	0.156	Capital investment
X_S	0.054	0.054	Housing structures
N	0.255	0.255	Hours worked
$\widetilde{m}/(wn-\tau)$	0.185	0.185	Debt-servicing costs (pre-tax)
i^M	0.0233	0.0233	Mortgage rate
Not targeted:			
Aggregate mortgage variables			
$\widetilde{D}$	1.61	2.35	Mortgage debt
γ	0.0144	0.0118	Amortization rate
Capital owner's variables			
$(1-\tau_K)(r-\delta_K)$	0.012	0.013	Net rate of return on capital
$[(r-\delta)k+\widetilde{m}^*]/[(r-\delta)k+\widetilde{m}^*+\tau^*]$	0.31	0.39	Income from assets to total income
$\widetilde{m}^*/[(1-\tau_K)(r-\delta)k+\widetilde{m}^*+\tau^*]$	0.089	N/A	Mortg. payments to total (net) income
Homeowner's variables			
τ_H	0	N/A	Housing wedge
$\widetilde{m}/[(1-\tau_N)(wn-\tau)]$	0.24	N/A	Debt-servicing costs (post-tax)
$(wn-\tau)/(wn-\tau)$	1.00	0.81	Income from labor to total income
Distribution of wealth			
$(K+\widetilde{D})/(K+H)$	0.71	0.82	Capital owners
$(H-\widetilde{D})/(K+H)$	0.29	0.18	Homeowners

Back

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Cyclical properties

	US data	Model FRM	Model ARM
Std			
Y	1.92	0.94	1.04
Rel. std			
Y	1.00	1.00	1.00
C	0.42	0.42	0.35
X_S	6.94	9.48	8.20
X_K	2.45	1.76	3.01
N	0.92	0.24	0.30
π	0.58	0.85	0.81
i	0.58	0.85	0.85
i^F	0.35	0.77	N/A
$i^F - i$	0.42	0.21	N/A
q	0.58	0.18	0.15
p_H	1.57	1.13	0.97
Corr			
(C_t, Y_t)	0.79	0.88	0.94
(X_{St}, Y_t)	0.60	0.99	0.85
(X_{Kt}, Y_t)	0.73	0.92	0.83
(N_t, Y_t)	0.84	-0.67	-0.05
(π_t, Y_t)	0.14	0.23	0.41
(i_t, Y_t)	0.36	0.32	0.48
(i_t^F, Y_t)	0.01	0.09	N/A
$(i_t^F - i_t, Y_t)$	-0.49	-0.98	N/A
(q_t, Y_t)	0.41	0.99	0.85
(p_{Ht}, Y_t)	0.55	0.99	0.85

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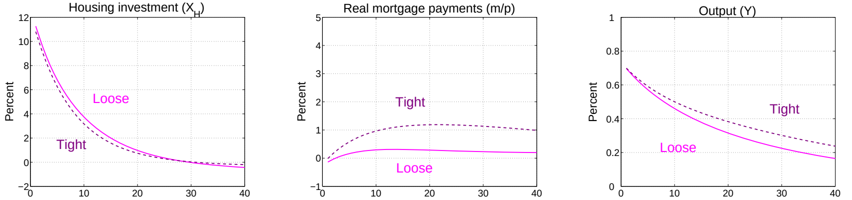
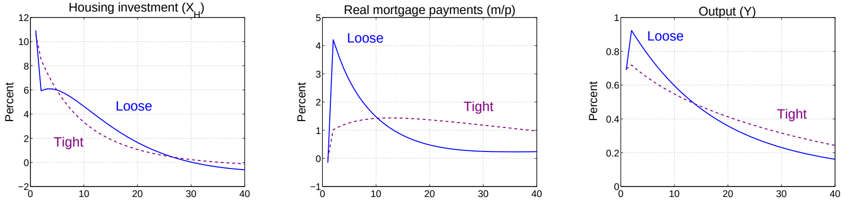
1% increase in A_t, tight vs loose policy

FRM



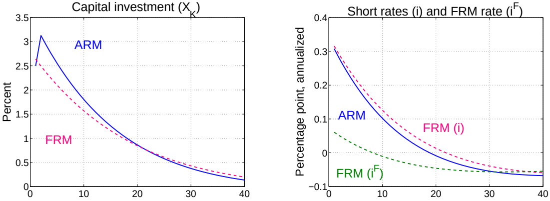
ARM



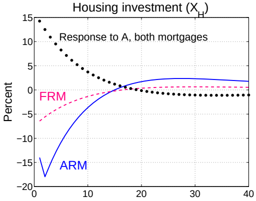
Back to inflation target shock

Equilibrium adjustments to A_t shock

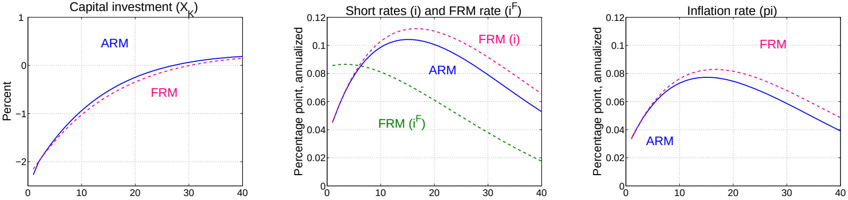
Responses to A (X_H and N const.)



Responses to i_t

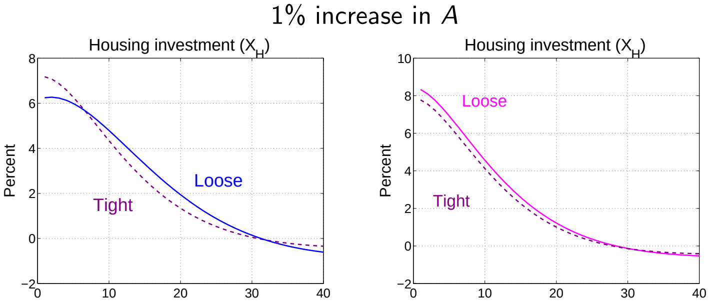


Responses to X_H (A and N constant)



Back to inflation target shock

Housing investment when homeowners can access bonds



Back to inflation target shock