Bank Balance Sheets and Boom-Bust Cycles[1]

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[1] The views expressed here are ours, and do not reflect those of the BIS.

The Goal of the Paper

- Understand the role of financial intermediaries during the boom-bust episode
- Provide a rich framework with explicit treatment of bank balance sheets, housing and realistic mortgage markets,
- Analyze the feedback mechanism between household and bank balance sheets in response to unexpected shocks.
- Use the framework to compare effectiveness of government policies during financial crisis (to be done).

MORTGAGES ARE SIGNIFICANT

- Mortgage debt is
  - The largest item in the household balance sheet as a liability (65%)
  - The largest item in the bank balance sheet as an asset (35%)
  - The largest component of the total loans outstanding (60%)
- Between 1990 and 2007, total mortgage debt outstanding as a fraction of disposable income increased from 60% to 100%
- By 2015, this ratio decreased to 70%

LITERATURE

- Our paper combines three frameworks:

1. Mortgage contracts
   - Hatchondo et al (2014), Chatterjee and Eyigungor (2015), Guler (2015), Arslan, Guler and Taskin (2015), Kaplan et al (2018), Paixao (2018), Garriga (2018)
2. Bank balance sheet effects
   - Mendoza and Quadrini (2009), Gertler and Karadi (2011), Gertler, Kiyotaki and Queralto (2011), Gertler and Kiyotaki (2015), Paixao (2018)
3. The role of financial conditions/liberalization
   - Favilukis et al (2013), Justiniano et al (2013), Kiyotaki et al (2013), Landvoigt (2015), Landvoigt et al (2015), Huo and Rios-Rull (2016), Piazzesi and Schneider (2016), Garriga (2018)
   - Glaeser et al (2010), Favara and Imbs (2015), Mian and Sufi (2013), Kermani and Maggio (2017)

Environment: Households-I

- Economy is populated by many households with deterministic time horizon (OLG).
- Utility from consumption and housing

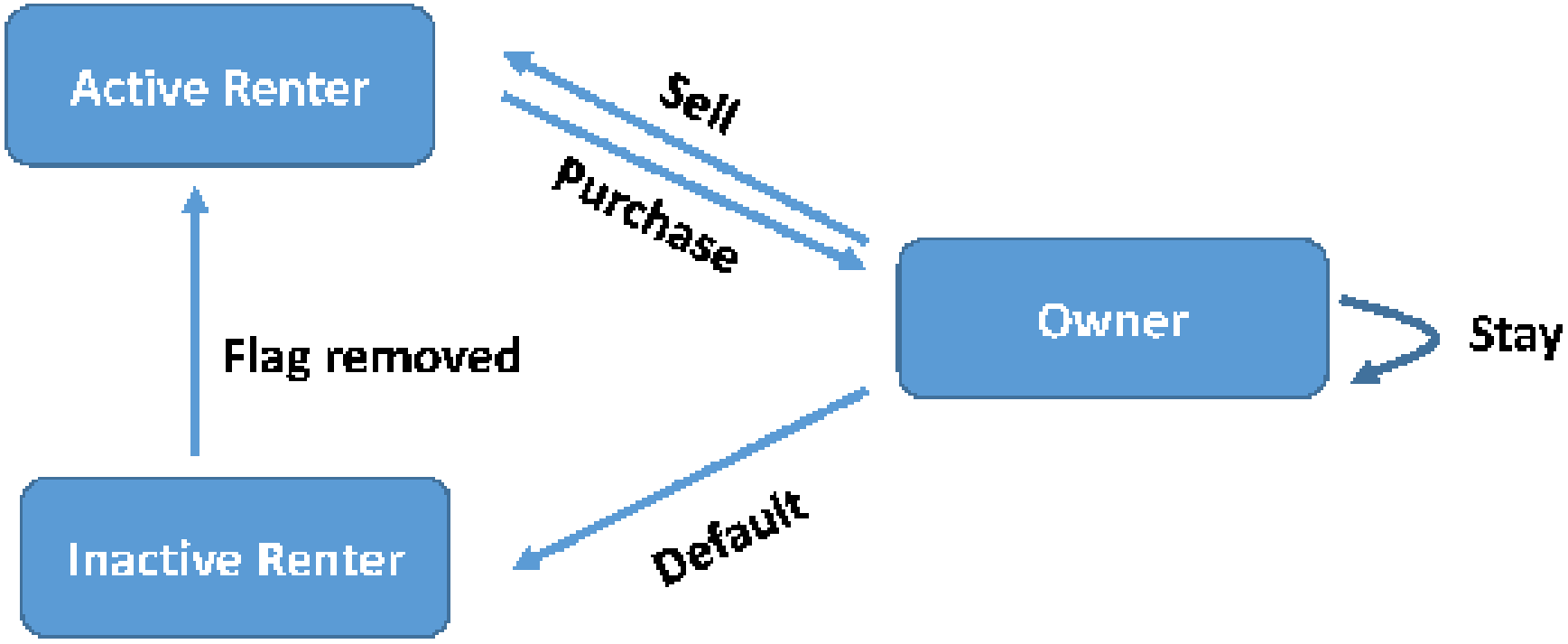
$$E_0[\sum_{j=1}^{J_r} \beta^{j-1} u(c_j, h_j)$$

- Households are subject to idiosyncratic income shocks
- Can either rent or own

Environment: Households-II

- Buying/Selling a house involves transaction costs.
- House purchase can be done through a mortgage
- Mortgage holders can default on the mortgage
- Terms of mortgage contracts are endogenous (down payment and mortgage interest rate)
- Homeowners can resize their house and/or refinance their mortgage
- Only fixed-rate mortgages (FRM)
- No unsecured borrowing

HOUSEHOLD'S DECISIONS



BANKS-I

- Competitive and identical bankers.
- Bankers maximize their life time welfare (Log utility).
- Bankers
  - accept deposits at rate r_t (exogenous) and
  - lend to the firms at r_t^* (endogenous)
  - issue mortgages and purchase existing mortgages.
- Are subject to capital requirement constraint: the amount of assets they can purchase cannot exceed a multiple of their net worth net of consumption
  - exogenous
  - endogenous

BANKS-II

$$\Psi_t(N_t) = \max_{B_{t+1}, L^k_{t+1}, c^B_t, \{\ell_{t+1}(\theta)\}} \left\{ \log\left(c^B_t\right) + \beta_L \Psi_{t+1}(N_{t+1}) \right\}$$

s.t.

$$\begin{aligned}
c^B_t + L^k_{t+1} + \int_\theta p_t(\theta)\,\ell_{t+1}(\theta) &= N_t + B_{t+1} \\
\Psi^D_{t+1}\left(\varphi\left(1 + r^*_{t+1}\right) L_{t+1}\right) &\leq \Psi_{t+1}(N_{t+1}) \\
N_{t+1} &= \int_\theta \int_{\theta'} v^l_{t+1}(\theta')\,\Pi(\theta'|\theta)\,\ell_{t+1}(\theta) \\
&+ L^k_{t+1}\left(1 + r^*_{t+1}\right) - B_{t+1}\left(1 + r_{t+1}\right) \\
v^l_{t+1}(\theta') &= m_{t+1}(\theta') + p_{t+1}(\theta').
\end{aligned}$$

BANKS-III

- Bank's problem implies borrowing cannot be too large compared to assets:

$$(1 + r^*_{t+1})(1 - \phi_{t+1}) L_{t+1} \geq (1 + r_{t+1}) B_{t+1}$$

where leverage follows a recursive rule

$$\phi_t = \varphi^{1-\beta_L} \left(\frac{1 + r_{t+1}}{1 + r^*_{t+1}} - 1 + \phi_{t+1} \right)^{\beta_L}$$

- A decline in bank seizure rate φ, and borrowing rate, r_{t+1} , or an increase in lending rate, r^*_{t+1}, increases bank leverage

PRODUCTION

- Firms rent
  - labor N_t at rate w_t and capital K_t^h from HH's at rate $\widetilde{r}_t$
  - Capital K_t^b from banks at rate r_t^*.
  - Firm's problem:

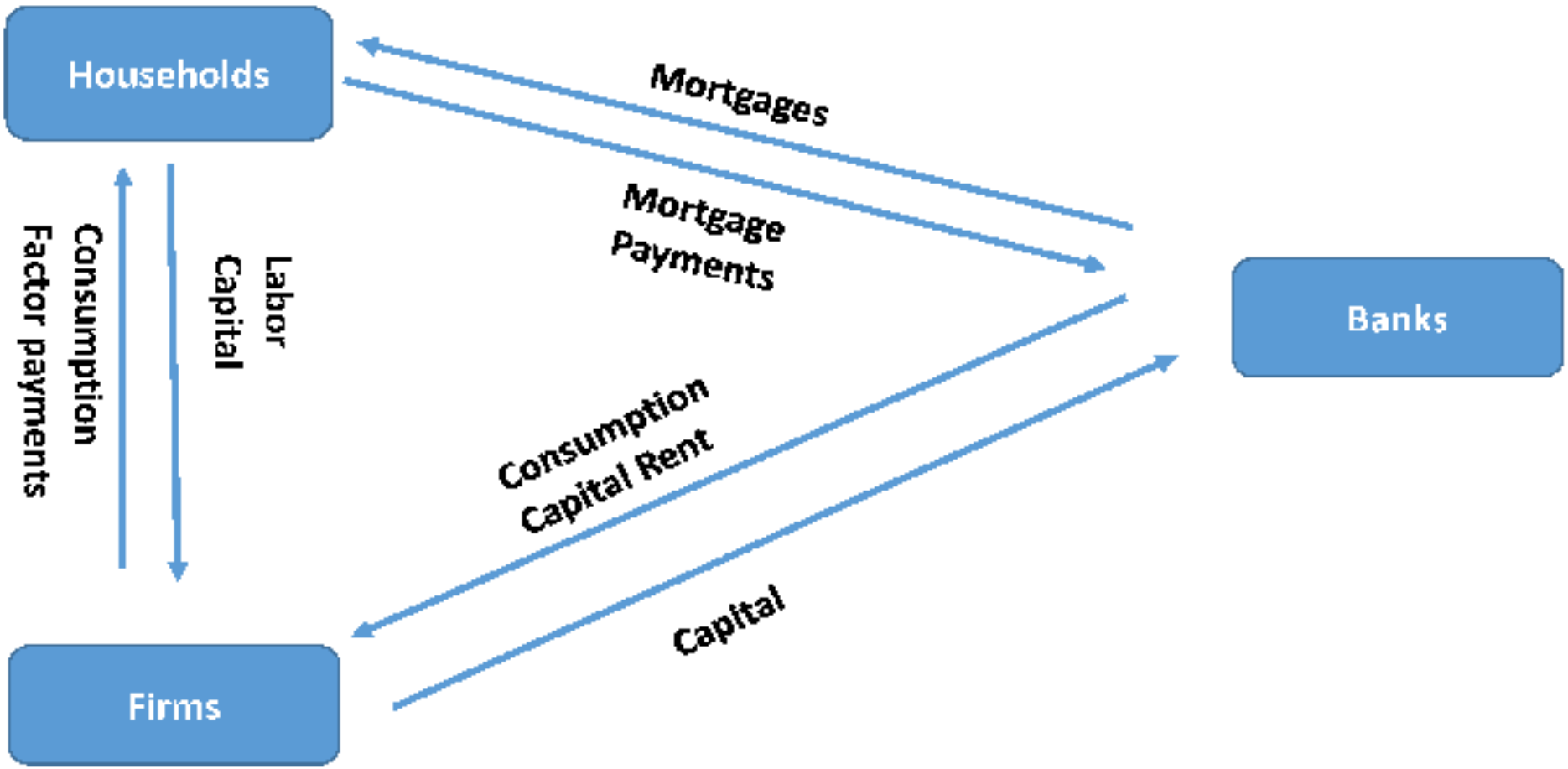
$$\max_{K_t, N_t} A_t \left(K_t^H\right)^{\alpha_H} \left(K_t^B\right)^{\alpha_B} N_t^{1-\alpha_H-\alpha_B} - w_t N_t - (\widetilde{r}+\delta) K_t^H - (r_t^*+\delta) K_t^B$$

Real Estate Companies

- Borrow from households
- Purchase housing stock at the market price p_h
- Rent them at rate p_r
- Rental units depreciate δ_r
- Zero-profit condition implies

$$p_r = p_h - \frac{1-\delta_r}{1+\widetilde{r}} p_h'$$

Aggregate Economy



EQUILIBRIUM

- A competitive equilibrium is a set of allocations, prices (r^*,$\tilde{r}$, p_h,p_r, **w and** q_m)
- Given prices households maximize expected utility
- Given prices firms and banks maximize profits
- Given prices real estate companies make zero-profit
- Markets clear
  - Loan market

$$L_{t+1} = K^B_{t+1} + \int_\theta p_t(\theta)\Gamma_t(\theta)$$

  - Housing market

$$H = \int_\theta s(\theta)d\theta$$

  - Asset market

$$K^h + B_r = A = \int_\theta a(\theta)d\theta$$

CALIBRATION-EXTERNAL

Parameter	Explanation	Value
σ	risk aversion	3
γ	consumption share	0.8
α_h	household capital share	0.25
ρ_ε	persistence of income	0.97
σ_ε	std of innovation to AR(1)	0.2
φ_h	selling cost for a household	7%
φ_i	selling cost for foreclosures	27%
r	risk-free interest rate	2%
ζ	fixed cost of mortgage origination	4%
δ_h	housing maintenance cost	1.5%
τ	variable cost of mortgage origination	0.75%
δ	prob. of being an active renter	0.14

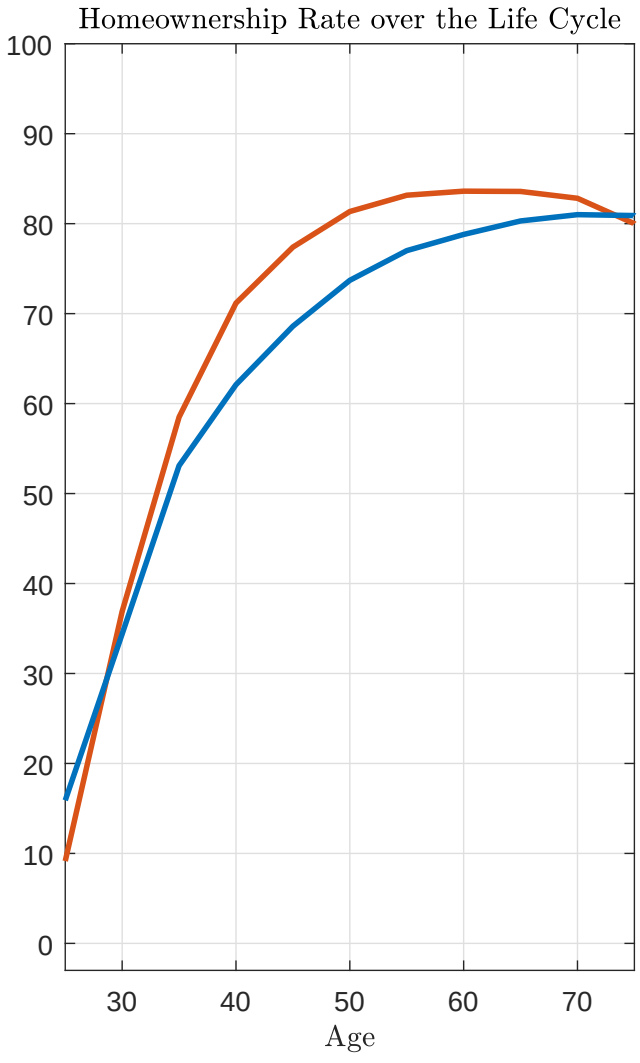
CALIBRATION-INTERNAL

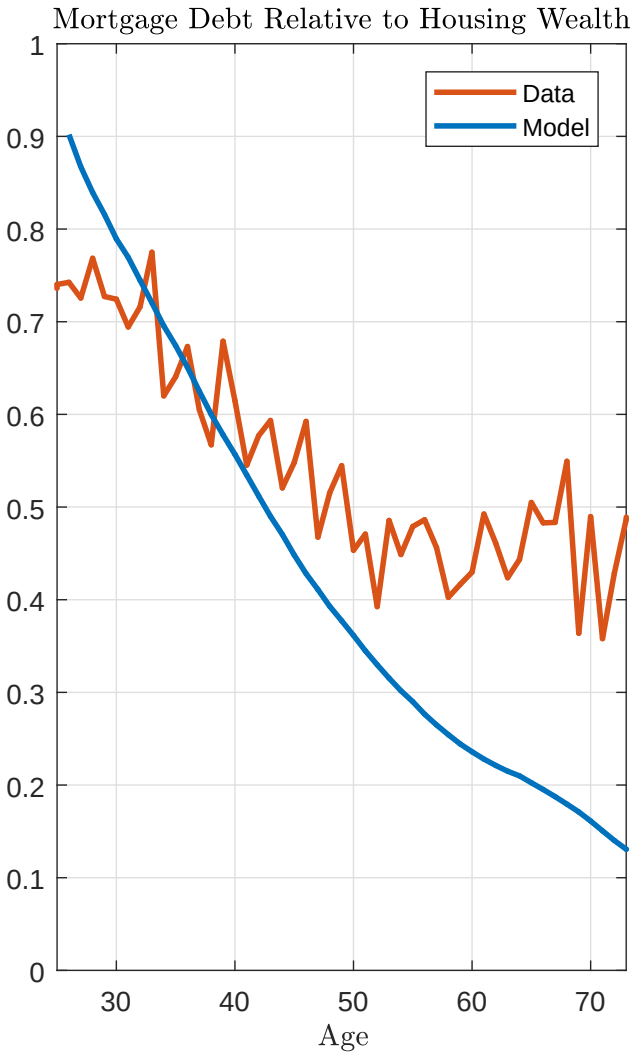
Parameter	Explanation	Value
β	discount factor	0.97
$\underline{h}$	minimum house size	0.80
θ	ownership premium	0.13
δ_r	rental depreciation	0.02
H	housing supply	1.29
α_b	bank capital share	0.07
β_L	bank discount factor	0.82
φ	bank seizure rate	0.23

CALIBRATION-MOMENTS

Statistic	**Data**	**Model**
Capital rental rate	4%	4%
Home-ownership rate-aggregate	66%	66%
Home-ownership rate-less than 40	39%	39%
House price/per-capita output	3.0	3.0
Maintenance cost share for rentals	30%	30%
Ratio of mortgage loans to total loans	0.5	0.5
Risk-free mortgage premium	2%	2%
Bank Leverage Ratio	10	10

Life Cycle Properties

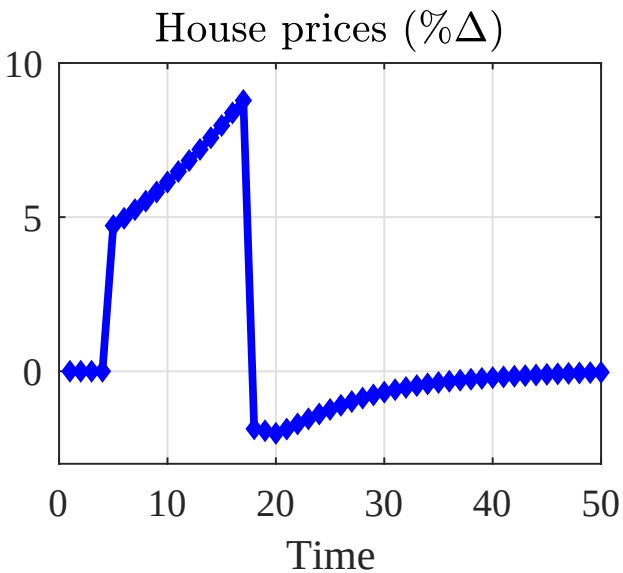


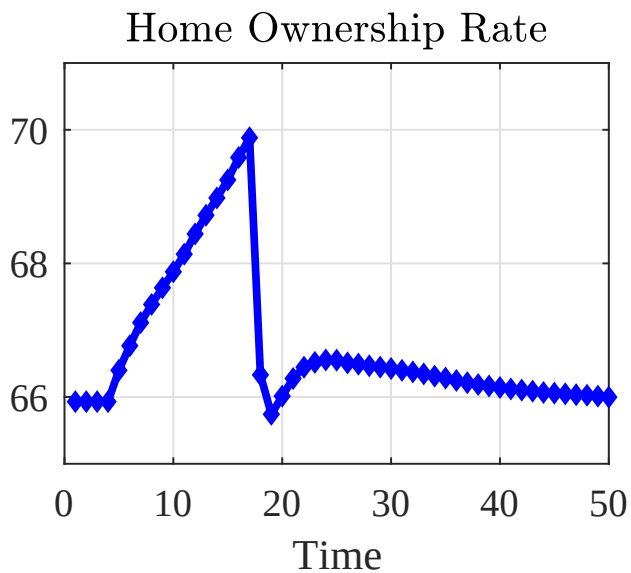


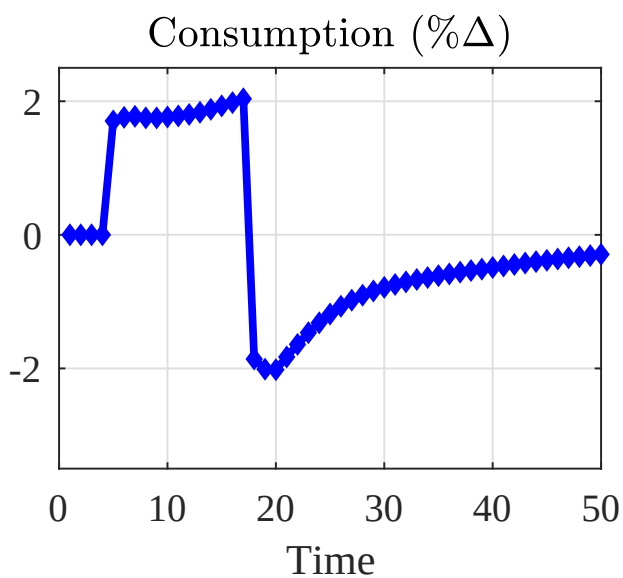
Bank Leverage Shocks

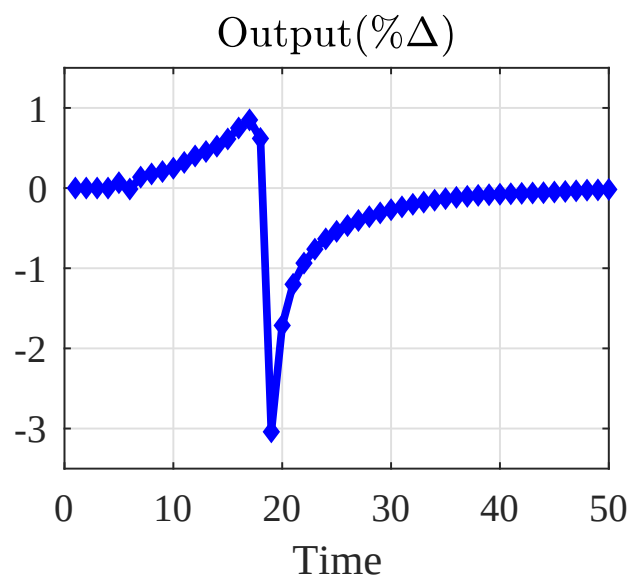
- At period 0 (1995), the economy is hit by an unexpected and permanent shock to the bank seizure rate: leverage is expected to increase from 10 to 40 linearly in 25 years: generates a slow boom
- At period 13 (2008), bank seizure rate unexpectedly and permanently reverts to its initial SS value: generates sudden bust
- Leverage ratio increases from 10 to approximately to 15 in 2007 and then declines back to 10.
- The decline in mortgage premia over treasury interest rates imply similar leverage dynamics.
- Haircuts more than doubled from 2007 to 2009
- Regulation after the crisis?

HOUSE PRICES, HOME OWNERSHIP RATE AND FORECLOSURES

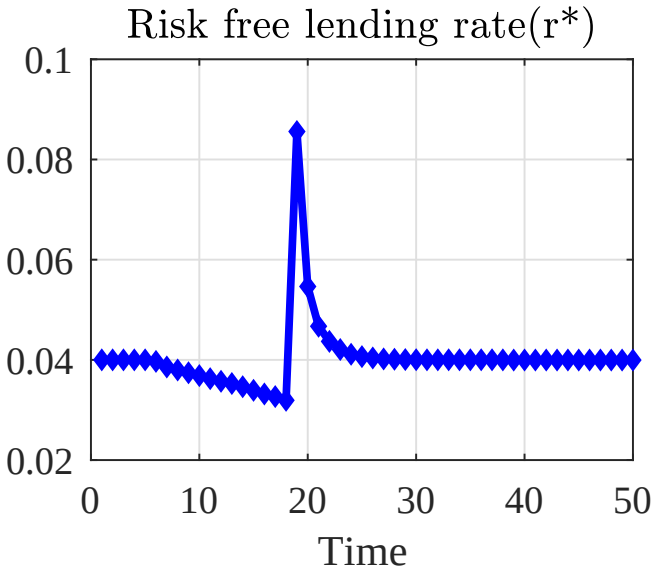


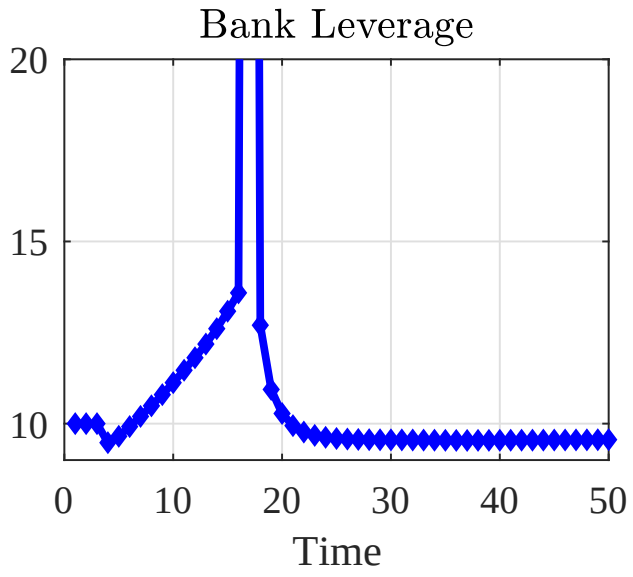


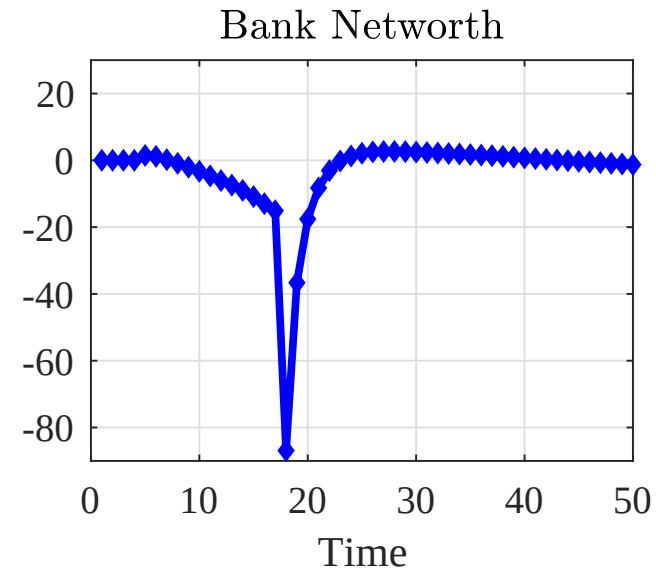


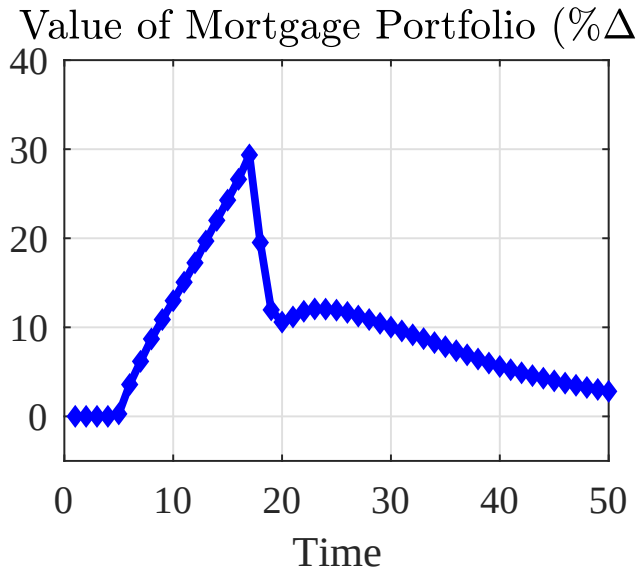


BANK BALANCE SHEETS

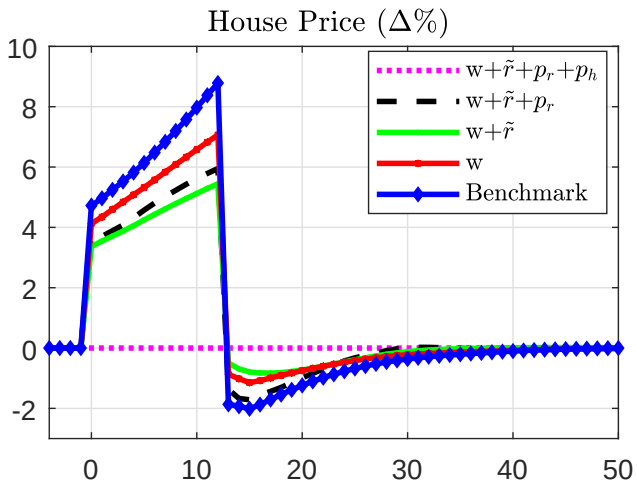


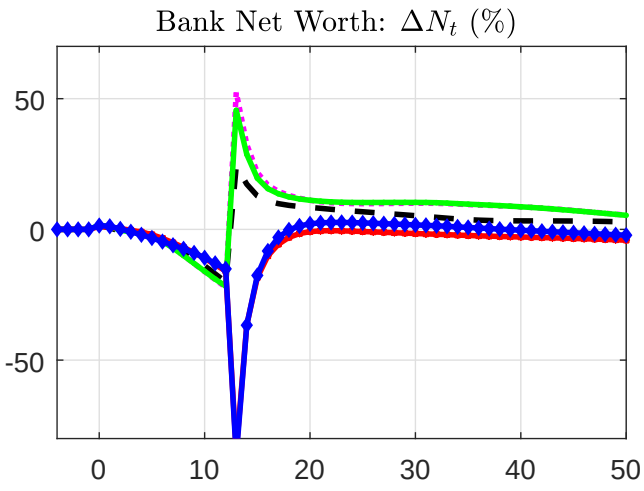


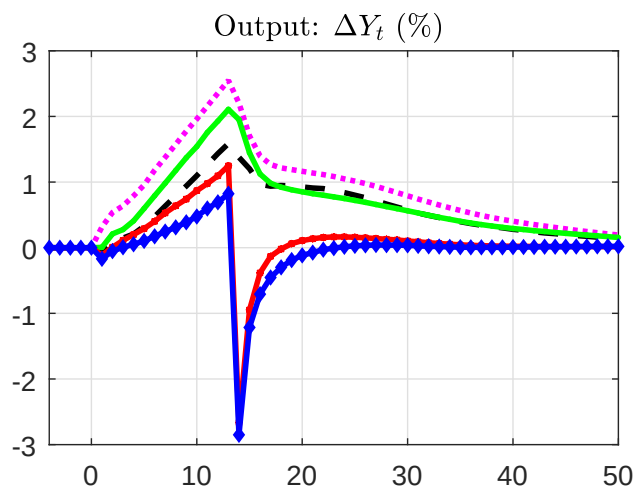


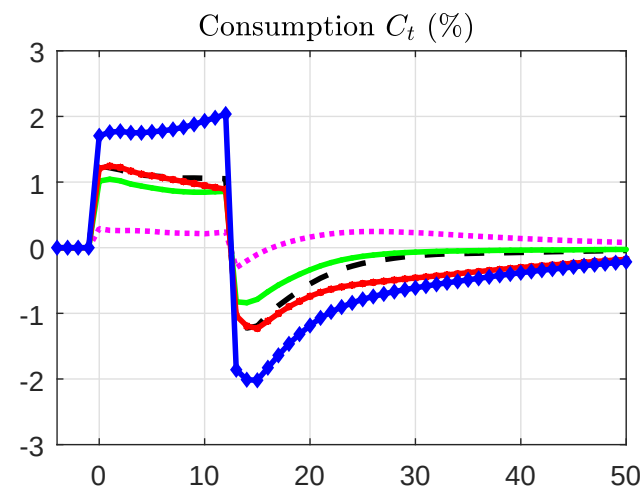


INTEREST RATES

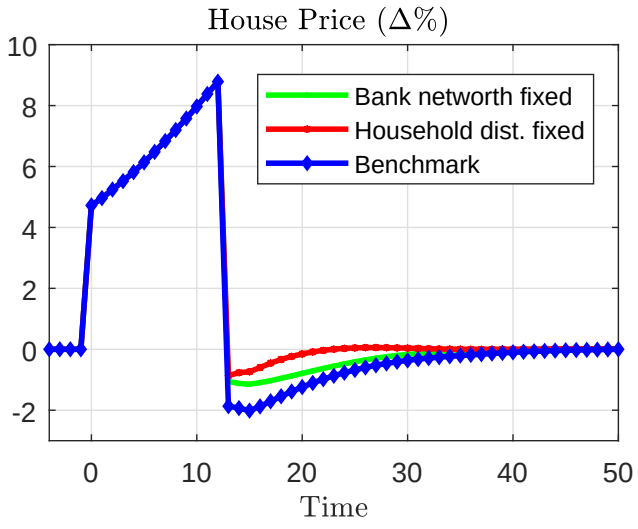


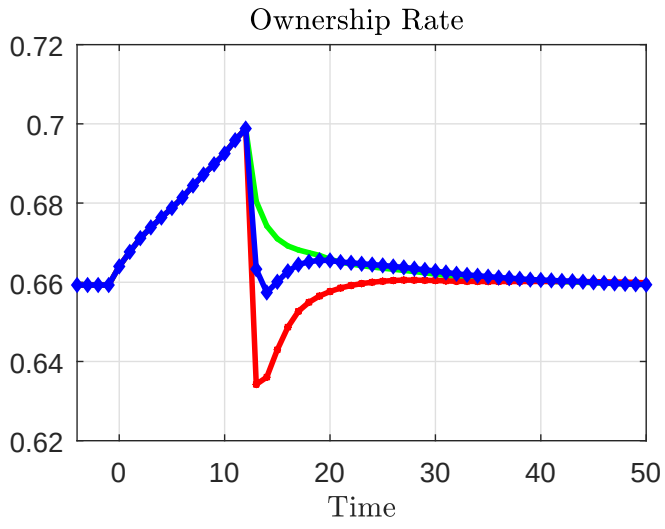


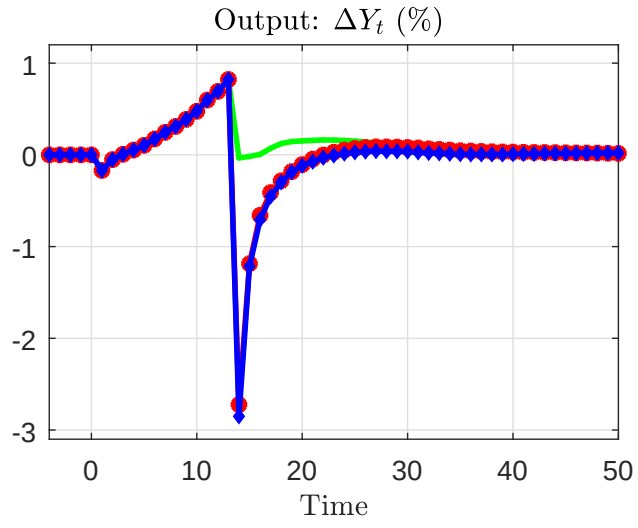


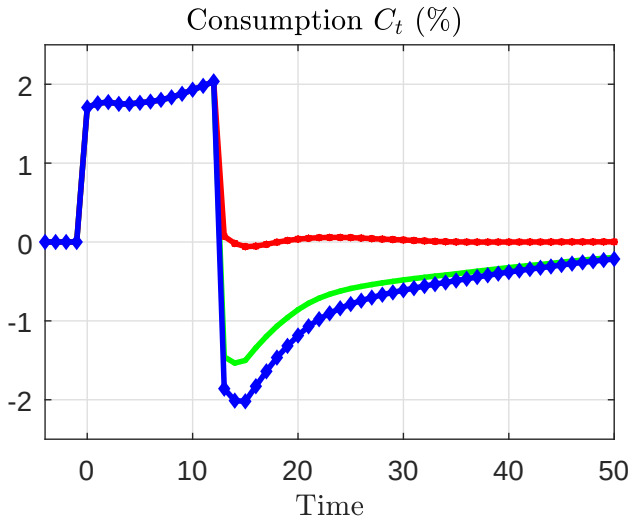


CONSUMPTION, OUTPUT AND LABOR

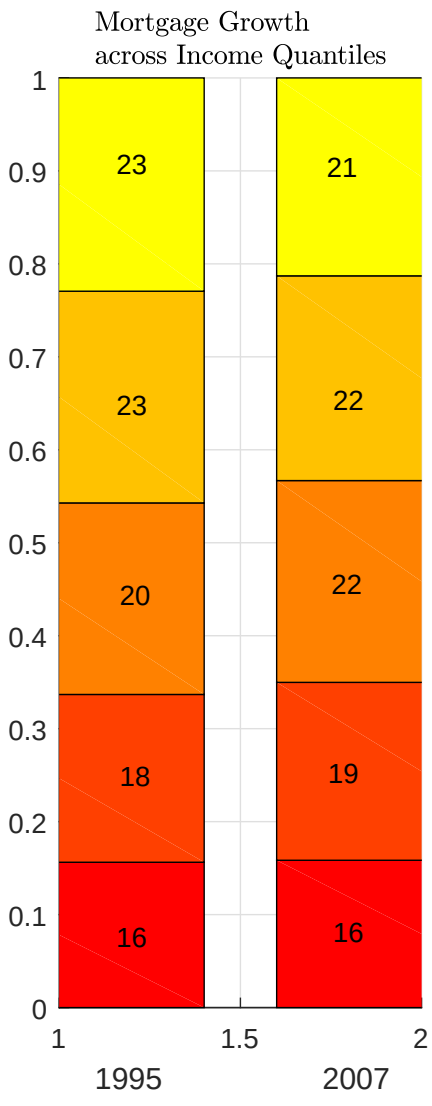


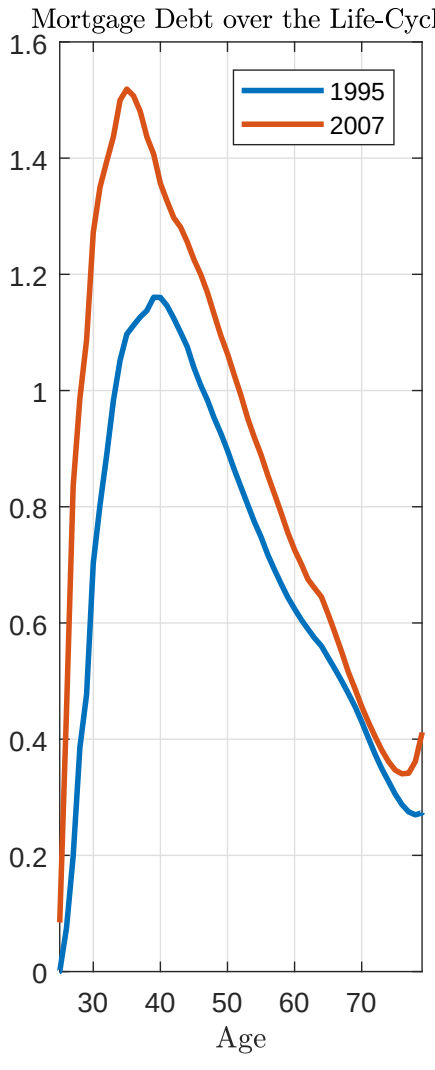


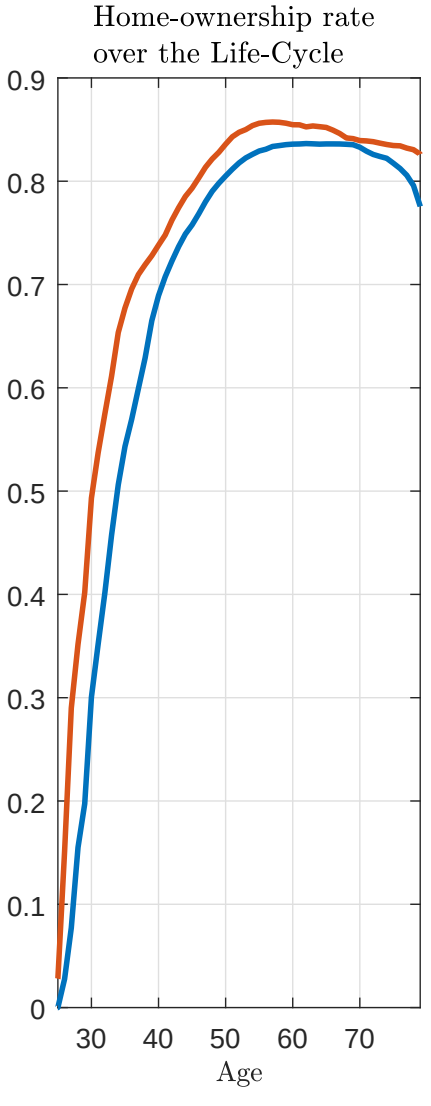




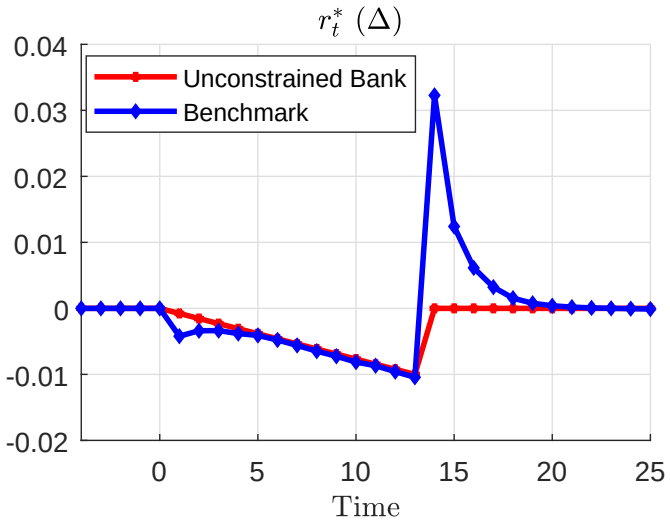
DISTRIBUTIONAL IMPLICATIONS

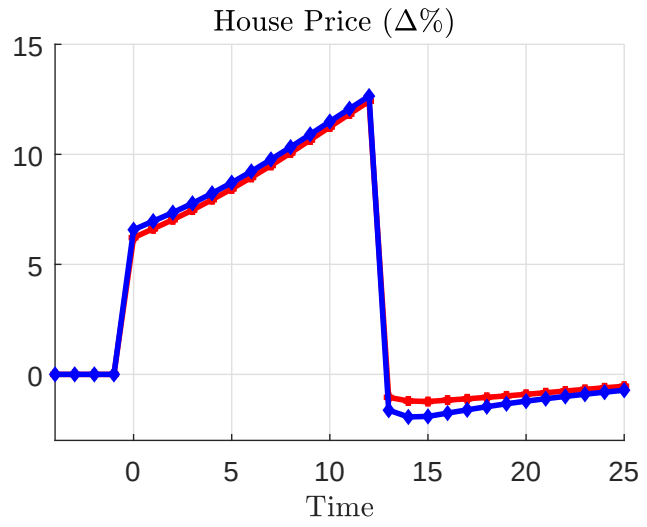


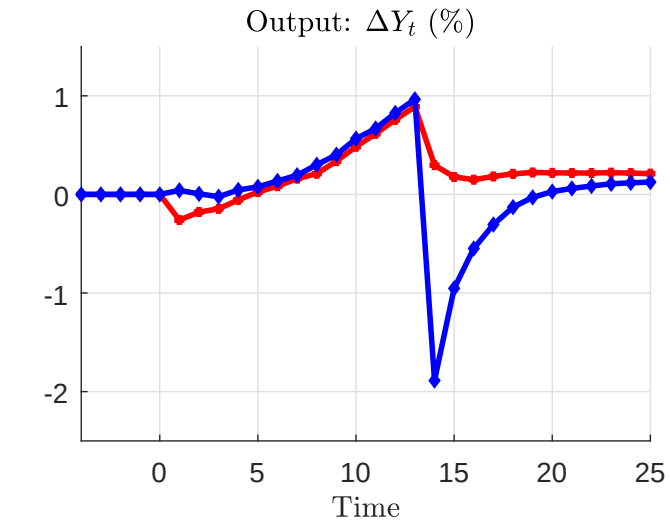


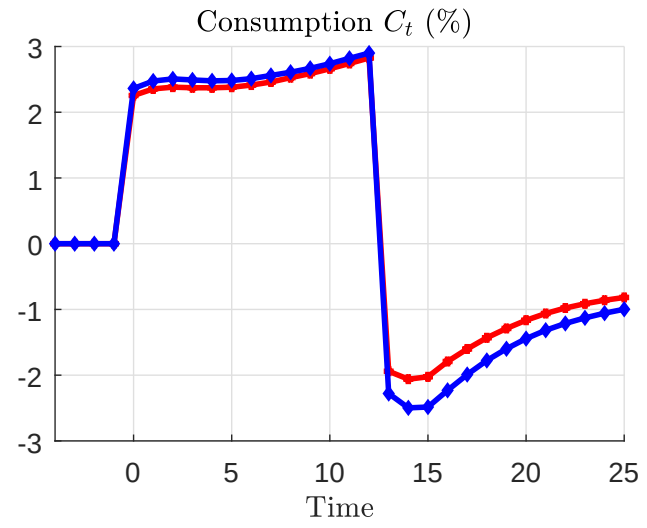


Interest rate shock with constrained and unconstrained banks

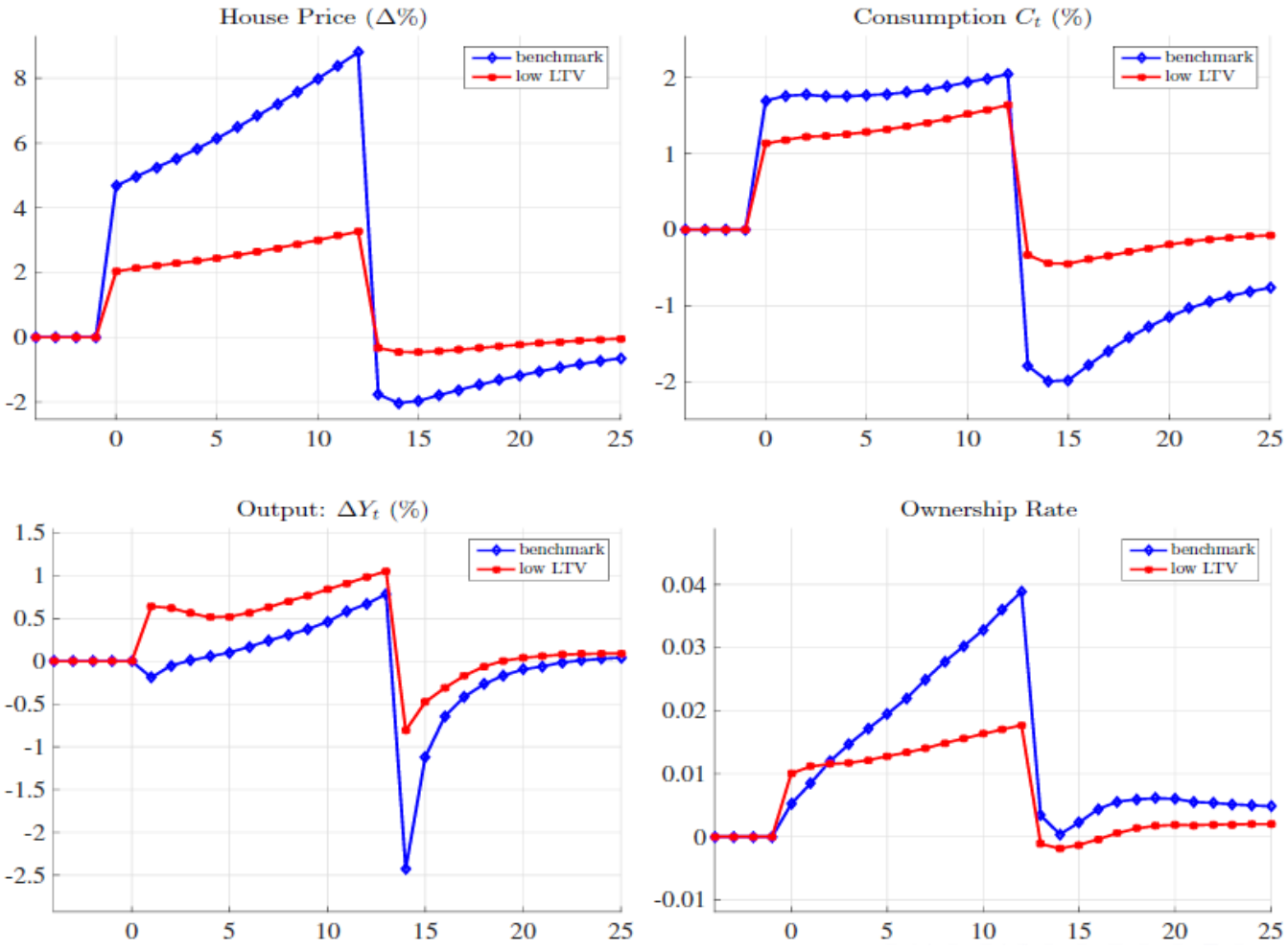








THE ROLE OF HIGH LTV(MAX LTV=1)



HOUSING PRICES AND CONSUMPTION: SHOCKS MATTER

Elasticity of consumption to house prices (from the peak of the boom to bust):

- 0.93 if the shock is productivity
- 0.35-0.38 if the shocks are leverage and interest rate
- 0.97 if the shock is housing preference
- Regression results from model generated data imply a similar heterogeneity

Conclusions

- We developed a framework which is consistent with many properties of the boom-bust episode
- Bank leverage can generate significant boom-bust cycles.
- The amplifying role of bank leverage constraints is small.
- Still there are things to be done:
  - policy analysis
  - other macroprudential policy tools
  - ARM mortgages
  - other shocks and consumption