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

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Should monetary policy systematically respond to house price fluctuations?
Overview

- Should monetary policy systematically respond to house price fluctuations?
- How does the traditional monetary policy prescription (i.e. inflation targeting) modify in the presence of financial frictions?
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- Main result: financial frictions modify optimal policy rule, in particular the response to house prices
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- Housing and collateralized borrowing: should the price of collateral be part of monetary policy objectives/targets?
- 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
Motivation

- Monetary policy and asset prices: where do we stand?
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Consolidated (pre-crisis) view: asset price variations should influence monetary policy only *insofar as they help forecasting inflation* (Bernanke and Gertler 2001)
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- Role of housing-related shocks and borrowing constraints in general equilibrium models for policy analysis (Iacoviello 2005, Iacoviello and Neri 2010)
- 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?
Related literature

- Iacoviello (2005): standard loss function minimization, no role for house price targeting
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- Mendicino and Pescatori (2008), Rubio (2011): welfare-optimal rules, pure inflation targeting no longer optimal, redistributive issues
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- Source of shocks matters: news (Lambertini et al. 2013)
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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

- Quadratic loss function minimization (business cycle stabilization): no sizeable nor systematic gain from response to house prices
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- Welfare gain is small: no sizeable difference if central bank does not react to house prices
Results preview

- 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
Model

- Closed-economy DSGE model, calibrated on euro-area data
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- Two-sector (housing, non-housing), two-agent (patient, impatient) setup (Iacoviello and Neri 2010)
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- Households’ utility:

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

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

- \( \epsilon_t^{D} \): housing preference shock, following AR(1) process
Model

- Financial frictions: a fraction $\omega$ 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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- Amplification effect: $\uparrow T_{D,t} \implies \uparrow$ collateral value $\implies \uparrow b_t^b \implies \uparrow C_t, D_t \implies \uparrow T_{D,t+1}, \ldots$
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- 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
Study optimal monetary policy in the class of *simple* and *operational* interest-rate rules (Schmitt-Grohe and Uribe 2007):

\[
\frac{R_t}{\bar{R}} = \left( \frac{\pi_t}{\bar{\pi}} \right)^{(1-\rho)\phi_\pi} \left( \frac{Y_t}{Y_{t-1}} \right)^{(1-\rho)\phi_\Delta y} \left( \frac{\pi_{D,t}}{\bar{\pi}_D} \right)^{(1-\rho)\phi_{\pi D}} \left( \frac{R_{t-1}}{\bar{R}} \right)^{\rho}
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Choose \( \phi_\pi, \phi_{\Delta y}, \phi_{\pi D} \) and \( \rho \) to maximize some objective function.
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- Shocks: housing demand, LTV ratio, productivity
### Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferences</strong></td>
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<tr>
<td>$\beta^B$</td>
<td>Discount factor (patient)</td>
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<td>$\beta^S$</td>
<td>Discount factor (impatient)</td>
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<td>$\sigma_X$</td>
<td>Intertemporal elasticity of substitution</td>
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<td>Labor supply elasticity (non-housing)</td>
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<td>$\sigma_{LD}$</td>
<td>Labor supply elasticity (housing)</td>
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<tr>
<td>$\omega$</td>
<td>Share of impatient agents</td>
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<td><strong>Final consumption</strong></td>
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<td>$h_s$</td>
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<td>$h_b$</td>
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<td>$\omega_D$</td>
<td>Share of housing services in consumption</td>
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<td>$\eta_D$</td>
<td>Nondurable consumption–housing substitution</td>
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<tr>
<td>$\delta$</td>
<td>Housing depreciation rate</td>
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<td>$\chi$</td>
<td>Downpayment ratio</td>
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<tr>
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<td>$\psi$</td>
<td>Capital utilization adjustment cost (non-residential)</td>
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<tr>
<td>$\phi_D$</td>
<td>Investment adjustment cost (residential)</td>
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<tr>
<td>$\psi_D$</td>
<td>Capital utilization adjustment cost (residential)</td>
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<tr>
<td><strong>Firms</strong></td>
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<tr>
<td>$\alpha_C$</td>
<td>Share of capital (non-residential)</td>
<td>0.30</td>
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<tr>
<td>$\alpha_D$</td>
<td>Share of capital (residential)</td>
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<td>Share of land (residential)</td>
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<td>$\mu_C$</td>
<td>Intermediate non-residential goods substitution</td>
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<tr>
<td>$\mu_D$</td>
<td>Intermediate residential goods substitution</td>
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<tr>
<td>$\mu_w$</td>
<td>Labor varieties substitution (residential)</td>
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<td>$\mu_{wc}$</td>
<td>Labor varieties substitution (non-residential)</td>
<td>4.33</td>
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<td><strong>Nominal rigidities</strong></td>
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<td>$\theta_C$</td>
<td>Calvo non-residential (goods)</td>
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<tr>
<td>$\gamma_C$</td>
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<tr>
<td>$\theta_D$</td>
<td>Calvo residential (goods)</td>
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<tr>
<td>$\gamma_D$</td>
<td>Indexation residential (goods)</td>
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<tr>
<td>$\theta_{wc}$</td>
<td>Calvo non-residential (labor)</td>
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<td>$\gamma_{wc}$</td>
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<td>0.23</td>
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<tr>
<td>$\theta_{wd}$</td>
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<td>$\gamma_{wd}$</td>
<td>Indexation residential (labor)</td>
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<tr>
<td>Interest-rate persistence</td>
<td>$\rho$</td>
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<tr>
<td>Response to inflation</td>
<td>$\phi_\pi$</td>
<td>1.25</td>
</tr>
<tr>
<td>Response to GDP growth</td>
<td>$\phi_\Delta y$</td>
<td>0.015</td>
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<tr>
<td><strong>Exogenous shocks: persistence</strong></td>
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<tr>
<td>Technology (non-residential)</td>
<td>$\rho^A$</td>
<td>0.90</td>
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<td>Technology (residential)</td>
<td>$\rho^{AD}$</td>
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<tr>
<td>Housing demand</td>
<td>$\rho^D$</td>
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<tr>
<td>Financial (loan-to-value)</td>
<td>$\rho^{LTV}$</td>
<td>0.95</td>
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<td><strong>Exogenous shocks: standard deviation</strong></td>
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- **Steady state ratios:**

<table>
<thead>
<tr>
<th>Variable</th>
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</tr>
</thead>
<tbody>
<tr>
<td>$R$</td>
<td>Nominal interest rate (annualized)</td>
<td>4.00</td>
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<tr>
<td>$C/Y$</td>
<td>Consumption-to-output ratio</td>
<td>0.58</td>
</tr>
<tr>
<td>$T_DZ_D/Y$</td>
<td>Residential investment-to-output ratio</td>
<td>0.03</td>
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<tr>
<td>$I/Y$</td>
<td>Investment-to-output ratio</td>
<td>0.21</td>
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<tr>
<td>$B/(4Y)$</td>
<td>Private debt-to-annual-output ratio</td>
<td>0.50</td>
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<tr>
<td>$P_HG/Y$</td>
<td>Public expenditure-to-output ratio</td>
<td>0.18</td>
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</tbody>
</table>

- **Second moments:**

<table>
<thead>
<tr>
<th>Model/Variable</th>
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<th>Data</th>
</tr>
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<tbody>
<tr>
<td>GDP</td>
<td>2.54</td>
<td>2.21</td>
</tr>
<tr>
<td>Consumption</td>
<td>2.35</td>
<td>2.20</td>
</tr>
<tr>
<td>Investment</td>
<td>6.23</td>
<td>6.18</td>
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<tr>
<td>Residential investment</td>
<td>6.51</td>
<td>5.70</td>
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<tr>
<td>Household debt</td>
<td>8.07</td>
<td>5.84</td>
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<tr>
<td>Nominal interest rate</td>
<td>0.32</td>
<td>0.39</td>
</tr>
<tr>
<td>CPI inflation</td>
<td>0.32</td>
<td>0.46</td>
</tr>
<tr>
<td>House price inflation</td>
<td>0.99</td>
<td>1.03</td>
</tr>
</tbody>
</table>
Business cycle stabilization

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

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

- Result: optimal response to house prices is virtually zero. Reacting is irrelevant.
- What if central bank has a preference over stabilizing house prices?
Business cycle stabilization

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

\[ L^A = \sigma_\pi^2 + \lambda \sigma_{\Delta y}^2 + \mu \sigma_{\Delta r}^2 + \nu \sigma_{\pi D}^2 \]

- Result: optimal response to house prices is virtually zero. Reacting is irrelevant
- What if central bank has a preference over stabilizing house prices?
  - 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
Welfare maximization

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

\[ \mathcal{W}_{t}^{social} \equiv \omega \mathcal{W}_{t}^{b} + (1 - \omega) \mathcal{W}_{t}^{s} \]

- 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
A systematic response to house prices improves social welfare:

<table>
<thead>
<tr>
<th></th>
<th>$W^{tot}$</th>
<th>$\phi_\pi$</th>
<th>$\phi_{\Delta y}$</th>
<th>$\rho$</th>
<th>$\phi_{\pi_D}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response to house prices</td>
<td>0.086</td>
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- However, financial frictions play a key role. Central bank information is also crucial
The role of financial frictions

- Financial frictions measured by share of borrowers ($\omega$) 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

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<td>Response to house prices</td>
<td>0.3</td>
<td>0.9</td>
<td>0.1038</td>
<td>1.69</td>
<td>1.04</td>
<td>0.00</td>
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<td>No response to house prices</td>
<td>0.2</td>
<td>0.8</td>
<td>0.1041</td>
<td>2.00</td>
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- Compute implicit weight assigned to housing in optimal price index that CB targets: $\pi_t^O = \pi_{\alpha;D,t}^{1-\alpha} \pi_t^1$: $\alpha = 0.02$
- Smaller than share in consumption (0.1), closer to weight in GDP
The role of financial frictions: fault-tolerance analysis

- Fault tolerance (Levin and Williams 2003): evaluate increase in welfare loss as one single parameter of optimized interest-rate rule varies, holding others at optimal values.
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- Thought experiment: what if CB does not know exactly the degree of financial frictions in the economy?
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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?
The role of financial frictions: fault-tolerance analysis

- Response to CPI inflation, GDP and lagged interest rate: no sizeable additional loss
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- Response to CPI inflation, GDP and lagged interest rate: no sizeable additional loss
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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

- Welfare maximization: a systematic response to house prices improves social welfare, but gain is small
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Conclusions

- Welfare maximization: a systematic response to house prices improves social welfare, but gain is small
- Systematic response to house prices is optimal if central bank is uncertain about actual degree of financial frictions: not responding generates large welfare losses
- 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
Optimal policy frontiers

![Graph showing optimal policy frontiers with two lines representing "no response to house prices" and "response to house prices".](image)
Welfare cost under alternative policy objectives
Augmented loss function:

$$\mathcal{L}^A = \sigma^2 + \lambda \sigma^2 + \nu \sigma^2_D + \mu \sigma^2_r$$

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

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

$$\bar{W}^b = E_0 \sum_{t=0}^{\infty} (\beta^b)^t \left\{ \frac{1}{1-\sigma_X} \left( X_t,^b (1 + \psi^b) \right)^{1-\sigma_X} - \Delta^w_{C,b,t} \frac{T_{C,b}}{1 + \sigma_{L_C,b}} \left( N_{b,c}^{b,a} \right)^{1+\sigma_{L_C,b}} - \Delta^w_{D,s,t} \frac{T_{D,b}}{1 + \sigma_{L_D,b}} \left( N_{d,c}^{b,a} \right)^{1+\sigma_{L_D,b}} \right\}$$

$$\bar{W}^s = E_0 \sum_{t=0}^{\infty} (\beta^s)^t \left\{ \frac{1}{1-\sigma_X} \left( X_t,^s (1 + \psi^s) \right)^{1-\sigma_X} - \Delta^w_{C,s,t} \frac{T_{C,s}}{1 + \sigma_{L_C,s}} \left( N_{s,c}^{s,a} \right)^{1+\sigma_{L_C,s}} - \Delta^w_{D,s,t} \frac{T_{D,s}}{1 + \sigma_{L_D,s}} \left( N_{d,c}^{s,a} \right)^{1+\sigma_{L_D,s}} \right\}$$

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

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**GDP**

- **Cons. (savers)**
- **Cons. (borrowers)**
- **Investment**

---

**Household debt**

- **Nominal int. rate (Annualized)**
- **Inflation rate (Ann.)**
- **Real house price**

---

*Welfare-max. rule*

*Standard Taylor rule*
LTV ratio shock
Productivity shock (non-housing)
Productivity shock (housing)
Fault-tolerance analysis

Response to non-durable inflation

Response to GDP growth

Response to lagged interest rate

Response to house prices
Fault-tolerance analysis

Response to house prices, savers welfare loss

Baseline
High FF

Response to house prices, borrowers welfare loss

Baseline
High FF