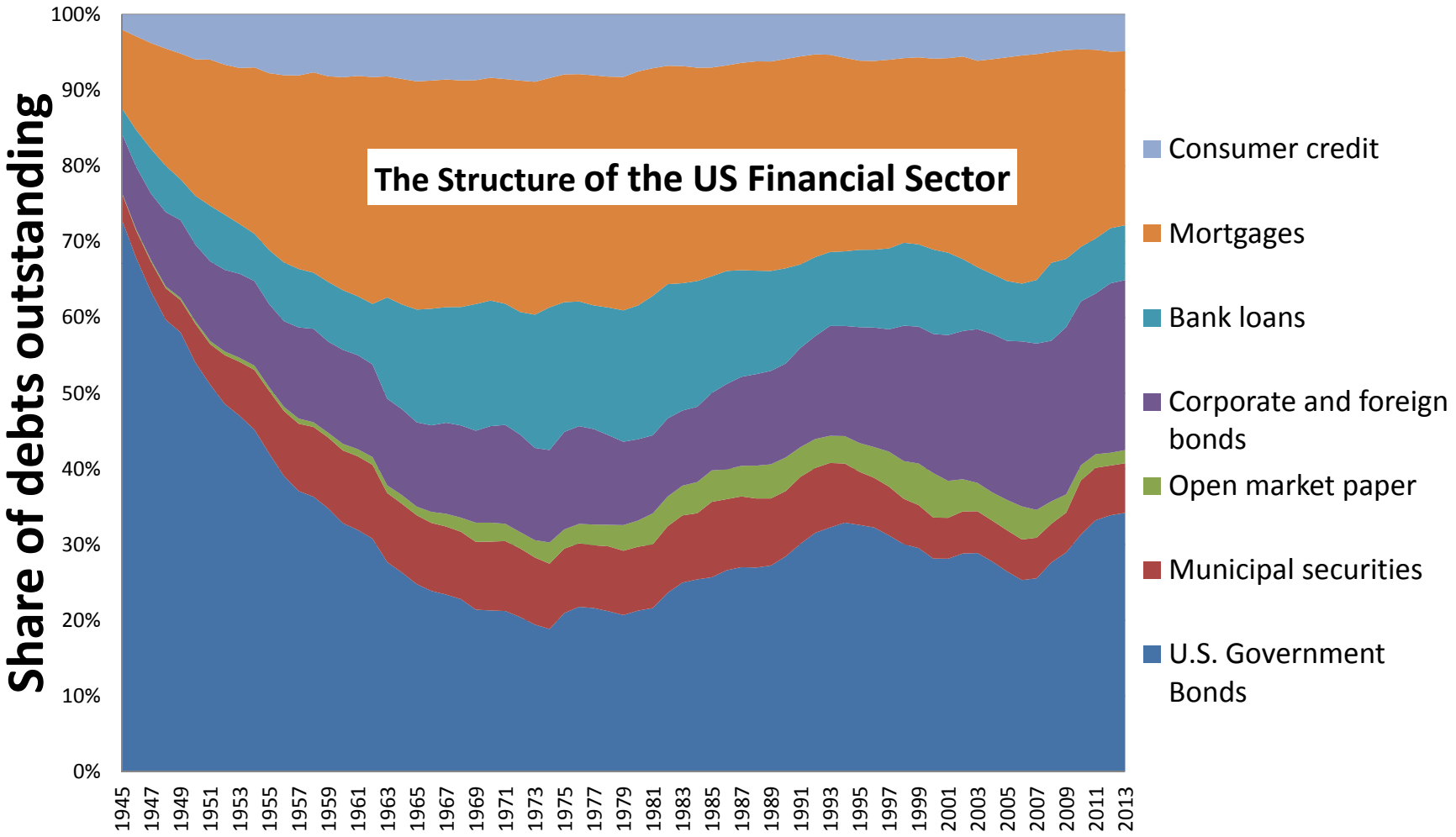
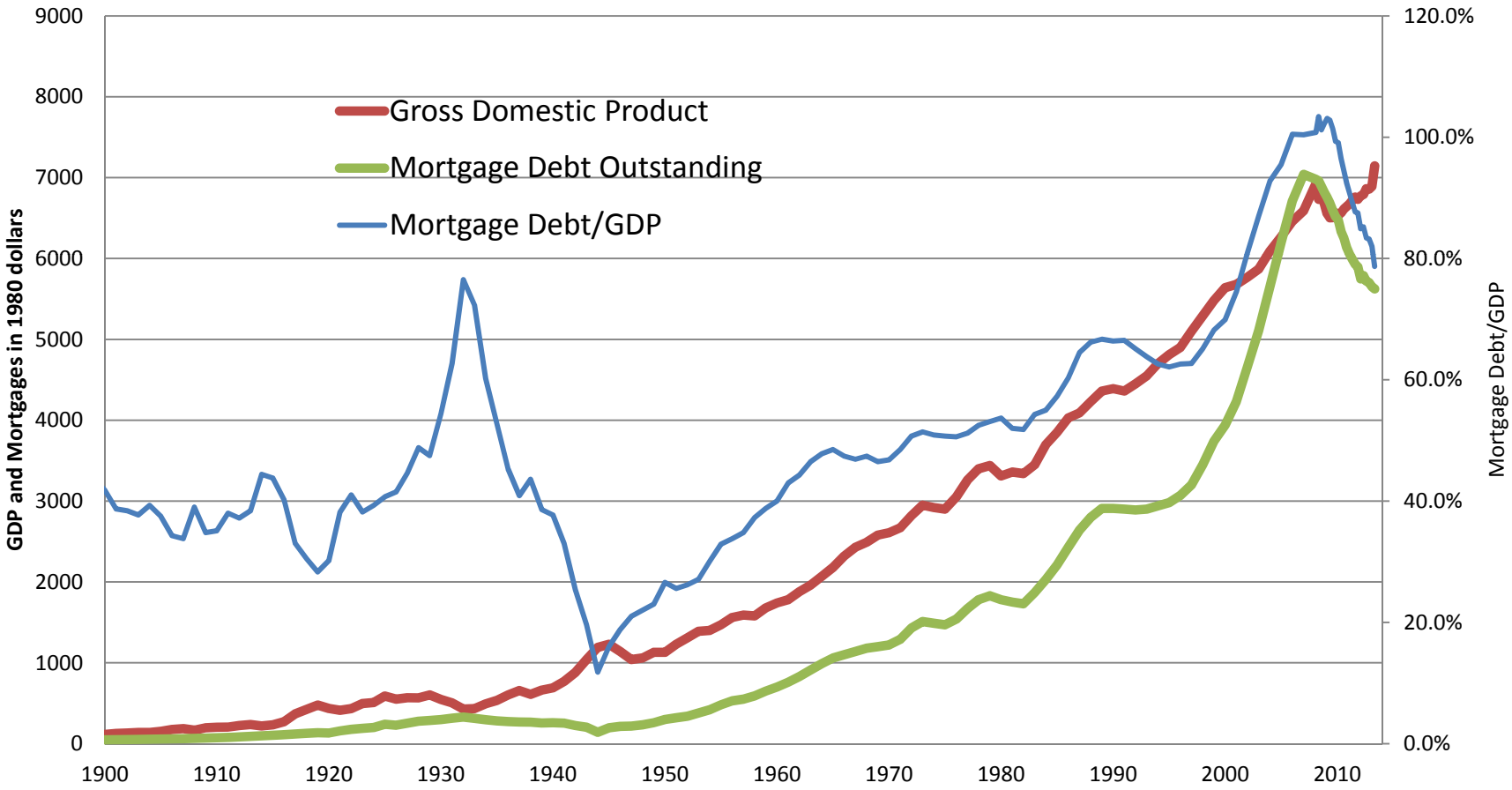
11-25 Class 17,
The problem of Mortgages

- Collateral lending: theory
- Lending on collateral before 1940 (land and real property); Information constraint (value of collateral only known locally); Short maturity, balloon payment, illiquid and poorly diversified
- Solution (1): Raise the information quality (lien registries); Financial innovation (covered mortgages)
- Solution (2): Mortgage backed securities and no leverage rules; Boom and bust

Why worry about mortgages



Crisis in the mortgage market



Collateral lending: theory

- Recall the structure of a riskless one period bond claim
  - Capital sum B, term T, coupon rate r_m. risk free interest rate r_F, and foreclosure cost c.
- NPV=$B(1+ r_m)/(1+r_F)$ Set r_m so NPV =B => $r_m=Br_F$
- Now suppose there are two possible outcomes each period:
  - perform(probability q) and borrower pays $B(1+ r_m)$
  - default (probability (1-q) and lender gets asset V and borrower pays penalty p.
- NPV=$[d(V-c)+(1-d)(B(1+r_m))]/(1+r_F)$
- Collateral loan, borrower has option to default (choses d).
  - So perform if $B(1+r_m)<V+p$
- As long as this inequality holds there is no default.
  - If so set $r_m=r_F$ and NPV=B.

Lending rule

- No default equilibrium
- Max B such that $B(1+r_m) < V+p \Rightarrow B=(V+p)/(1+r_m)$
- If V is certain, and the penalty (p) is large loan to value ratio (B/V) can be large but it has an upper bound.
- Now suppose V is uncertain. For a no default equilibrium what you need to know is the minimum value of V: $\underline{V}$ and then the rationing rule becomes $B=(\underline{V}+p)/(1+r_m)$
- Notice now that the rationing rule can be severe if p is small and c is non trivial.
  - Take the empirical distribution of home value changes in Los Angeles, the largest one year decline is -24%. $\Rightarrow \underline{V}=0.76V$
  - Take the empirical distribution of mortgage interest rate (r_m), the 75^{th} percentile of that distribution is 10%
  - So if I want to buy a house with value V in a no default equilibrium where p=0, then $B< \underline{V}/(1+ r_m) \Rightarrow B<0.76/1.1=0.69$
  - Notice that if you make payments monthly, then we can increase B to .75

Lending rule more periods

- Problem is that downturns can be severe and in fact persist:

largest declines over

- 2 years -39.5%. 3 years -41%.
- 4 years -37%. 5 years -40%.
- 7 year -32% 10 year 0%
- Then after that the minimum becomes positive. So you might think that having a high LtV might be feasible if you can be patient enough
- But remember a collateral loan is actually a put. So you have to worry about interim default.

Pricing risk

- Default rates (or rather foreclosure rates) are low but they are always positive so you have to price risk.
- Lets do this in two steps.
  - First fix the loan to value ratio (λ) and figure out the risk premium. (if LTV= λ; then B= λV^0)
  - Then see what happens when we let the risk premium vary.
  - For now maintain that risk is either idiosyncratic or local so it can be diversified away.

- Given a loan to value ratio and a penalty P and given some historical data on the evolution of prices, the problem is simply actuarial (because the lender can diversify the risk he acts like he is risk neutral). Need d and V^d
  - Borrower pays back as long as => $B<V^1+p-r_m$. Default rate (d) is the probability $B+p-r_m<V_1$
  - The value of the asset if foreclosure arises $V^d = E(V_1 | d=1)$
- Lender then sets r_m to be such that
- $B(1+r_F)=(1-d)B(1+r_m)+d(V^d-c)$
- $(1-d)Br_m=B(1+r_F)-B(1-d)-d(V^d-c)$
- $(1-d)Br_m=B(r_F+d)-d(V^d-c)$ Given that $B= \lambda V^0$
- $(1-d)\lambda V^0 r_m= \lambda V^0(r_F+d)-d(V^d-c)$
- $\Leftrightarrow r_m=[\lambda V^0(r_F+d)-d(V^d-c)]/[(1-d)\lambda V^0]$
- This is a number. So on one level it just algebra and some basic probability.

Implications for credit

- $r_m=[\lambda V^0(r_F+d)-d(V^d-c)]/[(1-d)\lambda V^0]$
- Notice
- The value of the asset in case of performance is irrelevant. (the lender does not get the upside)
- r_m increases d and
- R_m declines with V_d
- r_m increases with λ both directly and through the default probabilities.

Heterogeneous borrowers

- Local housing prices takes on two states high or low (with equal probability). And there are two types of borrowers (n of each) and the lender has 2nB to lend.
- Currently their collateral is worth V, they can borrow $\lambda V=B$
  - The collateral values are such that $V^{2l}<V^{1l}<B<V^{1h}<V^{2h}$
  - And $0.5V^{2l}+0.5V^{2h}= 0.5V^{1l}+0.5V^{1h}$ (project have equal total payoffs)
- Lender who is risk neutral knows she will get equal proportions of the two types
- So the price of credit is set by
  - $(1+r_F)B= 0.25V^{1l}+0.25V^{2l}+ 0.5(1+r_m)B$
  - $0.5(1+r_m)B= (1+r_F)B-0.25(V^{1l}+V^{2l})$

$$r_m= (1+2r_F)-0.5(V^{1l}+V^{2l})/B$$

This is the minimum interest rate such that lenders will participate without knowing more about the borrowers

Returns to lenders

- $r_m = (1+2r_F) - 0.5(V^{1l}+V^{2l})/B$
- If they face a type 1 lender they get
- $L_1 = 0.5V^{1l}+0.5(1+r_m)B$
- $L_2 = 0.5V^{2l}+0.5(1+r_m)B$
- Because $V^{1l}>V^{2l}$ $L_1 > L_2$
- So if r_m is the competitive rate and the lender makes no profits he actually looses money on every type 2 borrower and makes money on every type 1.

What borrowers decide

- Borrowers accept loan terms if
  - $\Pi_i = 0.5[V^{ih}–(1+r_m)B]>0$
  - Now because $V^{2l}<V^{1l}<V^{1h}<V^{2h}$
  - Borrowers of type 2 are always willing to participate if type 1 are willing.
- Now suppose $V^{1h} =(1+r_m)B$ so that borrower of type 1 is indifferent between being in the market or not ($\Pi_i = 0$).
- Suppose also that there is a contract in loanable funds so that instead of having 2nB the lender only has 2n'B
  - Suppose he raises interest rates
  - Then type 1 borrowers drop out and the lender is left with type 2 borrowers
  - lender raises interest rates to satisfy $(1+r_F)B= 0.5V^{2l}+ 0.5(1+r_{m2})B$
  - $r_{m2}= (1+2r_F)- V^{2l}/B$
  - But if n'>n/2 then he has excess funds to lend.

Collateral market equilibrium

- Notice that in this example it is the safer borrowers who drop out. And this poses problems for equilibrium
  - This is a bit artificial but it is important practically. The collateral loan in effect gives the mortgager an option on the asset.
  - Raising interest rates tends to select borrowers who have good up sides (V^{ih} is big) but not necessarily borrowers of high quality (V^{il} is big).
  - Notice this is different from standard demand theory (where private value and social value are the same)
- Two types of equilibrium
  - Serve only the high risk borrowers (at a high interest rate). This it turns out is inefficient because not all funds are lent and thus social returns are not maximized
  - Ration. Run a lottery over all applicants such that the probability of getting a loan is n'/n. This it turns out is efficient (since you lend out the maximal amount of loanable funds)

Making markets efficient

- We assumed that the lender can't tell who is type 1 and type 2.
  - Type relates to the assets (say whether you are along the coast or near the desert) this is something the lender will learn over time (at some cost).
- Information quality is a choice.
  - Does Competition lead to better information?
  - Sometimes yes sometimes no

Competition leads to efficiency

- Recall that
- $L_1 = 0.5V^{1l} + 0.5(1+r_m)B$
- $L_2 = 0.5V^{2l} + 0.5(1+r_m)B$
- Notice that $L_1 - L_2 = 0.5(V^{1l} - V^{2l})$
- That is the value of information (what you would pay to get only type 1 borrowers).
  - The likelihood of default times the difference in collateral value at foreclosure.
- Clearly this is always going to be a positive number
  - but if you think the likelihood of default is very low you do not care very much
  - Or if the difference in recovery values is low
  - And there is always a cost.
- Boom bust cycle in information.

Competition does not lead to efficiency

- Most banks and financial intermediaries reward their loan officers by commission (or bonuses) that reflect the number of loans they make.
- there is a loan committee that reviews each application
- Suppose the supply of loanable funds is large (so that intermediaries are competing for customers)
  - Banks want to make more loans so they need more loan officers
  - In effect they are competing for loan officers
  - Loan officers do not like rejected loans and they do not like having to make the effort to distinguish different types of borrowers.

Quiz 10

Consequence of collateral lending

- Variations in LTV (λ)
  - When LTV is low default rates are low (100% of loan value if LTV=0.5). No need for further information (the collateral screens). But only people with high wealth borrow.
  - The density of wealth distribution is decreasing (the number of households of a given wealth is declining in wealth) so raising LTV increase the number of households in the market.
  - So more bidders when LTV is low and that has impact on asset values.
- Interest rates (r_m)
  - As interest rates decline asset values go up. Simply because if v is the expected flow value (say rental income or value of this particular house to me) $V=v\Sigma 1/(1+r)^t$.
  - But impact is limited because you will have to sell your asset and there is mean reversion in interest rates (if interest rates are low, then you expect them to go up soon)
  - Also matters if the loan standards involve both LTV and income (because as interest rates go down you can finance a bigger loan for a given income.
- Information
  - Start with a pooling equilibrium (LTV plus income).
  - Market change involves
    - (1) better deals for better borrowers (cream skimming)
    - (2) Deals for worse borrower (sub prime credit)

From theory to data
the evolution of the mortgage market

- The traditional system
  - Peer to peer
  - high low LTV
  - Balloon payments
  - Fixed interest rates
  - Limited term

- Problems
  - Lenders poorly diversified
  - Loans illiquid
  - Borrowers severely rationed
  - Refinancing risk is severe

- Advantages
  - Good local information
  - Continuity of contract
  - No incentive problems

Efforts at innovation (1)

- Pick any problem, an intermediary should be able to help. And there are both market and bank solutions
- Mortgage bank
  - Banks makes mortgages and holds them
  - Raises its liabilities from the market so its stock and bonds are liquid. Stock is a reserve fund so its bonds are covered.
  - Has resources to make longer term loans and self amortizing mortgages so no refinancing risk
  - Reduction in rationing because bank can deal with default better than individuals lenders (its foreclosure costs can be reduced and it can price risk).

Efforts at innovation (2)

- Market solution
  - Create a pool of mortgages place them into a trust or a shell corporation (its only assets are the mortgages).
  - Then sell shares into a trust
  - And sell claims on that.
  - These could be equity claims or they could be debt. (Collateralized debt obligations, covered mortgages)
  - Then can go several steps further (but that is for Wednesday) in creating securities with specific claims on the pools of mortgages.
  - Problem here is continuity of contract

Intermediate solutions

- Local savings and loans
- Appeared in the 1810s mostly to fund urban mortgages, work well (no rate of insolvency)
- But limit to credit severe (balloon payments, 5 year term, and low LTV)
- Change in structure after the Great Depression. Moved to the self amortizing mortgage, but fixed interest rate)
- Mostly disappeared in the 1980 with both the consequences of inflation in the 1970s and deregulation.

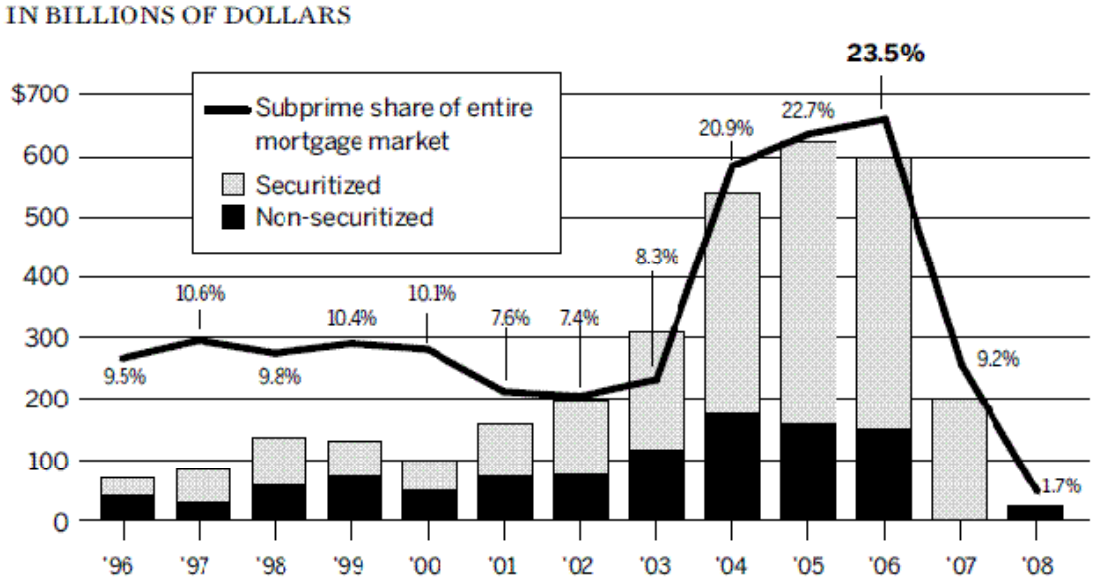
More recent innovation

- We will deal with the subprime crisis from the lender site next time
- Here we just want to get a sense of a few things
  - Innovation in qualifications
  - LTV changes
  - Regional distribution
  - Time path of the crisis

Mortgage Companies

Subprime Mortgage Originations

In 2006, $600 billion of subprime loans were originated, most of which were securitized. That year, subprime lending accounted for 23.5% of all mortgage originations.



NOTE: Percent securitized is defined as subprime securities issued divided by originations in a given year. In 2007, securities issued exceeded originations.

SOURCE: Inside Mortgage Finance

Figure 4. Estimated Percentage of Home Purchase Volume with an LTV or CLTV >=97%
(Includes FHA and Conventional Loans*)
and Combined Foreclosure Start Rate for Conventional and Government Loans

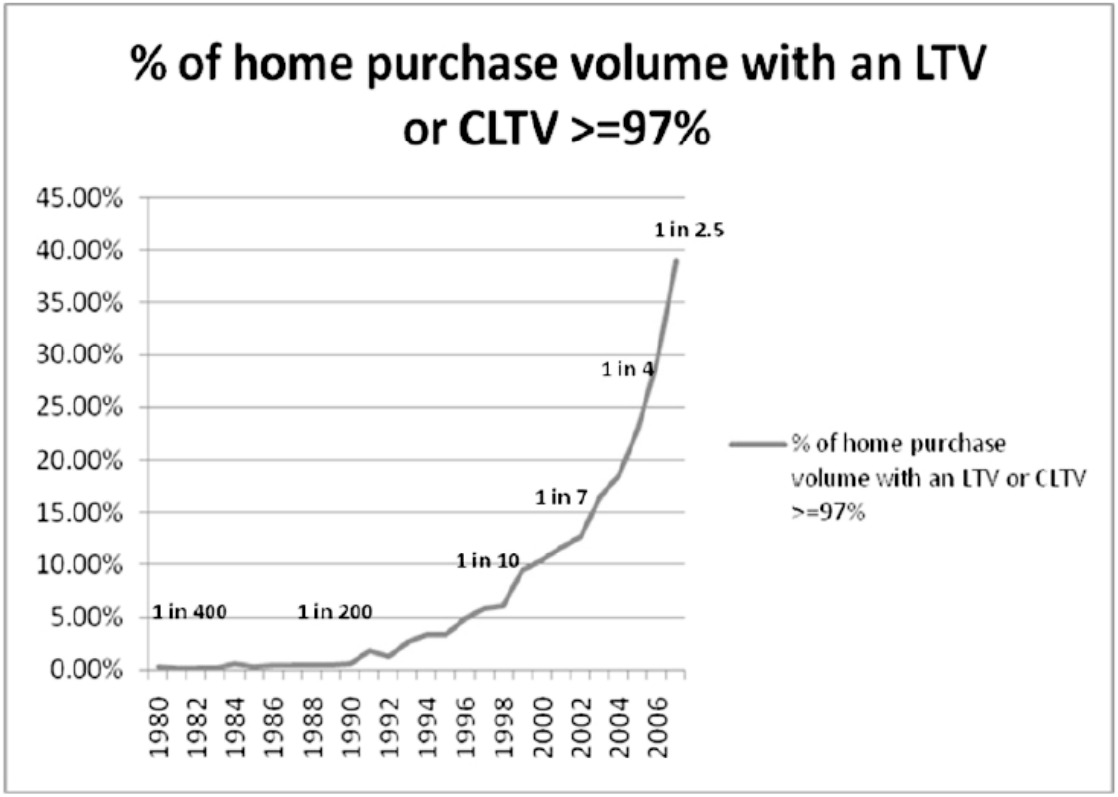
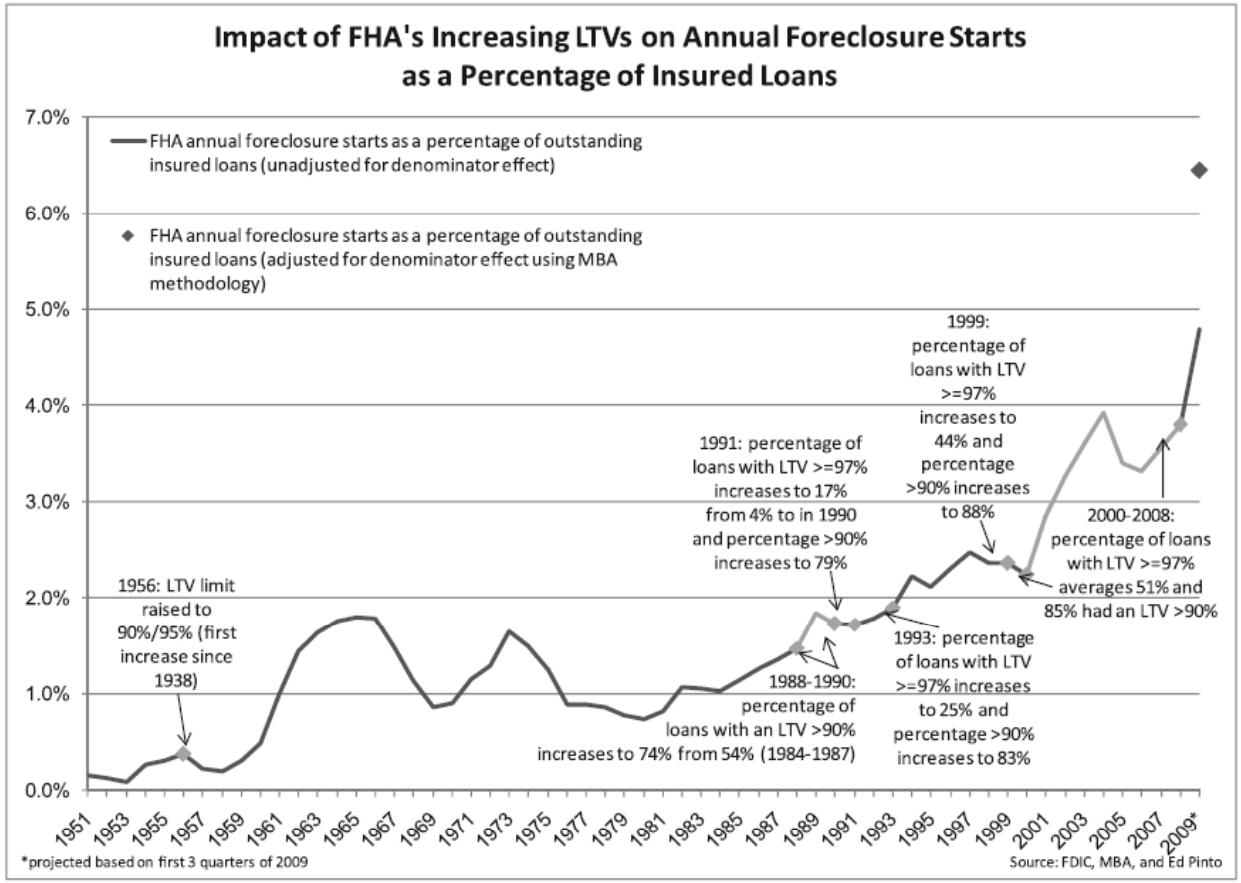
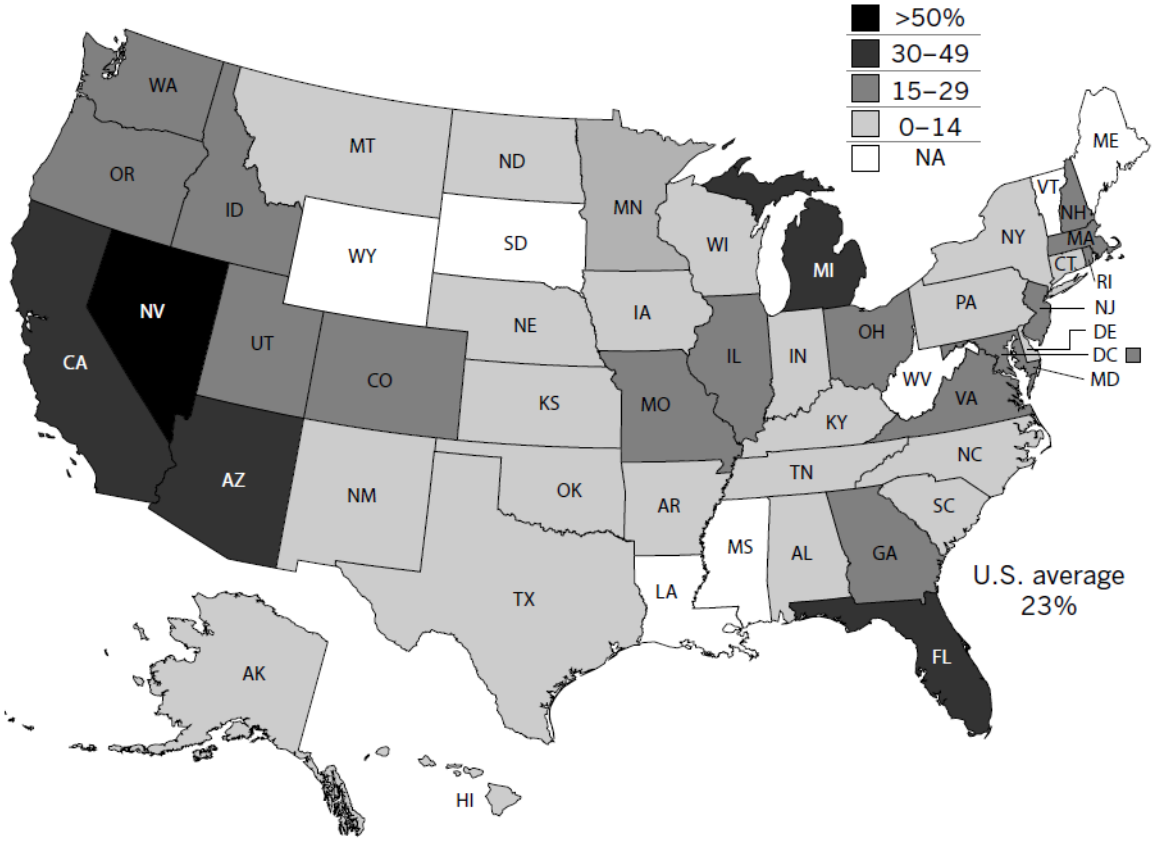


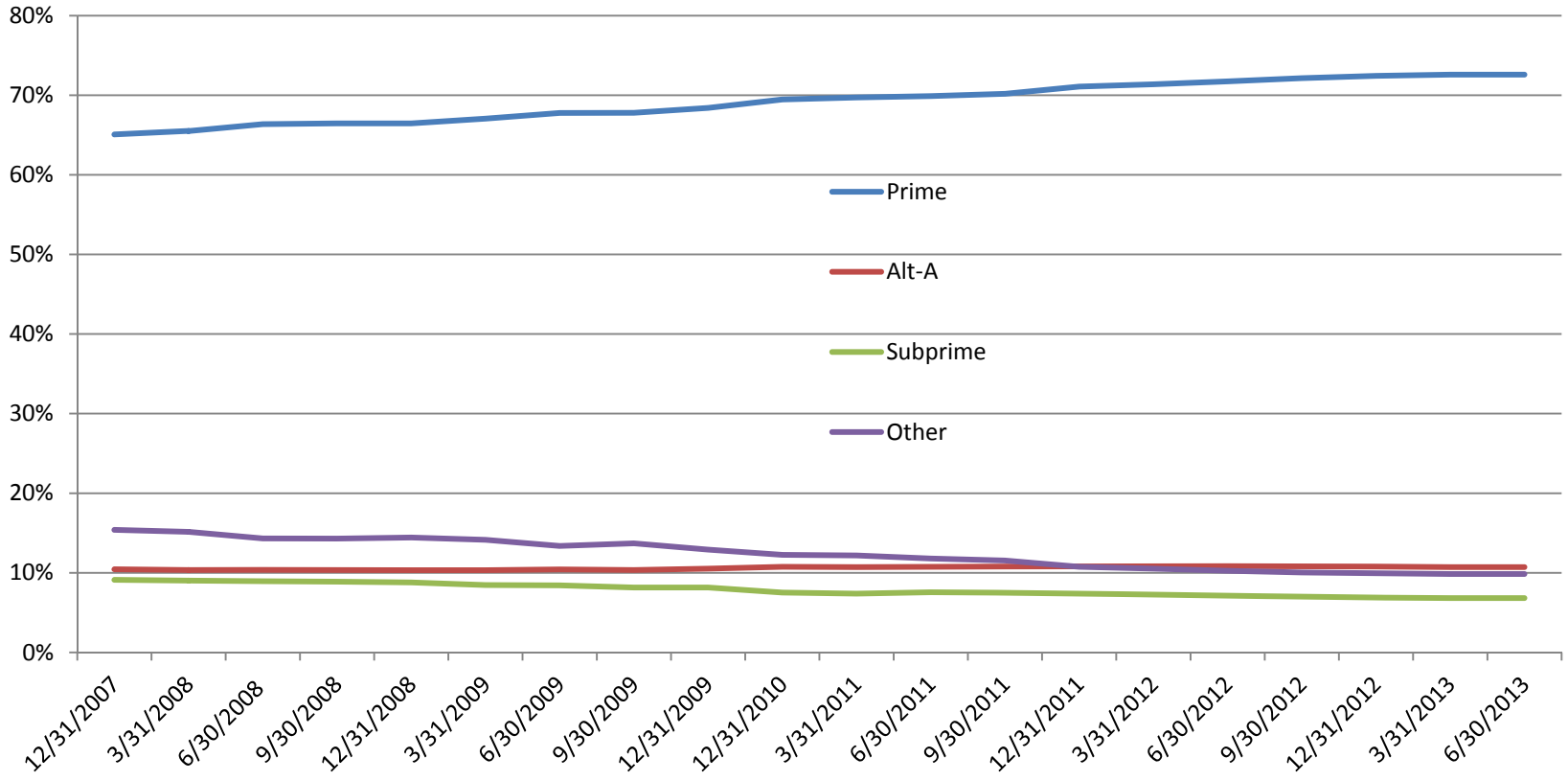
Figure 6.


Impact of FHA's Increasing LTVs on Annual Foreclosure Starts as a Percentage of Insured Loans
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
FHA annual foreclosure starts as a percentage of outstanding insured loans (unadjusted for denominator effect)
FHA annual foreclosure starts as a percentage of outstanding insured loans (adjusted for denominator effect using MBA methodology)
1956: LTV limit raised to 90%/95% (first increase since 1938)
1988-1990: percentage of loans with an LTV >90% increases to 74% from 54% (1984-1987)
1991: percentage of loans with LTV >=97% increases to 17% from 4% to in 1990 and percentage >90% increases to 79%
1993: percentage of loans with LTV >=97% increases to 25% and percentage >90% increases to 83%
1999: percentage of loans with LTV >=97% increases to 44% and percentage >90% increases to 88%
2000-2008: percentage of loans with LTV >=97% averages 51% and 85% had an LTV >90%
1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009*
*projected based on first 3 quarters of 2009
Source: FDIC, MBA, and Ed Pinto

SHARE OF LOANS WITH NEGATIVE EQUITY, THIRD QUARTER 2010



Innovation


80%
70%
60%
50%
40%
30%
20%
10%
0%
Prime
Alt-A
Subprime
Other
12/31/2007
3/31/2008
6/30/2008
9/30/2008
12/31/2008
3/31/2009
6/30/2009
9/30/2009
12/31/2009
12/31/2010
3/31/2011
6/30/2011
9/30/2011
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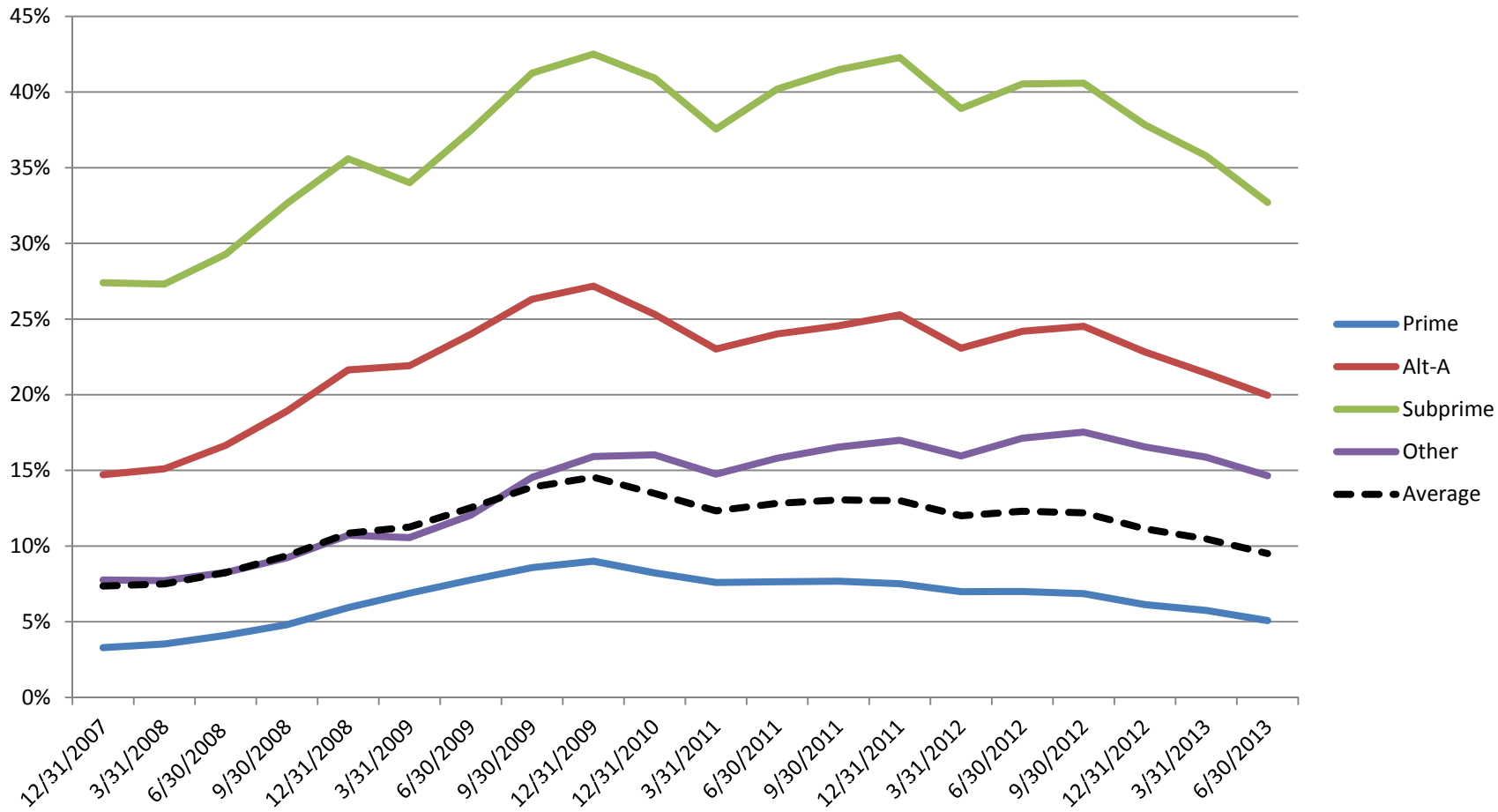
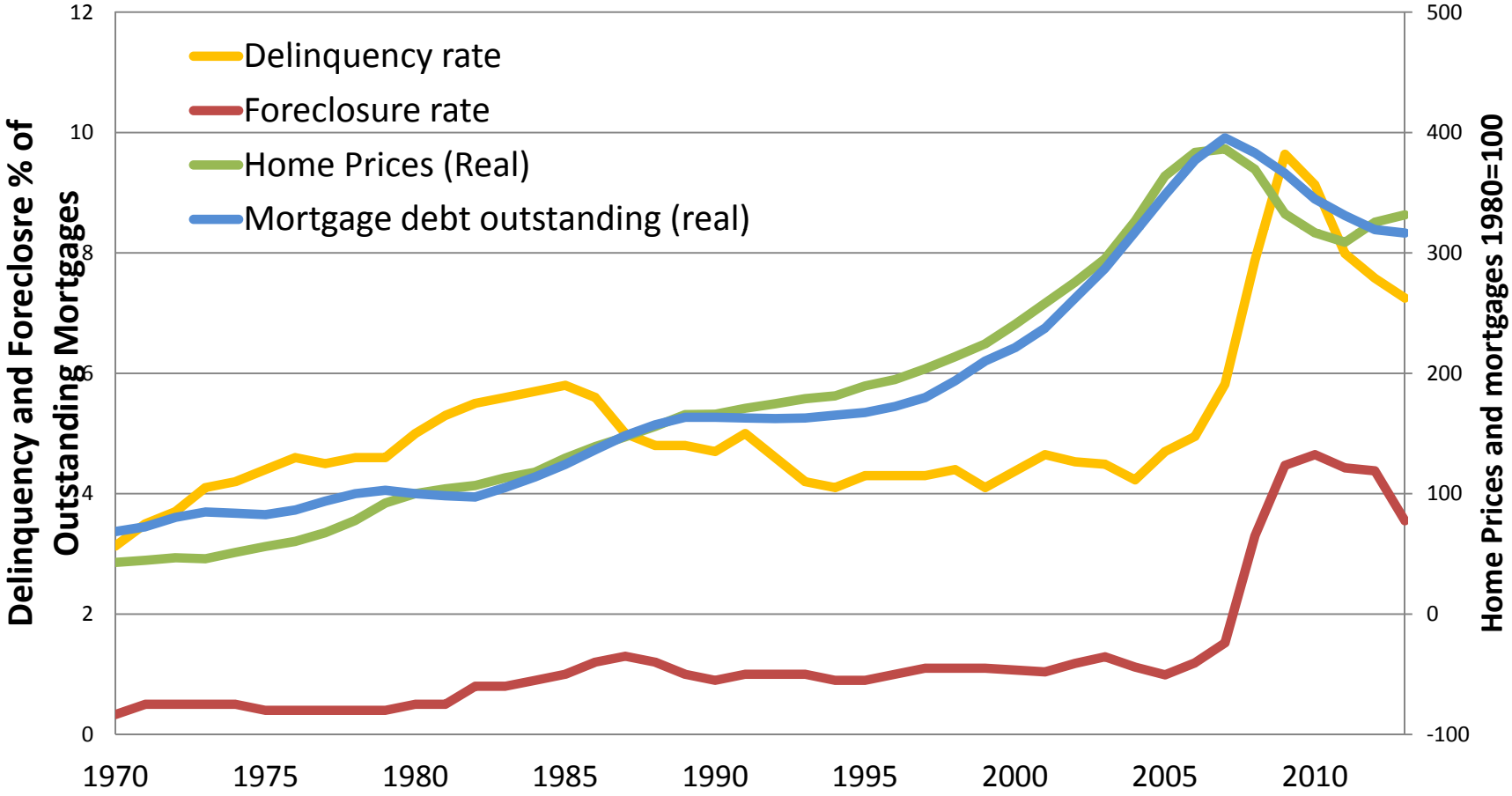
Persistence of crisis




Delinquency rate
Foreclosure rate
Home Prices (Real)
Mortgage debt outstanding (real)
Delinquency and Foreclosre % of Outstanding Mortgages
Home Prices and mortgages 1980=100
12
10
8
6
4
2
0
500
400
300
200
100
0
-100
1970
1975
1980
1985
1990
1995
2000
2005
2010

Evaluations