Optimal Monetary Policy Rules and House Prices: The Role of Financial Frictions

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- Main result: financial frictions modify optimal policy rule, in particular the response to house prices
- Central bank's knowledge of the economy crucially affects results

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- What role for house prices in monetary policy? Does a systematic reaction help stabilize business cycle?
- What about social welfare? How related to business cycle stabilization?

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- Jeske and Liu (2012): no financial frictions; optimal rule should stabilize sticky rental prices
- Multi-sector models: focus on relative price stickiness and consumption weight (Aoki 2001, Benigno 2004, Mankiw and Reis 2003); Erceg and Levin (2006): optimal rule should assign larger weight to durable goods than their relative share in consumption

Results preview

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- Quadratic loss function minimization (business cycle stabilization): no sizeable nor systematic gain from response to house prices
- Social welfare loss minimization: a systematic response to house prices improves social welfare
- Welfare gain is small: no sizeable difference if central bank does not react to house prices
- However, systematic response is optimal if central bank is uncertain about actual degree of financial frictions: not responding generates large welfare losses

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$$E_0 \sum_{t=0}^{\infty} (\beta)^t \left\{ \frac{1}{1-\sigma_X} (X_t)^{1-\sigma_X} - \frac{\overline{L}_C}{1+\sigma_{L_C}} (N_{C,t})^{1+\sigma_{L_C}} - \frac{\overline{L}_D}{1+\sigma_{L_D}} (N_{D,t})^{1+\sigma_{L_D}} \right\}$$

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- Consumption index:

$$X_t \equiv \left[\left(1 - \varepsilon_t^D \omega_D\right)^{\frac{1}{\eta_D}} (C_t - hC_{t-1})^{\frac{\eta_D - 1}{\eta}} + \varepsilon_t^D \omega_D^{\frac{1}{\eta_D}} (D_t)^{\frac{\eta_D - 1}{\eta_D}} \right]^{\frac{\eta_D}{\eta_D - 1}}$$

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- ε_t^D: housing preference shock, following AR(1) process

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- Financial frictions: a fraction ω of households face collateral constraint:

$$b_t^b = \varepsilon_t^{LTV}(1-\chi)E_t\left\{T_{D,t+1}D_t^b\frac{\pi_{t+1}}{R_t}\right\}$$

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- Financial accelerator: fluctuations in collateral price $\implies \uparrow$ volatility of real variables
- Asymmetric transmission of monetary policy due to (i) agents' heterogeneity and (ii) nominal debt contracts: $\uparrow$ in real interest rate (debt repayment) detrimental to borrowers but beneficial to savers

Analysis

- Study optimal monetary policy in the class of *simple* and *operational* interest-rate rules (Schmitt-Grohe and Uribe 2007):

$$\frac{R_t}{\overline{R}} = \left(\frac{\pi_t}{\overline{\pi}}\right)^{(1-\rho)\phi_\pi} \left(\frac{Y_t}{Y_{t-1}}\right)^{(1-\rho)\phi_{\Delta y}} \left(\frac{\pi_{D,t}}{\overline{\pi_D}}\right)^{(1-\rho)\phi_{\pi_D}} \left(\frac{R_{t-1}}{\overline{R}}\right)^{\rho}$$

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- Shocks: housing demand, LTV ratio, productivity

Calibration

Parameter	Description	Value
Preferences		
β^B	Discount factor (patient)	0.99
β^S	Discount factor (impatient)	0.96
σ_X	Intertemporal elasticity of substitution	1.00
σ_{L_C}	Labor supply elasticity (non-housing)	2.00
σ_{L_D}	Labor supply elasticity (housing)	2.00
ω	Share of impatient agents	0.20
Final consumption		
h_s	Habit persistence (patient)	0.82
h_b	Habit persistence (impatient)	0.28
ω_D	Share of housing services in consumption	0.10
η_D	Nondurable consumption–housing substitution	1.00
δ	Housing depreciation rate	0.01
χ	Downpayment ratio	0.20
Investment		
δ_K	Capital depreciation rate	0.03
ϕ	Investment adjustment cost (non-residential)	0.10
ψ	Capital utilization adjustment cost (non-residential)	3
ϕ_D	Investment adjustment cost (residential)	0.005
ψ_D	Capital utilization adjustment cost (residential)	10
Firms		
α_C	Share of capital (non-residential)	0.30
α_D	Share of capital (residential)	0.30
$\alpha_{\mathcal{L}}$	Share of land (residential)	0.15
μ_C	Intermediate non-residential goods substitution	4.33
μ_D	Intermediate residential goods substitution	4.33
μ_w	Labor varieties substitution (residential)	4.33
μ_w	Labor varieties substitution (non-residential)	4.33
Nominal rigidities		
θ_C	Calvo non-residential (goods)	0.92
γ_C	Indexation non-residential (goods)	0.50
θ_D	Calvo residential (goods)	0.00
γ_D	Indexation residential (goods)	0.00
θ_{w_C}	Calvo non-residential (labor)	0.92
γ_{w_C}	Indexation non-residential (labor)	0.23
θ_{w_D}	Calvo residential (labor)	0.93
γ_{w_D}	Indexation residential (labor)	0.44

Calibration

Parameter	Description	Value
Monetary policy rule		
Interest-rate persistence	ρ	0.85
Response to inflation	ϕ_{π}	1.25
Response to GDP growth	$\phi_{\Delta y}$	0.015
Exogenous shocks: persistence		
Technology (non-residential)	ρ^{A}	0.90
Technology (residential)	ρ^{A_D}	0.90
Housing demand	ρ^{D}	0.95
Financial (loan-to-value)	ρ^{LTV}	0.95
Exogenous shocks: standard deviation		
Technology (non-residential)	σ^{A}	1.50
Technology (residential)	σ^{A_D}	1.10
Housing demand	σ^{D}	2.85
Financial (loan-to-value)	σ^{LTV}	0.01

Calibration

- Steady state ratios:

Variable	Description	Value
R	Nominal interest rate (annualized)	4.00
C/Y	Consumption-to-output ratio	0.58
$T_D Z_D/Y$	Residential investment-to-output ratio	0.03
I/Y	Investment-to-output ratio	0.21
$B/(4Y)$	Private debt-to-annual-output ratio	0.50
$P_H G/Y$	Public expenditure-to-output ratio	0.18

- Second moments:

	Model	Data
GDP	2.54	2.21
Consumption	2.35	2.20
Investment	6.23	6.18
Residential investment	6.51	5.70
Household debt	8.07	5.84
Nominal interest rate	0.32	0.39
CPI inflation	0.32	0.46
House price inflation	0.99	1.03

Business cycle stabilization

- Does a systematic response to house prices help achieve business cycle stabilization?
- Quadratic loss function:

$$\mathcal{L}^{\mathcal{A}} = \sigma_{\pi}^2 + \lambda\sigma_{\Delta y}^2 + \mu\sigma_{\Delta r}^2$$

- Result: optimal response to house prices is virtually zero. Reacting is irrelevant Figure
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- What if central bank has a preference over stabilizing house prices? Augmented loss
- Systematic (non-zero) response may be optimal, but results heavily depend on central bank's preferences
- Overall best performance: inflation targeting and no response to house prices Figure

Welfare maximization

- Central bank's objective: social welfare loss function
- Computed as second order approximation to households' utility

$$\mathcal{W}_t^{social} \equiv \omega \mathcal{W}_t^b + (1-\omega)\mathcal{W}_t^s$$ Definitions

- Largely used in the literature since Rotemberg and Woodford (1997) to rank performance of alternative monetary policy rules
- Allows to account for heterogeneous consumption choices and capture sectoral dynamics, relative price movements

Welfare maximization

- A systematic response to house prices improves social welfare:

	$\mathcal{W}^{tot}$	ϕ_π	$\phi_{\Delta y}$	ρ	ϕ_{π_D}
Response to house prices	0.086	2.36	1.84	0.08	-0.12
No response to house prices	0.091	1.64	0.87	0.00	0.00

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- Conclusion: no substantial welfare improvement from responding to house prices
- However, financial frictions play a key role. Central bank information is also crucial Sensitivity

The role of financial frictions

- Financial frictions measured by share of borrowers (ω) and average loan-to-value ratio (LTV)
- Suppose the actual measures are:
  - $\omega = 30\%$ (instead of 20%)
  - $LTV = 90\%$ (instead of 80%)
- Economy is expected to display larger fluctuations in prices and quantities in response to shocks
- Result: slightly positive response to house prices is optimal

	ω	LTV	$\mathcal{W}^{tot}$	ϕ_π	$\phi_{\Delta y}$	ρ	ϕ_{π_D}
Response to house prices	0.3	0.9	0.1038	1.69	1.04	0.00	0.03
No response to house prices	0.2	0.8	0.1041	2.00	1.51	0.08	0.00

- Compute implicit weight assigned to housing in optimal price index that CB targets: $\pi_t^O = \pi_{D,t}^{\alpha}\pi_t^{1-\alpha}$: $\alpha = 0.02$
- Smaller than share in consumption (0.1), closer to weight in GDP

The role of financial frictions: fault-tolerance analysis

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- Thought experiment: *what if CB does not know exactly the degree of financial frictions in the economy?*
- Suppose CB enacts rule that is optimal for benchmark economy ($\omega = 0.2, LTV = 0.8$), but *true* degree of financial frictions is instead $\omega = 0.3, LTV = 0.9$: any additional welfare cost?

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- Rationale: inefficiencies associated to house price volatility outweigh those related to consumer price inflation. Contrasting house price movements reduces volatility in consumption induced by financial accelerator

Conclusions

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- Next: role of financial intermediation, model uncertainty

Thanks

Sensitivity analysis

- **House price stickiness**: response to house prices *increasing* in sectoral price stickiness; positive for $\theta_D > 0.3$
  - Presence of financial frictions does not alter traditional policy prescriptions (Aoki 2001, Benigno 2004)
- **Wage stickiness**: $\uparrow$ wage flexibility $\implies$ $\uparrow$ stronger response to CPI inflation and $\downarrow$ relevance of FF-distortions $\implies$ optimal response to house prices $\to 0$
- **Financial frictions**:
  - Varying share of borrowers: without borrowers, no incentive to accommodate $\uparrow$ in house prices $\implies$ response to h.p. positive and large
  - Varying LTV ratio: response to house prices $\uparrow$ with LTV (more leveraged economy)
- **Persistence of housing demand shocks**: no role

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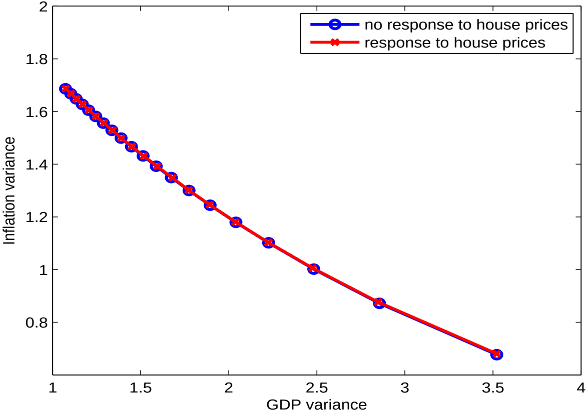
Optimal policy frontiers



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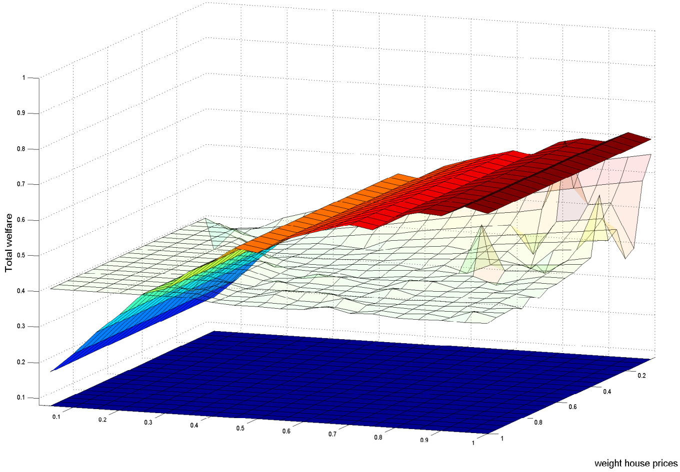
Welfare cost under alternative policy objectives



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Business cycle stabilization (2)

- Augmented loss function:

$$\mathcal{L}^{\mathcal{A}} = \sigma_{\pi}^2 + \lambda\sigma_y^2 + \nu\sigma_{\pi_D}^2 + \mu\sigma_{\Delta r}^2$$

- with $\lambda \in [0, 1]$, $\nu \in [0.001, 1]$, $\mu = 0.001$
- Note: cannot compare minimum values of $\mathcal{L}^{\mathcal{A}}$ and $\mathcal{L}^{\mathcal{S}}$, since arguments are different
- Compute second-order approximation of individual (and aggregate) utility functions under the two optimal rules and compare

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Welfare loss calculations

- Consumption equivalent: fraction of consumption from given policy regime (ψ) to be given to each agent to achieve steady-state welfare level. Solve:

$$\overline{\mathcal{W}^b} = E_0 \sum_{t=0}^{\infty} \left(\beta^b\right)^t \left\{ \frac{1}{1-\sigma_X} \left(X_t^{b,a}(1+\psi^b)\right)^{1-\sigma_X} - \Delta^w_{C,b,t} \frac{\overline{L}_{C,b}}{1+\sigma_{L_{C,b}}} \left(N_{C,t}^{b,a}\right)^{1+\sigma_{L_{C,b}}} - \Delta^w_{D,s,t} \frac{\overline{L}_{D,b}}{1+\sigma_{L_{D,b}}} \left(N_{D,t}^{b,a}\right)^{1+\sigma_{L_{D,b}}} \right\}$$

$$\overline{\mathcal{W}^s} = E_0 \sum_{t=0}^{\infty} (\beta^s)^t \left\{ \frac{1}{1-\sigma_X} (X_t^{s,a}(1+\psi^s)))^{1-\sigma_X} - \Delta^w_{C,b,t} \frac{\overline{L}_{C,s}}{1+\sigma_{L_{C,s}}} \left(N_{C,t}^{s,a}\right)^{1+\sigma_{L_{C,s}}} - \Delta^w_{D,b,t} \frac{\overline{L}_{D,s}}{1+\sigma_{L_{D,s}}} \left(N_{D,t}^{s,a}\right)^{1+\sigma_{L_{D,s}}} \right\}$$

- Aggregate welfare cost: $\psi \equiv \omega\psi^b + (1-\omega)\psi^s$

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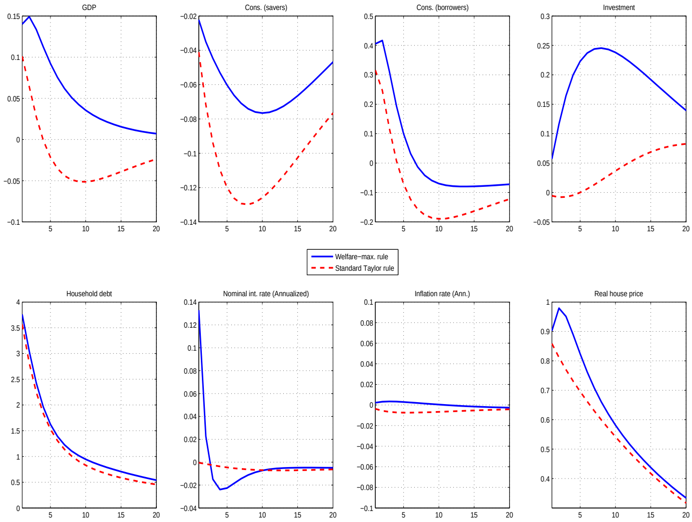
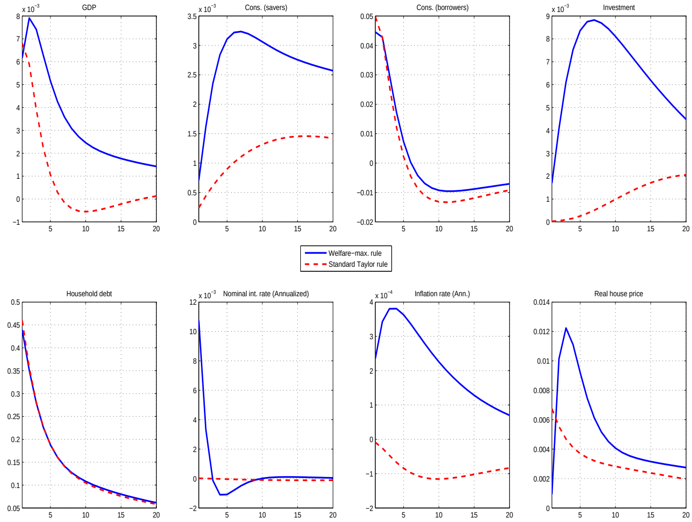
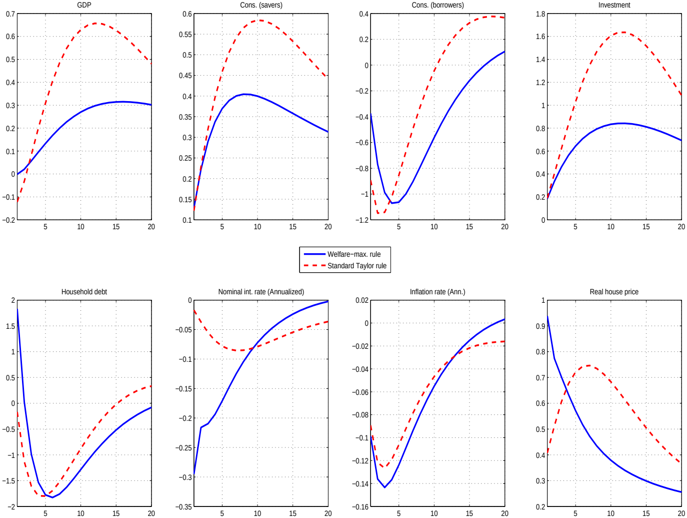
Housing demand shock



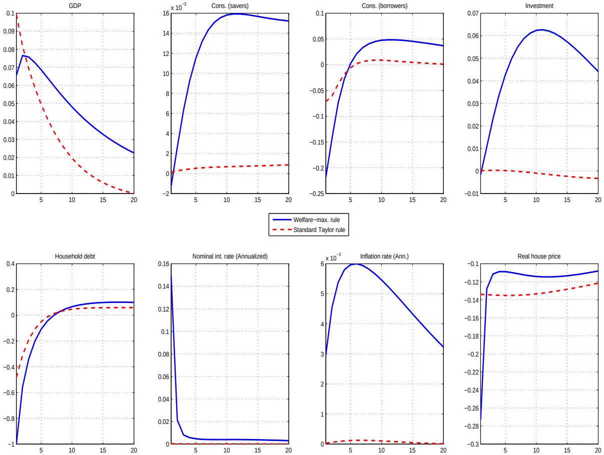
LTV ratio shock



Productivity shock (non-housing)



Productivity shock (housing)



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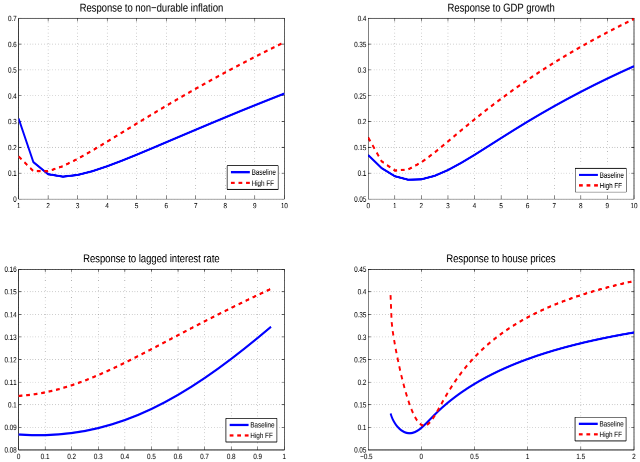
Fault-tolerance analysis



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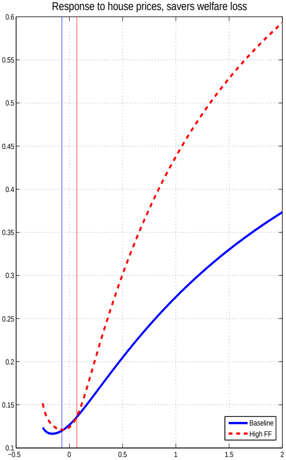
Fault-tolerance analysis



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