THE HOUSING BOOM AND BUST: MODEL MEETS EVIDENCE

Discussion

Marius Grünewald Lina Segers

March 11, 2025

European University Institute

Motivation

Why should we care?

- Housing market and housing financing important part of US economy.
- Understanding the roots of housing boom-bust cycle and its implications $\rightarrow$ particular focus GFC.
- Role for government intervention: What worked? What did not?

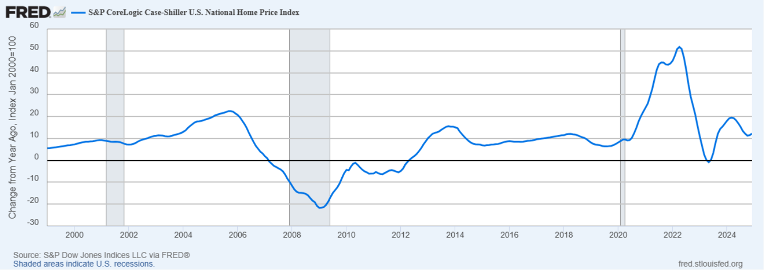


Figure 1: Y-o-Y growth rates in house price index.

Preview of Results

During the great recession…

- Main change in house prices from beliefs.
- Credit constraint crucial for foreclosures and ownership.
- Key driver of change in household (non-durable) expenditures: Drop in Household’s balance sheet.
- Thought experiment debt forgiveness: Impacts on defaults - beliefs and consumption not so much.

Table of contents

Research Questions

Research Question

Paper focuses on three questions related to role housing market in Great Recession:

1. What were the **sources** of the boom and bust in the housing market?
2. Through what **channels** did the movements in house prices transmit to consumption expenditure?
3. Was there a **role for debt foregiveness policies** at the height of the crisis?

Answers depend on two potential driving forces: **Credit conditions** & **Expectations**.

Approach

Approach

Structural equilibrium approach:

OLG LC model with incomplete markets, financing sector, rental sector, and realistic consumption behaviour.

- Potential drivers fluctuations housing investment, house prices, and mortgage risk spreads *in model:*
    1. Changes to household income, by aggregate productivity shocks.
    2. Changes in housing financing conditions, by shocks to model parameters.
    3. Changes in beliefs about future housing demand.
- Simulation boom-bust episode: All three shocks hit economy (first relaxed, then reversed).

Households

Household problem

- Live: J periods, retired after J_R.
- Consume:
  1. Nondurable goods c.
  2. Housing (renting or buying) s.
     - Option to default, sell, refinance or pay.
- Work: Inelastic labour, productivity shocks y.
- Save: Noncontingent financial asset (exogenous return) q_b.

Household problem cont.

Households receive idiosyncratic labor income endowment:

$$\log y_j^w = \log \Theta + \chi_j + \epsilon_j$$

With Θ index of aggregate labor productivity, χ age profile, ϵ shock.

Households can rent or own a home:

- There is a set of house sizes for rental and owned properties $\mathcal{H}$.
- Competitive frictionless housing market.
- Rental rates/prices depend on vector of aggregate states Ω.
- Homeownership financed with mortgage (follows US institutional characteristics).

Household problem cont.

Expected lifetime utility is given by:

$$\mathbb{E}_0 \left[\sum_{j=1}^{J} \beta^{j-1} u_j(c_j, s_j) + \beta^J v(\mathfrak{b}) \right]$$

With c consumption of nondurables, s consumption of housing services, and $\mathfrak{b}$ bequests.

Let $x = (b, h, m)$ be portfolio of household assets and liabilities.

Utility and bequest functions

Household problem in recursive form: Buyers and renters

A household who doesn't own solves:

$$V_j^n(b, y, \Omega) = \max \left\{ V_j^r(b, y, \Omega), V_j^r(b, y, \Omega) \right\}$$

$$
\begin{aligned}
V_j^r(b, y; \Omega) = \max_{c, \tilde{h}', b'} u_j(c, s) + \beta \mathbb{E}_{y, \mathcal{Z}} &\left[\mathbf{V}_{j+1}^n(b', y'; \Omega') \right] \\
s.t. & \\
c + \rho(\Omega) \tilde{h}' + q_b b' &\leq b + y - \mathcal{T}(y, 0) \\
b' &\geq 0 \\
s = \tilde{h}' &\in \tilde{\mathcal{H}} \\
y' \sim \Upsilon_j(y), &\quad \mathcal{Z}' \sim \Gamma_{\mathcal{Z}}(\mathcal{Z}) \\
\mu' &= \Gamma_\mu(\mu; \mathcal{Z}, \mathcal{Z}')
\end{aligned}
$$

Figure 2: Renter

$$
\begin{aligned}
V_j^o(b, y; \Omega) = \max_{c, b', h', m'} u_j(c, s) + \beta \mathbb{E}_{y, \mathcal{Z}} &\left[\mathbf{V}_{j+1}^h(\mathrm{x}', y'; \Omega') \right] \\
s.t. & \\
c + q_b b' + p_h(\Omega) h' + \kappa^m &\leq b + y - \mathcal{T}(y, 0) + q_j(\mathrm{x}', y; \Omega) m' \\
m' &\leq \lambda^m p_h(\Omega) h' \\
\pi_j^{\min}(m') &\leq \lambda^\pi \\
b' &\geq 0 \\
h' \in \mathcal{H}, &\quad s = \omega h' \\
y' \sim \Upsilon_j(y), &\quad \mathcal{Z}' \sim \Gamma_{\mathcal{Z}}(\mathcal{Z}) \\
\mu' &= \Gamma_\mu(\mu; \mathcal{Z}, \mathcal{Z}')
\end{aligned}
$$

Figure 3: Home buyer

Household problem in recursive form: Home owners

A household who owns a house solves (Retired, Default):

$$
V_j^h(x, y, \Omega) = \max \begin{cases} \text{Pay:} & V_j^p(x, y, \Omega) \\ \text{Refinance:} & V_j^f(x, y, \Omega) \\ \text{Sell:} & V_j^n(b_n, y, \Omega) \\ \text{Default:} & V_j^d(b, y, \Omega) \end{cases}
$$

$$
\begin{aligned}
V_j^p(\mathbf{x}, y; \Omega) = \max_{c, b', \pi} u_j(c, s) + \beta \mathbb{E}_{y, \mathcal{Z}} \left[\mathbf{V}_{j+1}^h(\mathbf{x}', y'; \Omega') \right] \\
s.t. \quad & \\
& c + q_b b' + (\delta_h + \tau_h) p_h(\Omega) h + \pi \leq b + y - \mathcal{T}(y, m) \\
& \pi \geq \pi_j^{\min}(m) \\
& m' = (1 + r_m) m - \pi \\
& b' \geq -\lambda^b p_h(\Omega) h \\
& s = \omega h, \quad h' = h \\
& y' \sim \Upsilon_j(y), \quad \mathcal{Z}' \sim \Gamma_{\mathcal{Z}}(\mathcal{Z}) \\
& \mu' = \Gamma_\mu(\mu; \mathcal{Z}, \mathcal{Z}')
\end{aligned}
$$

Figure 4: Home owner pays

$$
\begin{aligned}
V_j^f(\mathbf{x}, y; \Omega) = \max_{c, b', m'} u_j(c, s) + \beta \mathbb{E}_{y, \mathcal{Z}} \left[\mathbf{V}_{j+1}^h(\mathbf{x}', y'; \Omega') \right] \\
s.t. \quad & \\
& c_j + q_b b' + (\delta_h + \tau_h) p_h(\Omega) h + (1 + r_m) m + \kappa^m \\
& \quad \leq b + y - \mathcal{T}(y, m) + q_j(\mathbf{x}', y; \Omega) m' \\
& m' \leq \lambda^m p_h(\Omega) h \\
& \pi_j^{\min}(m') \leq \lambda^\pi y \\
& b' \geq -\lambda^b p_h(\Omega) h \\
& s = \omega h, \quad h' = h \\
& y' \sim \Upsilon_j(y), \quad \mathcal{Z}' \sim \Gamma_{\mathcal{Z}}(\mathcal{Z}) \\
& \mu' = \Gamma_\mu(\mu; \mathcal{Z}, \mathcal{Z}')
\end{aligned}
$$

Figure 5: Home owner refinances

Government

Government

- PAYG social security system.
- Government spends:
    - per capita (pensions): $y = \rho y_J^w(\Theta)$.
    - Services $G(\Omega)$ not valued by household.
- Government receives:
    1. Labor tax (progressive). $\mathcal{T}(y, m)$
    2. Property tax (proportional - deduct interest payments HHs) $\tau_h p_h(\Omega) h$.
    3. Sale of new land permits for construction.

Firms, Rental Sector and Banks

Financial Intermediaries

- Risk neutral, foreign agents with deep pockets
- Finance mortgages at expectation loan price
- g_j^i are policy functions of discrete choices

Figure 6: Mortgage Pricing

$$
\begin{aligned}
q_j(\mathbf{x}', y; \Omega) = {} & \frac{1-\zeta^m}{(1+r_m)\, m'} \cdot \mathbb{E}_{y,\Omega} \left\{ \left[g_j^n + g_j^f \right] (1+r_m)\, m' \right. \\
& + g_j^d \left(1 - \delta_h^d - \tau_h - \kappa_h\right) p_h\left(\Omega'\right) h' \\
& \left. + \left[1 - g_j^n - g_j^f - g_j^d\right] \langle \pi(\mathbf{x}', y'; \Omega') + q_{j+1}(\mathbf{x}'', y'; \Omega') \left[(1+r_m)m' - \pi(\mathbf{x}', y'; \Omega')\right] \rangle \right\}
\end{aligned} \tag{10}
$$

Rental Sector

- Competitive, endogenous rental sector
- Can buy and sell housing units frictionless; Rent at operating cost

Figure 7: Landlords

$$
\begin{aligned}
J(\tilde{H};\Omega) \quad &= \quad \max_{\tilde{H}'} \left[\rho\left(\Omega\right) - \psi\right] \tilde{H}' - p_h\left(\Omega\right) \left[\tilde{H}' - (1 - \delta_h - \tau_h)\tilde{H}\right] \\
&\quad + \left(\frac{1}{1+r_b}\right) \mathbb{E}_{\Omega}\left[J(\tilde{H}';\Omega')\right]
\end{aligned}
$$

Production

- Competitive final goods sector
- Competitive construction sector: Use labour and land
- Both depend on aggregate productivity
- Optimal housing supply depends on p_h
- Labour frictionless across sectors

Aggregate Risk and Beliefs

Aggregate Risk

Three independent stochastic risks

- Aggregate labour producitivity risk
- Correlated time-varying credit constraints: LtV, PtI, mortgage origination cost and wedge
- Aggregate uncertainty over housing preferences with three states: High, Low and Low with better exit chances (beliefs)

Law of motion of beliefs over owner-occupied house price depends on aggregate states Z

$$\log p_h'(p_h, Z, Z) = a_0(Z, Z) + a_1(Z, Z) \log p_h$$

with housing prices pinning down rental prices and mortgage pricing.

Parameters

- Housing values correspond to 0.1 , 0.5 and 0.9 percentile of equity wealth to total equity
- Owner to Renter ratio of 1.5

Targeted Moments

Figure 8: Targeted Moments

Moment	Empirical value	Model Value
Aggr. NW / Aggr. labor income (median ratio)	5.5 (1.2)	5.6 (0.9)
Median NW at age 75 / median NW at age 50	1.51	1.55
Fraction of bequests in bottom half of wealth dist.	0	0
Aggr. home-ownership rate	0.66	0.67
Foreclosure rate	0.005	0.001
P10 Housing NW / total NW for owners	0.11	0.12
P50 Housing NW / total NW for owners	0.50	0.38
P90 Housing NW / total NW for owners	0.95	0.80
Avg.-size owned house / rented house	1.5	1.5
Avg. earnings owners / renters	2.1	2.4
Annual fraction of houses sold	0.10	0.095
Home-ownership rate of $<$ 35 y.o.	0.39	0.37
Relative size of construction sector	0.05	0.05
Belief Shock		
Average expenditure share on housing	0.16	0.16
Expected annual house price growth	0.06-0.15	0.06
Avg. duration of booms and busts	5.4 and 5.5 years	5 and 5 years
Avg. size of house price change in booms and busts	0.36 and 0.37	0.34 and 0.32

Figure 9: Untargeted Moments

Moment	Empirical value	Model Value
Fraction homeowners w/ mortgage	0.66	0.56
Fraction of homeowners with HELOC	0.06	0.03
Aggr. mortgage debt / housing value	0.42	0.34
P10 LTV ratio for mortgagors	0.15	0.14
P50 LTV ratio for mortgagors	0.57	0.58
P90 LTV ratio for mortgagors	0.92	0.89
Gini of NW distribution	0.80	0.69
Share of NW held by bottom quintile	0.00	0.00
Share of NW held by middle quintile	0.05	0.08
Share of NW held by top quintile	0.81	0.69
Share of NW held by top 10 pct	0.70	0.35
Share of NW held by top 1 pct	0.46	0.07
P10 house value / earnings	0.9	1.0
P50 house value / earnings	2.1	2.0
P90 house value / earnings	5.5	4.3
BPP consumption insurance coeff.	0.36	0.41

Model Results

Results I

Figure 10: Which Shocks Generate a Boom-Bust Cycle - House Prices

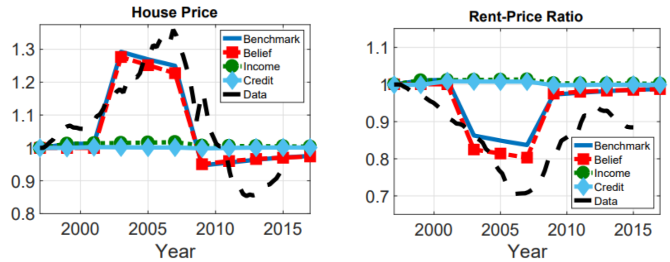


Figure 3: Left panel: house price. Right panel: rent-price ratio. Benchmark is the model's simulation of the boom-bust episode with all shocks hitting the economy. The other lines correspond to counterfactuals where all shocks are turned off, except the one indicated in the legend. Model and data are normalized to 1 in 1997.

- Beliefs matter for house prices; Income and credit shocks not so much

Results II

Figure 11: Which Shocks Generate a Boom-Bust Cycle - Home Ownership

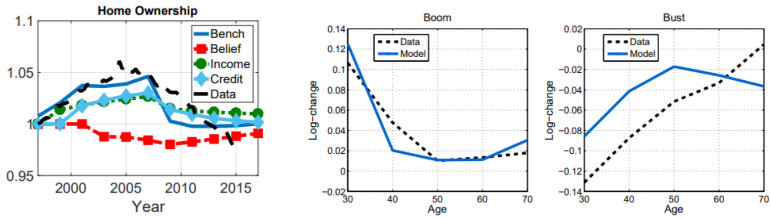


Figure 4: Change in home ownership over time (left panel) and across age groups (right panel) in the data and in the model. In the left panel, model and data are normalized to 1 in 1997.

- Credit and Income Shocks drive dynamics - ability to buy
- Beliefs make renting relatively cheaper
- Interaction: Beliefs about future house prices make sacrificing consumption worth it. The other shocks make you able to afford it.

Results III

Figure 12: Which Shocks Generate a Boom-Bust Cycle - Leverage

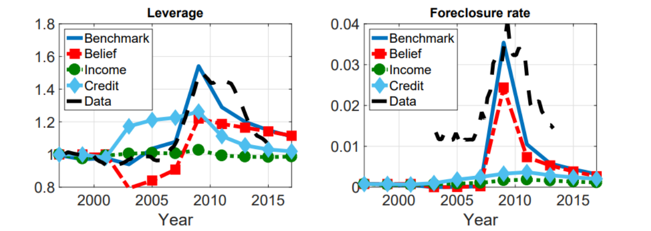
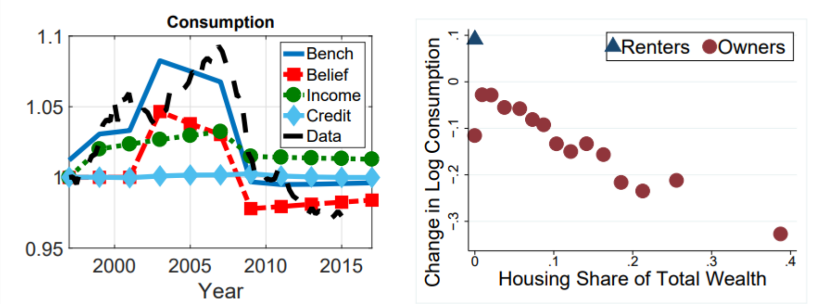


Figure 5: Left panel: leverage. Right panel: foreclosure rate. Benchmark is the model's simulation of the boom-bust episode with all shocks hitting the economy. The other lines correspond to counterfactuals where all shocks are turned off, except the one indicated in the legend. Model and data are normalized to 1 in 1997.

- In Boom: Loose credit constraint drive up leverage; beliefs about future house prices push leverage down
- In Bust: Beliefs change house prices $\implies$ increased leverage. Slow amortization drags effects out.

Results IV

Figure 13: Non-durable consumption



- In Boom: Mostly Income
- In Bust: Beliefs shocks wealth of agents (housing)
- Younger HH might become homeowners or level up (positive). Older are already there (negative).

Robustness

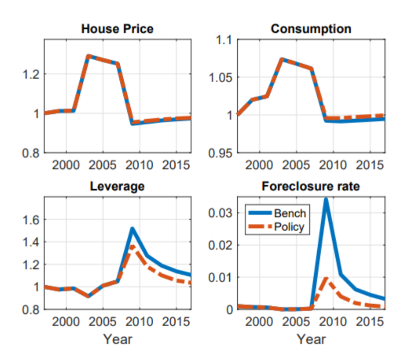
- Who's beliefs matter?
  a) Banks for ownership and foreclosures.
  b) Rental companies and households for house prices and consumption.
- Pure preference shock doesn't match consumption pattern.
- Results change when:
  a) Mortgage non-defaultable and short-term
  b) Results change when: Absence of rental market

  ...

Belief Decomposition

Policy Experiment

Figure 14: Where $LTV > 95\%$ in 2009 $\implies$ $LTV = 95\%$.



- Little effect on house prices: No direct link
- Little effect on consumption: Default as tool to increase consumption
- Big effect on default.

Conclusion

Conclusion

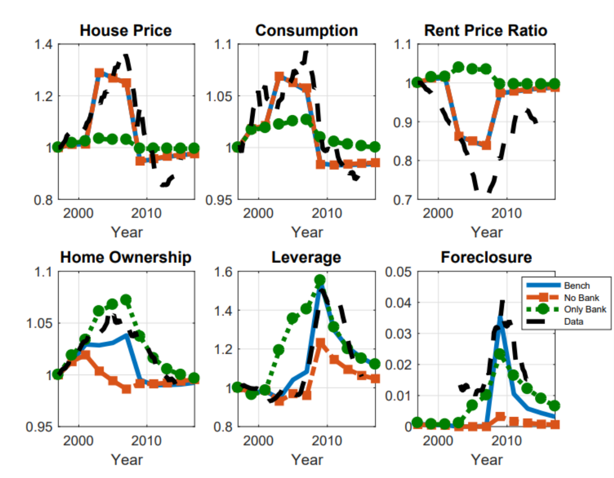
Tour de force that shows:

- The dynamics of house prices were belief-induced
- Credit constraint matter for ownership status
- Wealth effect on HH balance sheet drives consumption
- Debt forgeviness as policy experiment

Appendix

Lenders or Rental Companies?

Figure 15: Restricting House Price Beliefs



Back

Household problem functional forms

The utility function is:

$$u_j(c,s) = \frac{e_j[(1-\phi)c^{1-\gamma} + \phi s^{1-\gamma}]^{(1-\vartheta)/(1-\gamma)} - 1}{1-\vartheta}$$

With ϕ relative taste housing, γ elasticity of substitution, ϑ intertemporal ES, and e_j as the exogenous equivalence scale.

The felicity from bequests function is:

$$v(\mathfrak{b}) = \nu \frac{(\mathfrak{b} - \underline{\mathfrak{b}})^{1-\vartheta} - 1}{1-\vartheta}$$

With ν strength bequest motive, $\underline{\mathfrak{b}}$ extent bequest luxury good.

Back

Home owners cont.

- Sellers receive net costs proceeds from home sale $b_n = b + (1 - \delta_h - \tau_h - \kappa_h) p_h(\Omega) h - (1 + r_m) m \rightarrow \quad V^n_{j+1}$
- Retired:

$$
\begin{aligned}
V_J^p(\mathbf{x}, y; \Omega) = \max_{c, b'} \; & u_J(c, s) + \beta v(\flat) \\
& s.t. \\
& c + q_b b' + (1 + r_m) m \leq b + y - \mathcal{T}(y, 0) \\
& \flat = b' + (1 - \delta_h - \tau_h - \kappa_h) \mathbb{E}_{\mathcal{Z}} \left[p_h(\Omega') \right] h \\
& b' \geq 0 \\
& s = \omega h \\
& \mathcal{Z}' \sim \Gamma_{\mathcal{Z}}(\mathcal{Z}) \\
& \mu' = \Gamma_{\mu}(\mu; \mathcal{Z}, \mathcal{Z}')
\end{aligned}
$$

Figure 16: Retired home-owner

Back

Home owners cont.

Default incurs penalty ξ, and must rent one period $\rightarrow \quad V^r_{j+1}$

$$
\begin{aligned}
V^d_j(b, y; \Omega) = \max_{c, \tilde{h}', b'} \; & u_j(c, s) - \xi + \beta \mathbb{E}_{y, \mathcal{Z}} \left[V^r_{j+1}(b', y'; \Omega') \right] \\
s.t. \quad & \\
& c + \rho(\Omega) \tilde{h}' + q_b b' \leq b + y - \mathcal{T}(y, 0) \\
& b' \geq 0 \\
& s = \tilde{h}' \in \tilde{\mathcal{H}} \\
& y' \sim \Upsilon_j(y) \\
& \mathcal{Z}' \sim \Gamma_{\mathcal{Z}}(\mathcal{Z}) \\
& \mu' = \Gamma_\mu(\mu; \mathcal{Z}, \mathcal{Z}')
\end{aligned}
$$

Back