

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

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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

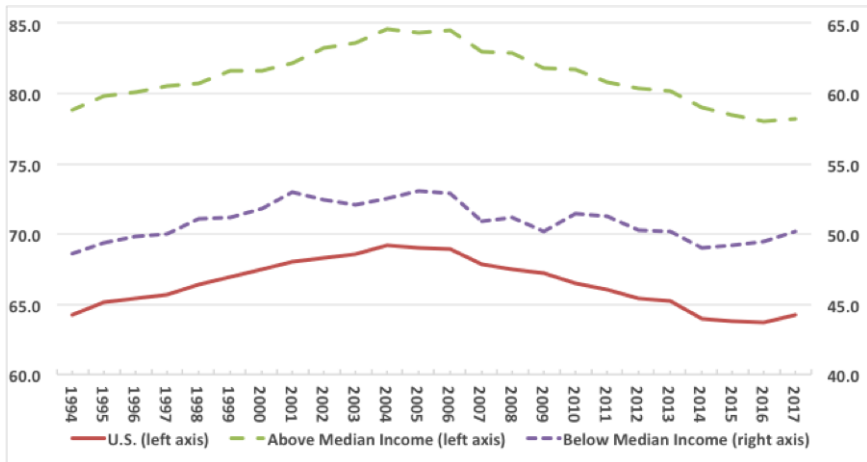
1. Summarize trends in home ownership and mortgage debt over past two decades
2. Present life cycle model that explores effect of relaxing and tightening mortgage credit constraint on home ownership and mortgage debt level
 - focus on change in maximum Loan-to-Value (LTV) household can take on to buy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

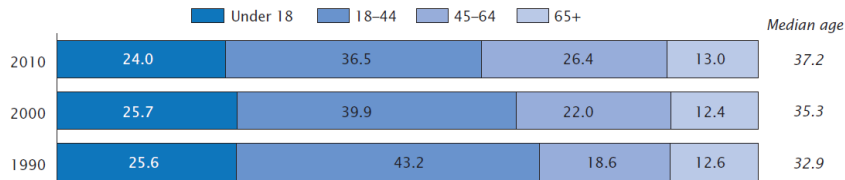
US Home Ownership Rate 1994 - 2017

Aggregate and by Income Category



Source: U.S. Census Bureau, Current Population Survey / Housing Vacancy Survey, July 26, 2018.

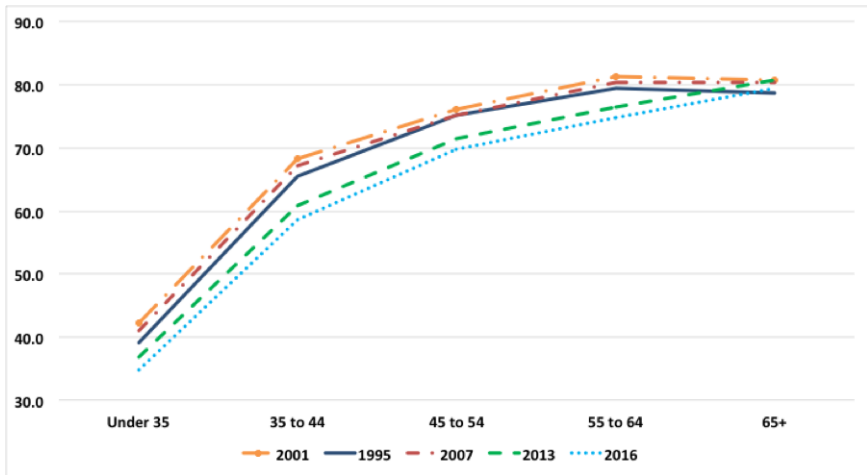
Aging of US Population



Source: Age and Sex Composition: 2010. 2010 Census Briefs, U.S. Census Bureau.

⇒ **Need to look at home ownership rates within age categories!**

US Home Ownership by Age Category

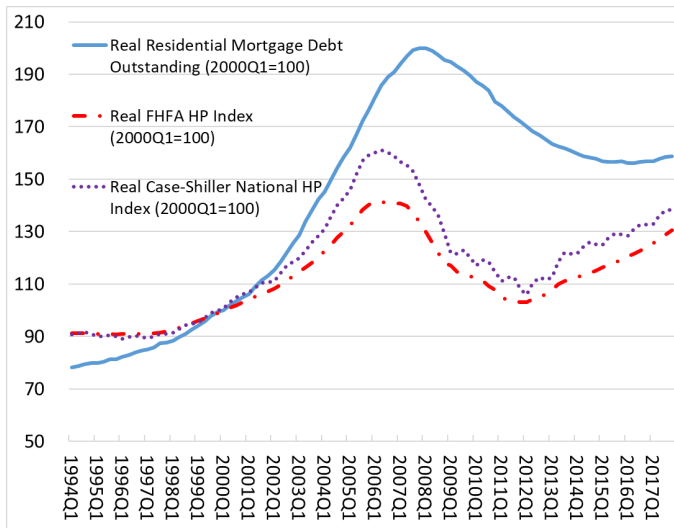


Source: U.S. Census Bureau, Current Population Survey / Housing Vacancy Survey, July 26, 2018.

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%

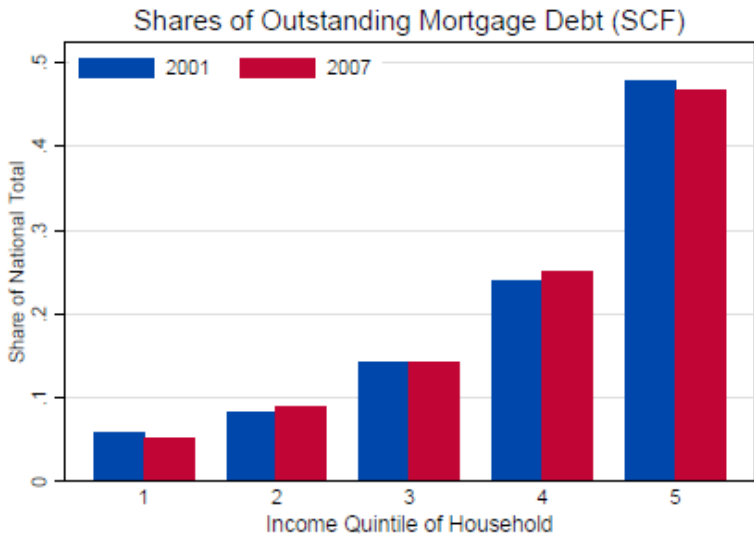
Assume: No increase in down payment size or income

	2000	2007	Growth
Home Price	\$ 300,000	\$ 420,000	40%
LTV	80%	86%	
Mortgage Debt	\$ 240,000	\$ 360,000	50%
Down Payment	\$ 60,000	\$ 60,000	

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

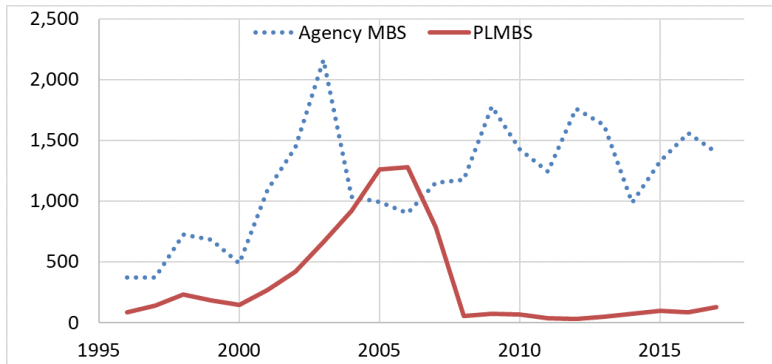
Growth in Mortgage Debt in Boom Broad-Based



Source: Foote, Loewenstein, and Willen (2016).

Growth in Nonprime Securities

Issuance of MBS in \$B



Source: SIFMA.

But average income for borrowers of mortgage in PLMBS pools >100,00\$ (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 δ every period
- Home owners must pay δ every period in which they own to maintain the property
- Financial intermediaries must pay a cost χ (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 π_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 λ 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 λ , and will decrease to size h_1 with probability λ
 - home of size h_3 will stay size h_3 with probability $1 - \lambda$ and will decrease to size h_2 with probability λ
 - 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 λ
- 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 ρ

Financial Intermediaries

- Accepts household savings and makes mortgage loans
- Earns the exogenously given rate r on savings
- Pays a servicing cost, ϕ , 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 δ on its housing stock
- Incurs a cost χqh 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:

$$y_t = \rho y_{t-1} + \gamma_1 \text{age}_t + \gamma_2 \text{age}_t^2 + \varepsilon_t \quad (1)$$

where ε_t has variance σ_ε^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 ψ to 0.76 implying that renters spend 24% of their consumption expenditure on housing (Davis and Ortalo-Magné, 2011)

Parameterization

Housing Costs

- Set χ , 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 ρ , 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
 - λ : probability of an idiosyncratic house price shock
 - house sizes, h_1 , h_2 , and h_3
 - mortgage servicing cost, ϕ
 - q : relative price of housing
 - δ : per period depreciation rate on housing

Steady State Equilibria

Moment	Data			Model		
	2001	2007	2016	no LDP	$v_{LDP} = 0.1$	$v_{LDP} = 0.0$
Home Ownership	68.0%	67.8%	63.7%	71.3%	71.5%	72.5%
Low Income				30%	30%	30%
Mid Income				83%	83%	83%
High Income				92%	92%	98%
Under 35	42%	41%	35%	31%	31%	37%
35-44	68%	67%	59%	70%	71%	70%
45-54	76%	75%	70%	81%	81%	81%
55-65	81%	80%	75%	86%	86%	86%
65+	81%	80%	80%	76%	76%	76%
Loan-to-Income	182%	241%	230%	208%	207%	199%
Share LDPs				-	2.2%	12.0%
TRAD Mtg Rate				5.27%	5.27%	5.27%
NDP Mtg Rate				-	5.93%	7.08%
Avg. 30-year Mtg Rate	4.97%	4.34%	1.65%	5.27%	5.28%	5.33%
Foreclosure Rate				1.29%	1.31%	1.41%

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