Do Changes in Mortgage Credit Constraints Explain the Housing Boom and Bust?

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Tipping Points III Symposium
Washington, DC

October 12, 2018
Introduction

- Significant changes in mortgage credit and home ownership over past two decades

- Causes of 2000-2007 housing boom still not completely understood

- Effects of regulatory tightening in the residential mortgage market during bust unclear
  - Declines in home ownership hard to disentangle from changes in preferences for home ownership, changes in household formation, etc...
This Paper

1. Summarize trends in home ownership and mortgage debt over past two decades

2. Present life cycle model that explores effect of relaxing and tightening mortgage credit constraint on home ownership and mortgage debt level
   • focus on change in maximum Loan-to-Value (LTV) household can take on to buy home

Take homes:
1. Relaxation of LTV constraint cannot explain 2000-2007 boom period data
   • in data no increase in age-adjusted US home ownership during boom period
2. Tightening of LTV constraint can explain some of the decline in US home ownership in the bust period
US Home Ownership Rate 1994 - 2017
Aggregate and by Income Category

Aging of US Population


⇒ Need to look at home ownership rates within age categories!
US Home Ownership by Age Category

Summary of Home Ownership Patterns

1. Increase in aggregate and age-adjusted home ownership rates 1994-2001

2. Slight decrease in age-adjusted home ownership rates 2001-2007

3. Significant decrease in aggregate and age-adjusted home ownership rates 2007-2017
US Real Mortgage Debt and Home Prices, 1994-2017

Sources: Federal Reserve Financial Accounts of the United States, FHFA, FRED, and BLS.
Can Rising Home Prices Explain Explosion in Debt Levels?

Hypothetical Change in Mortgage Debt for Home Price Growth of 40%

Assume: No increase in down payment size or income

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2007</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Price</td>
<td>$300,000</td>
<td>$420,000</td>
<td>40%</td>
</tr>
<tr>
<td>LTV</td>
<td>80%</td>
<td>86%</td>
<td></td>
</tr>
<tr>
<td>Mortgage Debt</td>
<td>$240,000</td>
<td>$360,000</td>
<td>50%</td>
</tr>
<tr>
<td>Down Payment</td>
<td>$60,000</td>
<td>$60,000</td>
<td></td>
</tr>
</tbody>
</table>

So, at most, ability to afford same home with rising prices can explain half the increase in mortgage debt.

Adelino, Schoar, and Severino (2018) actually find no change in CLTV ratios at origination so actual increase caused by decreasing affordability is likely much smaller.
Growth in Mortgage Debt in Boom Broad-Based

Source: Foote, Loewenstein, and Willen (2016).
But average income for borrowers of mortgage in PLMBS pools >100,000$ (Ghent, Hernández-Murillo, and Owyang (2015))

- Subprime / alt-A was a middle-class phenomenon
Take Aways

1. Housing boom period (2000-2007) saw no growth in home ownership rate other than through demographic change

2. **More than doubling** of stock of mortgage debt during boom
   - Explosion of Nonprime PLMBS market
   - Must be due to growth along the intensive margin given home ownership patterns
   - Likely a significant role for home equity extraction after mortgage origination during boom

3. Significant decline in non-demographic related homeownership in bust
Model Overview

- Life cycle / OLG endowment economy

- Households choose:
  - tenure
  - house size (if owners)
  - mortgage type (if owners)
  - whether to default
  - consumption
  - saving

- Equilibrium mortgage rate for each mortgage type sets expected PV of mortgage equal to mortgage amount

- Sources of risk:
  - home values (idiosyncratic)
  - income (idiosyncratic)
Overview

- Exogenous risk-free rate, $r$
- Exogenous relative price of housing, $q$
- Housing stock depreciates at a rate of $\delta$ every period
- Home owners must pay $\delta$ every period in which they own to maintain the property
- Financial intermediaries must pay a cost $\chi$ (percent of home value) to rehabilitate any home acquired through foreclosure
Households

- Born at age 0 and live for at most $J$ periods
  - start life with no assets and as renters

- “Work” for the first $J_{RET}$ periods of life

- Each period face a probability $\pi_j$ of dying

- Bequest motive

- Face stochastic income risk
  - income follows a Markov Process

- If home owner, face stochastic home values
Households

Tenure Choice

- Each period, chooses whether to own or rent
- If chooses to rent, no home size choice
  - rents a home of size $h_1$
- If chooses to own, buys a home of size $h_2$ ($h_2 > h_1$) or $h_3$ ($h_3 > h_2$)
  - cannot buy a home of size $h_1$
Households

Tenure Choice

• Felicity depends on tenure
  • allow for the possibility that there is a utility premium from owning

• Can transition in any period between owning and renting
Households

Home Values

• Use same mechanism as Corbae and Quintin (2015) to capture home price volatility

• Each period while an owner, there is a probability \( \lambda \) that the home will change in value
  • home of size \( h_2 \) will stay size \( h_2 \) with probability \( 1 - 2\lambda \), will increase to size \( h_3 \) with probability \( \lambda \), and will decrease to size \( h_1 \) with probability \( \lambda \)
  • home of size \( h_3 \) will stay size \( h_3 \) with probability \( 1 - \lambda \) and will decrease to size \( h_2 \) with probability \( \lambda \)
  • owner-occupied home of size \( h_1 \) will stay size \( h_1 \) with probability \( 1 - \lambda \) and will increase to size \( h_2 \) with probability \( \lambda \)

• Rental homes do not change size (always size \( h_1 \))
Households
Mortgage Choices

• Two ways to finance home ownership:

  1. Traditional Mortgages (TRADs):
     • require down payment of $v_{TRAD}\%$ of the home value
     • term is $T$ periods
     • payments are calculated such that the mortgage is fully amortizing over $T$ periods
     • carry interest rate $r_{TRAD}$

  2. Low Down Payment (LDP) loans:
     • require down payment of just $v_{LDP}\%$ of home value
     • term is $T$ periods
     • payments are calculated such that the mortgage is fully amortizing over $T$ periods
     • carry interest rate $r_{LDP}$
Households
Mortgage Choices

- No refinancing
  - keeps computation tractable

- Can terminate the mortgage in any period by either
  - defaulting, or
  - prepaying

- If defaults, loses the home and must rent for that period

- Prepays by selling the home
  - pays selling cost $\rho$
Financial Intermediaries

- Accepts household savings and makes mortgage loans
- Earns the exogenously given rate \( r \) on savings
- Pays a servicing cost, \( \phi \), on mortgages it holds
- Holds a stock of housing capital which it can rent out at rate \( R \) per unit or sell to households as owner-occupied housing
- Incurs the maintenance cost \( \delta \) on its housing stock
- Incurs a cost \( \chiqh \) of rehabilitating housing units it acquires through foreclosure
- In equilibrium, it must make zero profits
  \[ \implies R = rq + \delta \]
Equilibrium

- Equilibrium mortgage interest rates, $r_{TRAD}$ and $r_{LDP}$:
  - mortgage interest rate that makes the expected present value of the mortgage equal to the amount of the mortgage
  - lender discounts expected cash flows by $r + \phi$

- No closed form solution to this problem

- Solve numerically:
  - inner loop solves household optimization problem for each value of state variable
  - outer loop for mortgage interest rates
Parameterization

Demographics

- Period corresponds to 3 years
- Household ‘born’ at age 25
- Household lives to at most 85 chronological years of age ($J = 20$)
- Household ‘retires’ at age 64 ($J_{RET} = 13$)
- Survival rates taken from Arias et al. (2008)
Parameterization

Income

• Assume that the income process during working years follows an AR(1) process:

\[ y_t = \rho y_{t-1} + \gamma_1 a_{ge_t} + \gamma_2 a_{ge_t}^2 + \varepsilon_t \]  

(1)

where \( \varepsilon_t \) has variance \( \sigma_{\varepsilon}^2 \)

• Estimate (1) using triennial PSID data on earnings from 1967 to 1992

• Approximate (1) with a three state Markov chain using the approach of Tauchen and Hussey (1991)

• After retirement, labor income is set to 60% of income in the last working year following Cocco, Gomes, and Maenhout (2005) and Yao and Zhang (2005)
Parameterization
Preferences: Felicity Function

- Felicity function follows

\[ u(c, h, H) = \psi \ln c + (1 - \psi) \ln h \]

- Set \( \psi \) to 0.76 implying that renters spend 24\% of their consumption expenditure on housing (Davis and Ortalo-Magné, 2011)
Parameterization

Housing Costs

- Set $\chi$, foreclosure rehabilitation costs, to 0.25 (consistent with Campbell, Giglio, and Pathak, 2011)

- Set $T$, mortgage term, to 10 such that mortgages have 30 year terms

- Set $v_{TRAD} = 0.2$ such that TRADs require a 20% down payment

- Set $r$, risk-free rate, to 0.12

- Set $\rho$, selling-costs, to 8% as in Cocco (2005)
Parameterization

Housing Costs

• Use the following parameters to calibrate the model to certain characteristics in the data
  • $\lambda$: probability of an idiosyncratic house price shock
  • house sizes, $h_1$, $h_2$, and $h_3$
  • mortgage servicing cost, $\phi$
  • $q$: relative price of housing
  • $\delta$: per period depreciation rate on housing
## Steady State Equilibria

| Moment             | Data     | Model
<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>2001</td>
<td>2007</td>
</tr>
<tr>
<td>Home Ownership</td>
<td>68.0%</td>
<td>67.8%</td>
</tr>
<tr>
<td>Low Income</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Mid Income</td>
<td>83%</td>
<td>83%</td>
</tr>
<tr>
<td>High Income</td>
<td>92%</td>
<td>92%</td>
</tr>
<tr>
<td>Under 35</td>
<td>42%</td>
<td>41%</td>
</tr>
<tr>
<td>35-44</td>
<td>68%</td>
<td>67%</td>
</tr>
<tr>
<td>45-54</td>
<td>76%</td>
<td>75%</td>
</tr>
<tr>
<td>55-65</td>
<td>81%</td>
<td>80%</td>
</tr>
<tr>
<td>65+</td>
<td>81%</td>
<td>80%</td>
</tr>
<tr>
<td>Loan-to-Income</td>
<td>182%</td>
<td>241%</td>
</tr>
<tr>
<td>Share LDPs</td>
<td>-</td>
<td>2.2%</td>
</tr>
<tr>
<td>TRAD Mtg Rate</td>
<td>5.27%</td>
<td>5.27%</td>
</tr>
<tr>
<td>NDP Mtg Rate</td>
<td>-</td>
<td>5.93%</td>
</tr>
<tr>
<td>Avg. 30-year Mtg Rate</td>
<td>4.97%</td>
<td>4.34%</td>
</tr>
<tr>
<td>Foreclosure Rate</td>
<td>1.29%</td>
<td>1.31%</td>
</tr>
</tbody>
</table>

Notes: 1) Data sources are US Census CPS / Housing Vacancy Survey, Federal Reserve Consumer Finance Survey, and Federal Reserve Bank of St. Louis.
Squaring the Model with the Data

Relaxing LTV constraint raises home ownership rate for young, high-income households

- HHs that cannot come up with a down payment but want to smooth consumption
- Reduces average debt ratios slightly

If relaxation of LTV constraint caused the boom, we would have seen an increase in the home ownership rate, especially young HHs

Model is consistent with tightening of LTV constraint during bust causing a decline in home ownership

- Consistent with empirical evidence of Duca and Rosenthal (1994) and Gete and Reher (forthcoming) regarding effect of credit constraints on home ownership
Empirical Facts:

1. No increase in age-adjusted home ownership rate over boom
2. Doubling of real residential mortgage debt during boom
3. Significant increase in home ownership rate in years leading up to the boom
4. Significant decline in home ownership rate during bust

Model of tenure choice predicts that main effect of relaxation of LTV constraint is an increase in home ownership

Main beneficiaries of relaxation of LTV constraints in model are high-income young households