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# Mortgage Default Option Mispricing and Procyclicality

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## I. Executive Summary and Introduction

This paper examines the role of mortgage supply characteristics in both affordability and financial risk outcomes, in the wake of the mortgage crisis. A hallmark of the crisis was a shift in mortgage lending products (shown in Figure 1). What impact did this shift have on consumers, investors and the overall financial system? In an effort to better understand the impact of various products on affordability as well as financial risk outcomes, we address the performance of these products and their interaction with the financial sector in the production of systemic risk. While *ex post* the performance of these mortgages was disastrous (shown in Figure 6), and neither expected nor priced, we also show that *ex ante* credit risk was mispriced. The links between mortgage lending instruments, such as interest only, negative amortization or subprime mortgages, and underlying house price volatility and associated risks have been explored in recent empirical and theoretical research. While it may seem obvious that such instruments allow more borrowing than otherwise would occur in previously affordability and credit score-constrained markets, and prices rise as a result, the relationship may very well go both ways. That is, it is possible that markets with rising prices invite more supply of nontraditional mortgage products, and, under certain conditions, this could occur without an increase in credit risk, for example, if there is an innovation in lending technology that better discriminates good from bad risks and expands the credit box.

This paper reviews the literature on this question, summarizing models in which the expansion of nontraditional mortgages (NTM) is associated with a decrease as well as an increase in overall financial risk. Increased risk may come from several sources. First, it is possible that the expansion of NTM occurs along with the easing of credit constraints and underwriting standards associated with increased default risk; in short, increasing lending to riskier borrowers. Secondly, it is possible that the mortgage instruments themselves are riskier.). Third, it is possible that the risk due to either of these factors is not priced. But as noted it also possible that an increase in NTM occurs without an increase in risk but rather with a decrease in risk. That is, NTM expands when prices expand, and this is rational because prices increase due to a decline in risk as a result of an innovation in mortgage lending technology.

The problem with this latter explanation as a model of the recent housing and mortgage market boom and bust is that there is evidence that during the expansion period, a key driver of default risk indisputably increased, and that is the consolidated loan-to-value (CLTV) ratio. If technology also shifted so that risk could be calibrated or diversified better, then higher CLTVs could be sustainable. It may have been supposed that there was such a technology shift. But, as we discuss, in fact such a technology shift did not occur in the bubble years.

We examine the role of the provision of NTMs for credit risk along with affordability and then turn to systemic risk. Most economies depend on the financial sector for real estate lending, thus real estate booms and financial busts often occur together. And while real estate booms may occur without crises in the financial sector, and vice-versa, these two phenomena have nevertheless been linked in a remarkable number of instances. If the financial sector is exposed to credit risk of sufficient magnitude, the result will be a liquidity and solvency event. Despite the intervention of monetary authorities through QE I, II and III, to maintain low interest rates, a rise in the cost of capital for housing has occurred, along with a significant increase in borrowing constraints.

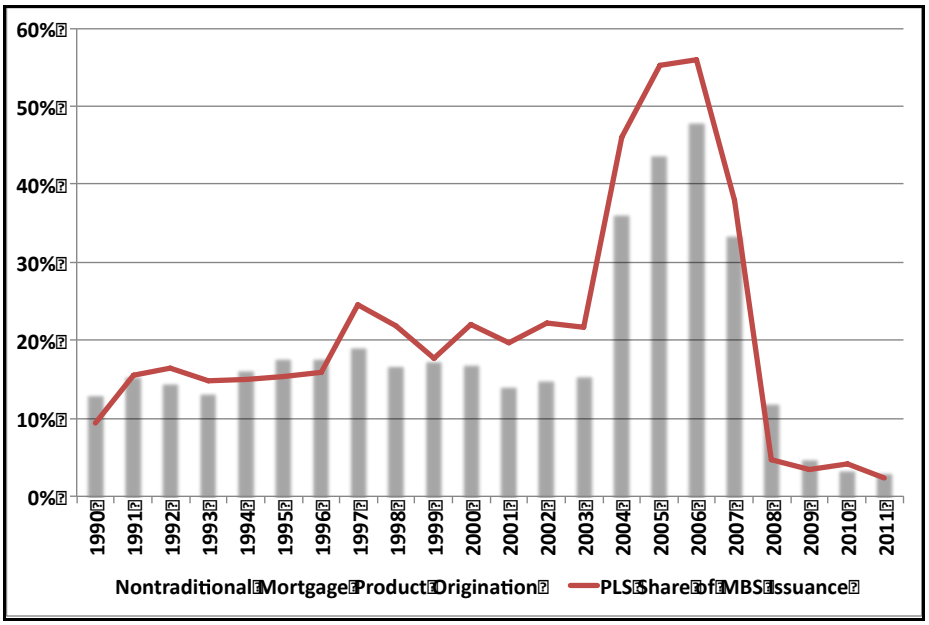
In Part II, which follows, we discuss the expansion and performance of nontraditional mortgages. We then turn to a discussion of the cost of credit when consolidated loan-to-value ratios are accounted for and present results on the ex ante pricing of risk for NTM in Part III. In Part IV we discuss the implications of the expansion in NTM for affordability and homeownership. Part V discusses how and

why credit risk in mortgage lending is related to systemic risk, particularly as demonstrated in the recent history of the mortgage crisis in the US and concludes with implications for policy.

## II. The Expansion of Nontraditional Mortgage Instruments

In this section, we provide data on the rapid expansion of NTMs in the years 2000 through 2005 and show their performance.[1] In the first half of the 2000s, subprime mortgages, interest only loans, negative amortizing, teaser rate ARMs, Payment (Pay) option ARMs and alt-A mortgages as well as second liens dramatically increased their share of the overall mortgage origination market (Figure 1, Table 1, and Figure 2).[2] As it expanded, the subprime market developed new products whose features had never faced a market test. This included a particular class of initially discounted "hybrid ARMs" with short initial adjustment periods, also referred to as 2/28 and 3/27 loans—30-year loans with a fixed rate teaser period of two or three years and annually adjusted rates thereafter. Buyers qualified based on the initial low "teaser" rate, even though they were not able to shoulder the higher payments that were scheduled, if they could not refinance to lower interest rate loans. Such products were overlaid overtime with increasing use of second liens and alt-A mortgages, such as low and no doc loans.

**Figure 1: Market Share of Nontraditional Mortgage Products and Private Label Securitization**



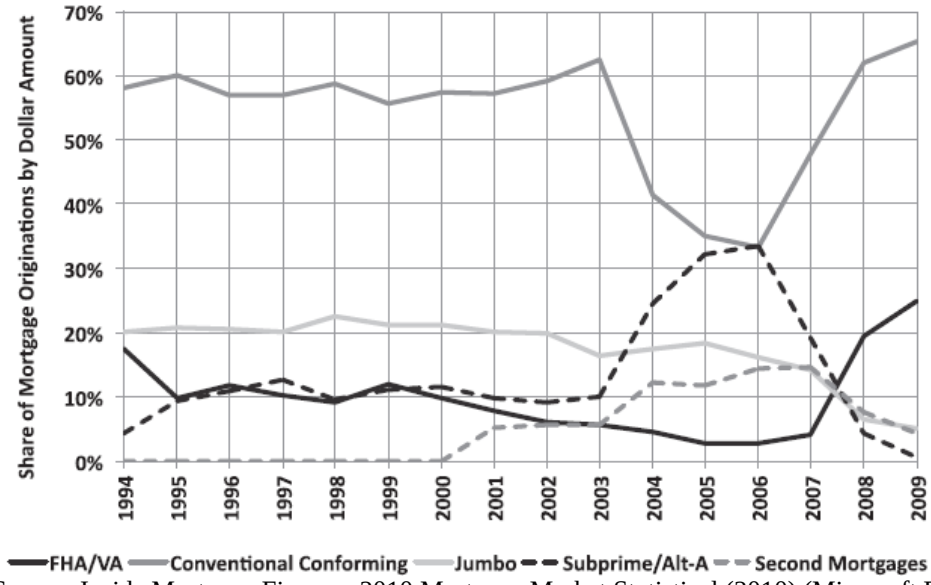

Source: Inside Mortgage Finance 2012 Mortgage Market Statistical Annual. Nontraditional mortgage products are subprime, alt-A and home equity loans.

[1] See Pavlov and Wachter, (2012) "Explaining the Housing Bubble," http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1669401 for a description of the causes of the rise of NTM lending.

[2] Interest-only loans allow borrowers to make no principal payments; negative amortizing loans is when monthly payments are less than interest owed; pay option adjustable-rate mortgages (ARMs) allow borrowers to choose the monthly payment level, including making interest only or negatively amortizing payments; and alt-A loans also called "low doc" or "no doc" loans require little or no down payment, documentation, or proof of income.

Subprime and low doc loans had long existed as part of mortgage markets but their share had remained limited from their origin in the 1970s through the early 2000's, with conforming loans, Jumbo loans, and FHA representing a stable share of around 90% of all loans originated (as shown in Figure 2). As of 2003, subprime and alt-A loans only accounted for about 10% of mortgage origination (Levitin and Wachter, 2012). Between 2003 and 2007 NTMs became a significant share of the mortgage-finance market. A third of mortgages issued in 2006 were subprime or alt-A mortgages. Including second liens, 47% of the market was made of NTM in 2006 (Figure 2 and Table 1). The growth in NTMs coincided with the growth in Private Label Securities (PLS), which represented more than half of MBS issued in 2006, at their peak, and in which the vast majority of the NTMs were securitized (Figures 1 and 3). After the housing bust, NTM products disappeared along with PLS.[3]

**Figure 2. Origination Volume by Mortgage Type, 1990–2009**




Source: Inside Mortgage Finance, 2010 Mortgage Market Statistical (2010) (Microsoft Excel supplemental files).

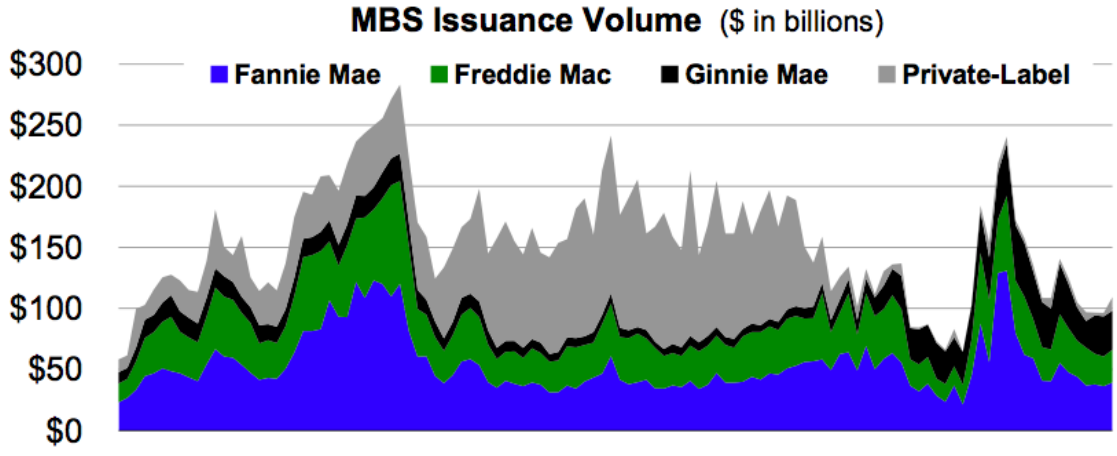
[3] See Thomas and Van Order (2010) for a discussion of this relationship.

**Table 1: Mortgage Originations by Product**

| | FHA/VA ↓ | Conv/Conf ↓ | Jumbo ↓ | Subprime ↑ | Alt A ↑ | HEL ↑ |
|---|---|---|---|---|---|---|
| ***2001*** | ***8%*** | ***57%*** | ***20%*** | ***7%*** | ***2%*** | ***5%*** |
| 2002 | 7% | 63% | 21% | 1% | 2% | 6% |
| 2003 | 6% | 62% | 16% | 8% | 2% | 6% |
| 2004 | 4% | 41% | 17% | 18% | 6% | 12% |
| 2005 | 3% | 35% | 18% | 20% | 12% | 12% |
| ***2006*** | ***3%*** | ***33%*** | ***16%*** | ***20%*** | ***13%*** | ***14%*** |
| 2007 | 4% | 48% | 14% | 8% | 11% | 15% |

Source: Inside Mortgage Finance 2008 Mortgage Market Statistical Annual

**Figure 3. Mortgage-Backed Securities Issuance Volume, 2001-2010**



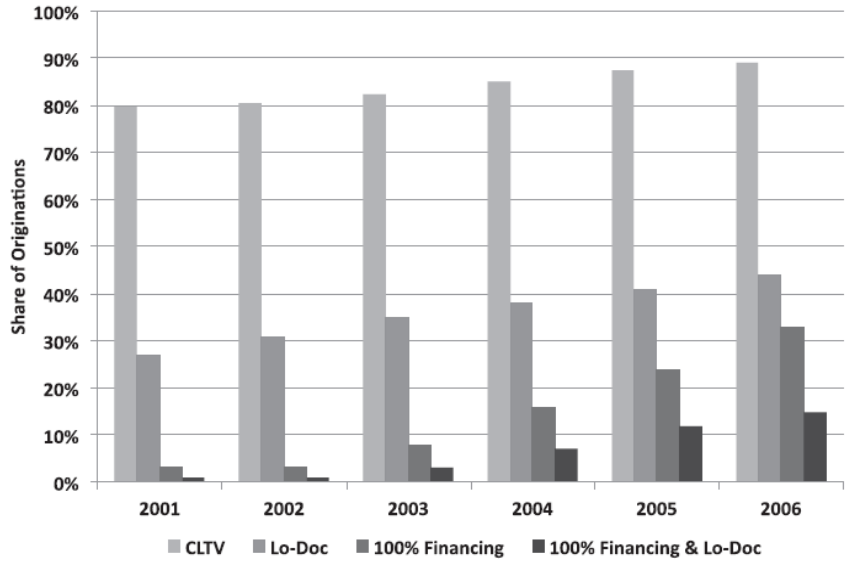

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | YTD |
|---|---|---|---|---|---|---|---|---|---|---|
| Enterprises | 67% | 68% | 70% | 47% | 41% | 40% | 58% | 73% | 72% | 66% |
| Ginnie Mae | 13% | 9% | 8% | 7% | 4% | 4% | 5% | 22% | 25% | 29% |
| Total Agency | 80% | 77% | 78% | 54% | 45% | 44% | 63% | 95% | 97% | 95% |

Source: Inside Mortgage Finance, Enterprise Monthly Volume Summaries, (2010)

The development of NTM instruments after 2003 coincided with a rise in long-term interest rates that ended the market for prime refinancing and required the mortgage industry to develop new products to maintain its origination volumes and earnings level (Levitin and Wachter, 2012). The growth in subprime and alt-A mortgages, as well as in second mortgages (home-equity loans and lines of credit) was accompanied by a loosening in underwriting standards with increased loan-to-value ratios, and limited verification of borrowers' income as shown in Figure

4. The relaxation of underwriting standards over the period was particularly concentrated in NTM products, as shown in Table 2. In 2006, less than 20% of alt-A's mortgages had full documentation and nearly 90% were interest only. Investors represented 16.5% of the alt-A borrowers at the peak and were far greater users of both Alt-A and subprime than owner occupants, adding to the default risk.[4] For both subprime and alt-A, Table 2 also shows a sharp increase in CLTV and in the proportion of borrowers who use a second lien, after 2003.

**Figure 4. Erosion of Residential Mortgage Underwriting Standards**




Source: Whitney Tilson, *Value Investing Website*, T2 PARTNERS LLC, http://www.t2partnersllc.com (Last visited Mar. 16, 2012). These figures reflect all mortgages, not just subprime.

[4] See Levitin and Wachter (2012) for further discussion.

**Table 2: Deterioration of Lending Standards by Product Type**

ARMS

| | Orig Yr | CLTV | CLTV>80 | Seconds | Full Doc | IO% | DTI | FICO<700 | Investor | WAC | SpdtoWAC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Prime | 2002 | 66.4 | 4.1 | 1.9 | 56.0 | 46 | 31.0 | 20.7 | 0.7 | 5.5 | - |
| | 2003 | 68.2 | 10.1 | 10.9 | 48.6 | 53 | 31.8 | 21.8 | 1.6 | 4.6 | - |
| | 2004 | 73.5 | 20.7 | 23.1 | 51.2 | 71 | 33.5 | 22.0 | 2.1 | 4.5 | - |
| | 2005 | 74.1 | 21.7 | 26.8 | 47.3 | 81 | 33.6 | 18.9 | 1.9 | 5.4 | - |
| | 2006 | 75.3 | 26.2 | 35.3 | 33.6 | 91 | 37.2 | 19.5 | 2.3 | 6.2 | - |
| Alt A | 2002 | 74.3 | 20.8 | 2.7 | 29.3 | 26 | 35.4 | 46.4 | 9.9 | 6.3 | 0.8 |
| | 2003 | 78.0 | 33.3 | 23.4 | 28.1 | 56 | 35.3 | 44.7 | 12.9 | 5.6 | 1.0 |
| | 2004 | 82.6 | 46.9 | 39.1 | 32.6 | 75 | 36.2 | 44.3 | 15.3 | 5.5 | 1.0 |
| | 2005 | 83.5 | 49.6 | 46.9 | 28.3 | 83 | 37.0 | 40.5 | 16.5 | 6.0 | 0.6 |
| | 2006 | 85.0 | 55.4 | 55.4 | 19.0 | 87 | 38.3 | 44.2 | 13.5 | 6.8 | 0.6 |
| Subprime | 2002 | 81.2 | 46.8 | 3.7 | 66.9 | 1 | 40.0 | 93.4 | 4.7 | 8.5 | 3.0 |
| | 2003 | 83.5 | 55.6 | 9.9 | 63.5 | 5 | 40.2 | 91.6 | 4.9 | 7.5 | 2.9 |
| | 2004 | 85.3 | 61.1 | 19.1 | 59.9 | 20 | 40.6 | 90.6 | 5.3 | 7.1 | 2.6 |
| | 2005 | 86.6 | 64.4 | 28.1 | 55.9 | 32 | 41.2 | 89.7 | 5.4 | 7.3 | 1.9 |
| | 2006 | 86.7 | 64.0 | 31.0 | 54.6 | 20 | 42.1 | 91.8 | 5.7 | 8.2 | 2.0 |

Spreads declined

CLTV, %>80 and use of Seconds increased

% Full Doc declined

Not much change in FICO or DTI

Source: Loan Performance data as of November 2006. UBS, April 16, 2007, Thomas Zimmerman, "How Did We Get Here and What Lies Ahead"

The development of NTM products contributed to an increase in the supply of credit (Figure 5). Current empirical evidence points to a relationship in which credit supply causes an increase in house prices and reciprocally the increase in house prices contributes to the relaxation of constraints and expansion in mortgage supply through new instruments. Recent studies such as Anundsen & Jansen (2012) and Berlinghieri, (2010) use structural vector error correction models to identify whether mortgage expansion Granger-causes price rises or whether rising prices Granger-causes an expansion in mortgage credit. Their findings generally support bidirectional causality.[5]

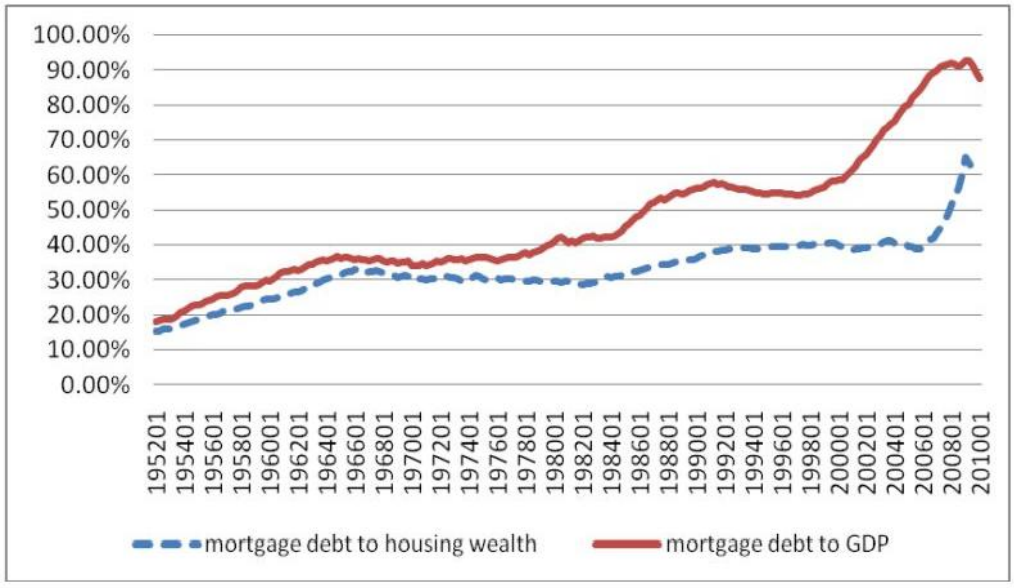
Figure 5 shows the co-determination of housing prices and mortgage debt, as both increased from 1992 through 2005 with their ratio unchanged. But what initially caused the expansion in both credit supply and housing prices? If the increased supply in NTMs is due to a risk reducing innovation that allows the overcoming of former credit constraints, the result will be lower risk, lower required returns, and higher welfare. The argument is that innovations such as risk-based credit pricing, and/or improved risk models could have allowed for the sustainable easing of constraints[6] and an appropriate pricing of the risk associated with NTM. In a theoretical model,

[5] See Levitin and Wachter (2013). "Why Housing?" http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2114620 for a further discussion of the literature. Also see Coleman et al. (2008) for a model of prices influencing supply and Pavlov and Wachter (2011) for a model of supply influencing prices.

[6] See Favilukis et al. (2012) for a description of a model in which financial innovations through financial market liberalization and technological gains allow households to smooth their consumption by reducing the risk in the economy and the risk of investments, enabling higher asset prices.

these innovations could lead to a permanent lowering of mortgage interest rate spreads over comparable Treasury rates and enable consumers to better smooth consumption over the life-cycle.

**Figure 5. Mortgage Debt to GDP and Housing Wealth**




Source: Federal Reserve Bank, Flow of Funds, Households sector's balance sheet

In the event, the data show that NTMs had historically high rates of default and a far higher rate of foreclosure than other mortgage products. As shown in Figure 6, which provides data on the quarterly rate of foreclosure by market segment, subprime ARMs had by far the highest foreclosure rate (almost 30% annually at the peak).

Option-pricing theory provides a structural framework for modeling ex ante risk in mortgage instruments, including credit risk. At each period, borrowers have the choice to: (1) stop making payments and default, or (2) payoff the entire mortgage balance (by refinancing the loan or selling the property). These two choices may be considered as two embedded "options"; the option to "call" the mortgage by prepaying the loan, and the option to "put" the property to the lender in exchange for the loan. With non-recourse loans, there is no other obligation to repay the loan.[7] The call option allows refinancing when interest rates fall. In the subprime market this option could also be used to refinance into the prime market if the borrower's credit condition improved.[8]

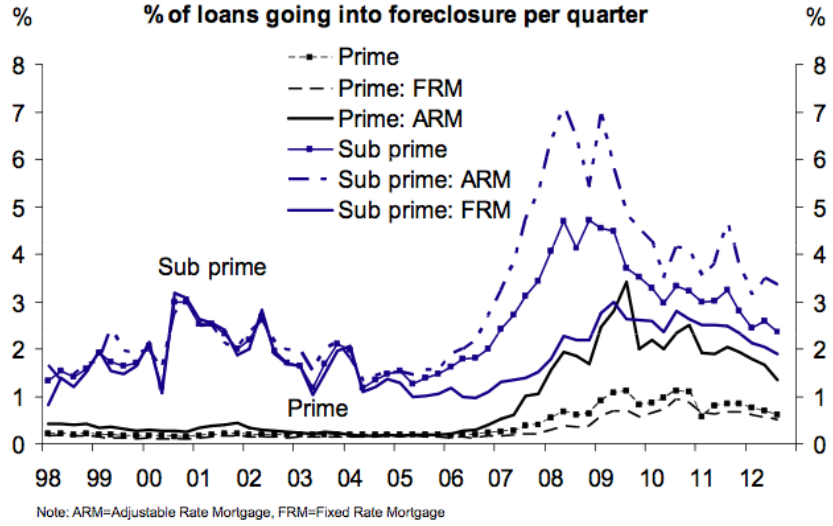
The literature establishes the likelihood of borrower distress and price declines as jointly contributing to default, so that temporary price rises could conceal a heightened risk of default due to a shift in the composition of loans. The higher default rates in the subprime segment are

[7] In many states, mortgages are nonrecourse, in others they are effectively so, given costly and limited recovery.

[8] Cutts and Van Order (2004) posit that the dynamics of these options differ between prime and subprime borrowers. Within the prime market, when interest rates fall, rational borrowers exercise their call option to refinance into lower rates. On the other hand, subprime borrowers find it harder to qualify for a new loan and are therefore, unable to optimally exercise their call option when rates decline.

generally interpreted as being due to subprime borrowers being more susceptible to trigger events, their property being more likely to fall in value (e.g., due to neighborhood effects), and/or to the risk of the instrument itself. More generally NTMs are likely to have higher credit risk ex ante and in fact expected returns were somewhat higher. Next we turn to an empirical examination of those returns and the question of whether they reflected ex ante credit risk.

**Figure 6. Foreclosure by Market Segment**




Source: MBA, Datastream, DB Global Markets Research

## III. A Hunt for Borrower Cost Reduction: Evidence of Mispriced Mortgage Risk

In this section, we quantify the role of mortgage features that contributed to housing price volatility combining evidence from origination data with models of borrower behavior.

We decompose borrower total cost into three terms:

- Loan Rate
- Down Payment
- Mispriced Credit Risk

Our analysis here follows the work of Davidson and Levin (2012), which analyzes the history of the mid-2000s housing bubble and the subsequent decline to reveal the role contributed by each of the constituent components. Our conclusions generally agree with other studies that seek the root of the crisis in availability of credit stemming primarily from unregulated non-agency securitization (Levitin and Wachter, 2012), and loans with non-standard features (Berkovec et al., 2013).

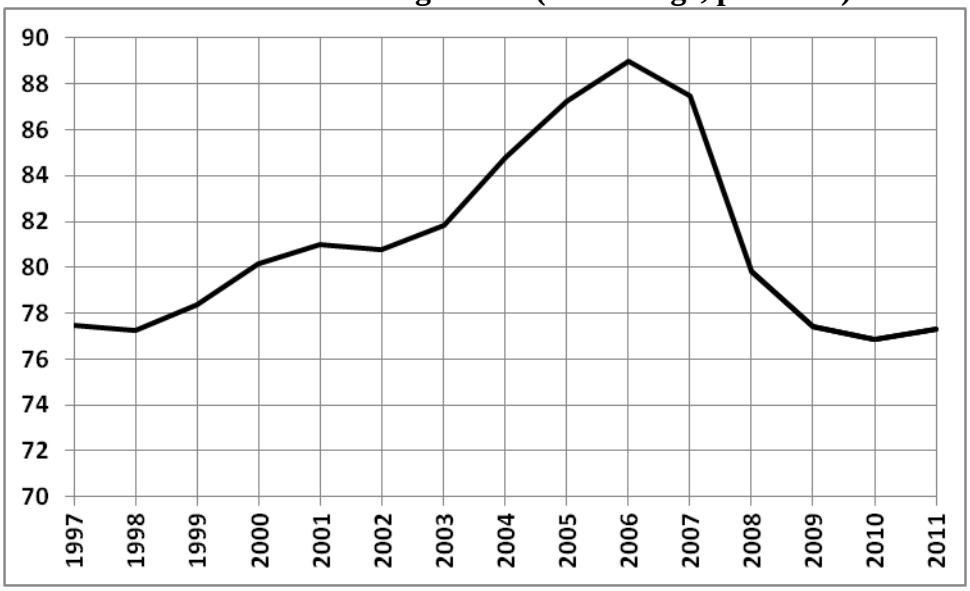
### *The Role of the Down Payment (Equity)*

When entering into a loan, borrowers need to come up with equity, or "borrow" a down payment at an "equity" rate. If we blend the loan rate (payable on debt) with equity rates (applied to down payment), we may have a better gauge of what the loan really costs. For example, combining a traditional 20% down payment at a 20% return-on-equity (ROE) rate (20.08% payment rate assuming the 30-yr amortization) with an 80% debt at a 6% rate (7.3% payment rate), gives us 9.9% of an annual total cost measured off the full price of a home. If the loan rate drops to 4% (5.8% payment rate), the total cost will go down to 8.7%. In this example, loan payments fall by 20%, but the total cost moved down only 12%.

Naturally, a reduced requirement for a down payment will be shown as a lower equity cost on borrower balance sheet--even with an unchanged loan rate. If, in the above example, we replaced the 20% down payment with a 10% down payment, the total cost would drop from 9.9% to 8.7% or by 13 %.

These examples give us a hint of what happened in the 2000s. During the housing bubble, the CLTV rate on non-agency *purchase* loans rose significantly. That trend was reversed in 2008–2011 (for that period, the data in Figure 7 reflects agency loans rather than non-agency loans, given the lack of new non-agency origination).

**Figure 7. Historical CLTV at Origination (US average, purchase)**




Pre-2008: Non-agency loans; 2008-11: Agency loans. Sources: Intex, Freddie Mac, AD&Co

Using the concept of the equity cost, we can state with certainty that the shift in down payment alone moved the combined borrower cost down from 2000 to 2006 and up since 2006. The drop in interest rates in recent years was largely offset by the increase in down payment cost. Therefore, even in a falling interest rate environment, housing could become less affordable. By the end of 2011, the loan cost constituted only about 50% of the blended cost.

***Credit Risk Under-Pricing***

An historical chart of blended financing rates would not yield sufficient information without also considering loan quality. A pool of subprime borrowers that is projected to lose 20% of its principal over a five-year average life can be viewed as losing 4% per annum. If that pool has a 7% Weighted Average Coupon, it will effectively be paying only 3%—if we attempt to monetize borrowers' economics (regardless of whether the investor is protected by loan insurance or not). Such a loan instinctively catches borrowers' attention even if they cannot assess their own credit risk objectively. This example shows that an undervalued risk may lead to a strong demand to buy homes. It is the loss-adjusted rate that matters for modeling the borrower incentive. Creating financing privileges and loopholes for weak borrowers stimulates them and inflates demands for housing.

How can we determine whether the credit risk was or was not correctly priced in newly originated loans? We conducted the following quantitative study. For each non-agency origination quarterly cohort, starting from 2000, we ran a Credit OAS model (see Levin and Davidson, 2008) to assess expected loan losses and (after dividing by the projected Weighted Average Life) annualize them. This approach utilized an empirical model of borrower behavior (the AD&Co LoanDynamics$^{TM}$ Model) and a risk-adjusted (conservative) Home Price Index (HPI) stochastic simulation model (see Table 3). For each of these retrospective analyses, we employed economic data (interest rates, home prices) that were available only by the time of analysis (e.g., we did not use future actual economic trajectories).

There are four components to this valuation approach. The first component is simulation of interest rates and home prices. The analysis relies on hundreds of paths for interest rates and home prices. The simulation relies on a median path for home prices that depends on past home prices as well as interest rates. Rising home prices in the past contribute to rising home prices in the future. Rising interest rates produce falling home prices over the first few years of the forecast and then produce higher home prices over longer time horizons.

The second component is a forecast of month-by-month prepayments, defaults and severity for the mortgages. The forecast takes into account the economic variables: interest rates and home prices from the simulation. The forecast also considers the nature of the collateral, the terms of the mortgage and the credit worthiness of the borrower. The forecast also takes into account the delinquency status of the loans at the start of the analysis. For this analysis we used the Andrew Davidson & Co., Inc. LoanDynamicsTM Model.

The form of the modeling is a dynamic transition matrix or Markov model. The model assumes that the state of the loan is determined by its delinquency status. A loan can be current, delinquent (2-5 months), seriously delinquent (more than six months) or terminated. The transitions between these states are dynamic models based on borrower, collateral, loan and economic variables.

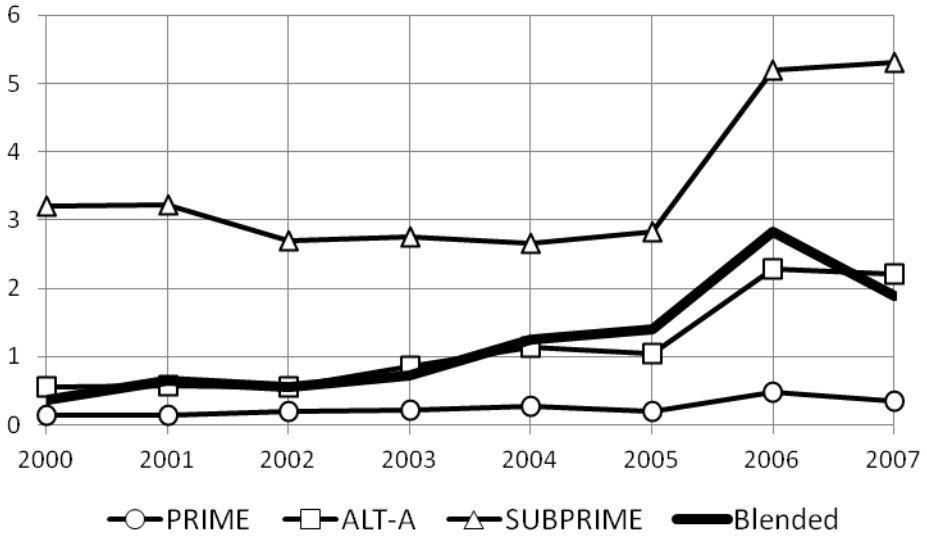
The third component is the cash flow generator. For loans this is a relatively simple process to transform the prepayment, default and severity forecasts into monthly forecasts of principal and interest payments, based upon the characteristics of the loans.

The final component is the computation of the Credit Option Adjusted Spread (OAS), which represents the spread which when added to the discount rates for each path results in an average price across all paths that equals the market price, or in this case the proceeds to the borrower (par less points). In this phase of the analysis other analytical metrics such as the average life time loss can also be computed. The average loss we use in the analysis is not the loss from a single path, but reflects the average of paths: some with greater losses, some with little or no loss, reflecting the option-like feature of mortgage default.

This approach differs from standard Rating Agency models in that we dynamically assess the value of the imbedded options, while rating agency methods generally are designed not to vary as market conditions change. That is ratings are designed to reflect specific stress scenarios, such as a regional economic decline or a national economic decline. The model used here is designed to value loans and securities and therefore takes into account the current values and implied forecasts of economic factors. Results are shown in Figure 8.

**Figure 8. Projected Credit Losses and Rates (US)**

A) Annual Loss Rate




B) Loss Adjusted Coupon Rate

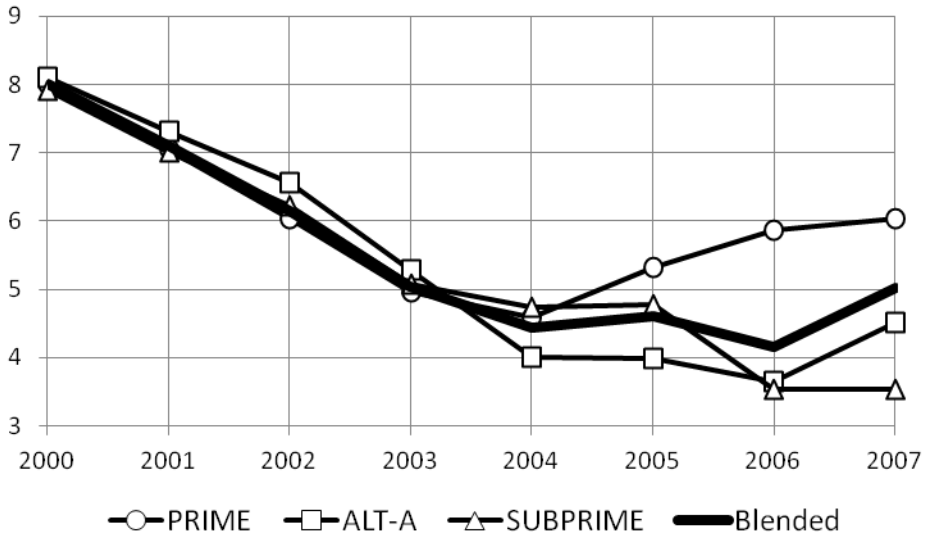



Figure 8 (Panel B) shows that, before 2004, loss-adjusted rates had been strikingly similar among prime, Alt-A and subprime loans, suggesting that the risk had been priced fairly. Since 2004, the lower quality loans were under-priced, with the loss-adjusted rate falling below that of top-quality loans. [9]

We have further analyzed the cause of this phenomenon in detail. We found that the credit-risk mispricing could be attributed to

a) Uneconomically low loan origination rates for Alt-A and subprime loans,

[9] This is consistent with findings by Levitin and Wachter (2012) and Courchane and Zorn (2012) showing that after 2004 the spread between prime and subprime mortgages narrowed even as risk mounted.

b) The growing percentage of ARMs and Option ARMs and
c) The increase of CLTV,

with the worsened *ex-ante* HPI outlook not appropriately priced into non-conventional products. In particular, we see that the reduced down payment standards affected both the equity cost and the expected credit losses, effectively reducing the borrower cost in each case.

The critical economic driver, the Home Price Appreciation (HPA) outlook, is shown in Table 3. In forming this assumption, our model reacts to the observed HPA trend and statistically separates systematic (diffusive) term from non-systematic (jumpy) term. It also gauges the total cost of financing that affects changes in HPI equilibrium. In particular, the worsening in the HPI outlook from 2004 to 2005 and again from 2005 to 2006 was mostly due to the change of trend in HPA. The fact that the HPA stopped growing suggests a reversion in the second-order differential equations that describe the HPA diffusion term in the model. In contrast, the persistent pessimism through 2007 was fueled by the quick increase in financing cost that occurred when poorly underwritten loan products ceased to exist and the high down payment regime ended (Figure 7).

**Table 3.** Forward, Risk-Adjusted HPA*

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **HPA Outlook** | 2-yr cumulative % | 11.5 | 12.8 | 12.8 | 8.0 | 9.3 | 4.1 | -11.8 | -10.7 |
| | 5-yr cumulative % | 28.4 | 26.0 | 22.0 | 11.5 | 14.3 | 9.3 | -11.8 | -10.5 |
| **Prior-year HPA** | 1-yr cumulative % | 10.4 | 10.7 | 10.5 | 11.0 | 14.0 | 14.0 | 7.0 | -0.3 |

* Produced by the AD&Co HPI2 model for the 25-MSA Composite index using forward interest rates at each analysis date and a constant risk adjustment for HPA. These are median scenarios shown for illustration purposes; the actual Credit OAS model works with random interest rates and HPA paths.

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Table 4 lists results of the retrospective analysis by loan type and by origination shelf. It shows some of the key variables that affect credit cost. In general, there was an increase in CLTV in many of the segments and a move toward riskier, lower loss-adjusted rates, products.

**Table 4. Credit-Risk Mispricing in Detail (Historical Averages for US Purchase Loans)**

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **PRIME FRM** | Share, % | 66.0 | 51.3 | 45.6 | 35.0 | 10.8 | 10.6 | 11.6 | 29.8 |
| Input Data | FICO | 695 | 709 | 714 | 737 | 744 | 745 | 744 | 748 |
| | CLTV | 74.5 | 76.7 | 77.4 | 78.1 | 77.3 | 80.9 | 83.5 | 84.9 |
| | FULL DOC % | 65.2 | 71.8 | 62.3 | 57.1 | 46.2 | 41.5 | 40.4 | 40.9 |
| | Rate | 8.23 | 7.37 | 6.79 | 5.88 | 5.90 | 5.90 | 6.50 | 6.41 |
| Results | Annual Loss | 0.07 | 0.07 | 0.09 | 0.07 | 0.07 | 0.10 | 0.30 | 0.25 |
| | Loss Adjusted Rate | 8.16 | 7.29 | 6.69 | 5.81 | 5.83 | 5.80 | 6.19 | 6.16 |
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| **PRIME ARM*** | Share, % | 17.3 | 12.2 | 23.4 | 30.4 | 26.6 | 16.2 | 13.0 | 13.3 |
| Input Data | FICO | 711 | 724 | 730 | 737 | 737 | 744 | 742 | 750 |
| | CLTV | 81.1 | 71.9 | 77.7 | 81.6 | 82.8 | 81.1 | 81.3 | 81.6 |
| | FULL DOC % | 22.6 | 52.7 | 42.6 | 46.3 | 48.1 | 43.7 | 42.2 | 38.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rate | 7.86 | 6.45 | 5.10 | 4.35 | 4.44 | 5.25 | 6.20 | 6.30 |
| Results | Annual Loss | 0.41 | 0.43 | 0.38 | 0.37 | 0.35 | 0.26 | 0.63 | 0.55 |
| | Loss Adjusted Rate | 7.45 | 6.02 | 4.73 | 3.98 | 4.09 | 5.00 | 5.57 | 5.75 |

*Including a small share of Option ARMs

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **ALT-A FRM** | Share, % | 8.9 | 21.6 | 15.5 | 12.9 | 9.1 | 10.3 | 13.3 | 16.1 |
| Input Data | FICO | 675 | 697 | 707 | 710 | 715 | 723 | 716 | 722 |
| | CLTV | 77.9 | 77.4 | 79.6 | 81.5 | 83.7 | 87.9 | 90.1 | 89.6 |
| | FULL DOC % | 38.2 | 28.6 | 33.5 | 30.1 | 29.4 | 25.2 | 16.6 | 20.2 |
| | Rate | 9.11 | 7.96 | 7.32 | 6.47 | 6.47 | 6.43 | 7.16 | 7.12 |
| Results | Annual Loss | 0.60 | 0.54 | 0.39 | 0.45 | 0.37 | 0.38 | 1.12 | 1.26 |
| | Loss Adjusted Rate | 8.50 | 7.42 | 6.93 | 6.01 | 6.10 | 6.05 | 6.04 | 5.86 |

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **ALT-A ARM*** | Share, % | 1.4 | 1.4 | 3.6 | 6.1 | 19.5 | 19.1 | 17.0 | 16.1 |
| Input Data | FICO | 676 | 708 | 713 | 703 | 710 | 714 | 712 | 718 |
| | CLTV | 78.4 | 79.5 | 75.5 | 81.5 | 87.0 | 89.1 | 91.8 | 91.6 |
| | FULL DOC % | 9.8 | 70.2 | 45.4 | 35.1 | 29.8 | 23.9 | 14.1 | 14.0 |
| | Rate | 7.30 | 6.63 | 6.32 | 5.76 | 5.56 | 6.13 | 7.14 | 7.44 |
| Results | Annual Loss | 0.21 | 1.20 | 1.26 | 1.70 | 1.51 | 1.16 | 2.69 | 2.95 |
| | Loss Adjusted Rate | 7.09 | 5.44 | 5.06 | 4.07 | 4.04 | 4.97 | 4.45 | 4.50 |

*Excluding Option ARMs

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **ALT-A Option ARM** | Share, % | 0.4 | 0.0 | 0.2 | 0.5 | 5.8 | 10.8 | 11.4 | 9.3 |
| Input Data | FICO | 711 | | 696 | 710 | 727 | 723 | 723 | 727 |
| | CLTV | 77.5 | | 76.3 | 76.0 | 78.4 | 82.6 | 85.2 | 85.3 |
| | FULL DOC % | 18.4 | | 17.9 | 19.5 | 23.3 | 16.6 | 10.4 | 10.6 |
| | Rate | 4.27 | | 4.55 | 2.52 | 1.72 | 1.72 | 2.70 | 4.82 |
| Results | Annual Loss | 0.88 | | 1.07 | 1.30 | 1.06 | 1.45 | 3.04 | 2.59 |
| | Loss Adjusted Rate | 3.39 | | 3.49 | 1.22 | 0.67 | 0.28 | -0.34 | 2.24 |

| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| **SUBPRIME FRM** | Share, % | 1.8 | 3.9 | 2.8 | 4.1 | 4.7 | 4.9 | 6.5 | 2.9 |
| Input Data | FICO | 590 | 613 | 636 | 656 | 659 | 658 | 650 | 640 |
| | CLTV | 89.1 | 94.5 | 93.8 | 87.3 | 84.7 | 91.9 | 94.1 | 92.7 |
| | FULL DOC % | 30.0 | 29.4 | 44.5 | 42.1 | 42.0 | 38.9 | 40.3 | 54.8 |
| | Rate | 11.14 | 10.26 | 9.32 | 8.16 | 8.04 | 8.55 | 9.44 | 9.61 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Results | Annual Loss | 2.17 | 1.61 | 0.74 | 0.78 | 0.72 | 0.67 | 1.68 | 2.39 |
| | Loss Adjusted Rate | 8.97 | 8.65 | 8.59 | 7.38 | 7.32 | 7.88 | 7.75 | 7.22 |
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| **SUBPRIME ARM*** | Share, % | 4.1 | 9.6 | 8.9 | 11.0 | 23.6 | 28.1 | 27.3 | 12.4 |
| Input Data | FICO | 593 | 598 | 619 | 631 | 648 | 646 | 642 | 638 |
| | CLTV | 92.0 | 92.7 | 91.7 | 89.3 | 88.5 | 91.5 | 92.2 | 91.0 |
| | FULL DOC % | 37.5 | 25.8 | 47.4 | 46.0 | 43.5 | 37.8 | 33.6 | 40.9 |
| | Rate | 11.10 | 10.22 | 8.79 | 7.70 | 7.28 | 7.45 | 8.58 | 8.68 |
| Results | Annual Loss | 3.66 | 3.87 | 3.32 | 3.50 | 3.04 | 3.20 | 6.04 | 6.01 |
| | Loss Adjusted Rate | 7.43 | 6.35 | 5.47 | 4.21 | 4.23 | 4.25 | 2.53 | 2.67 |

*Including a small share of Option ARMs; Sources: Intex and AD&Co

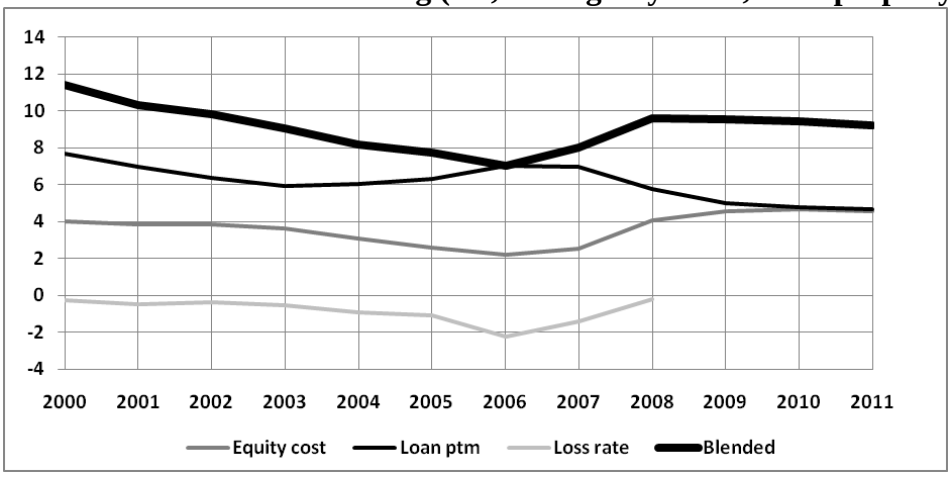
In the beginning of 2000s, the blended rate's spread of non-prime loans above the prime-borrower rate was in the 50-100 bps range for Alt-A borrowers and about 300 bps for subprime borrowers. These spreads did not widen and, in some cases, tightened by 2006 – contrary to the worsening dynamics of our HPA outlook.

A rising share of non-prime ARMs and Option ARMs that offered below-market introductory rates was another problem. Even with comparable FICO and LTV levels, ARMs are proven to be riskier products relative to FRMs due to both the reset-related payment shocks and the way borrowers are self-selected and qualified for the product. In addition, the quality of so-called Alt-A loans deteriorated as evidenced by the falling percent of fully documented loans. Interestingly, FICO scores did not deteriorate and mostly improved in each loan category, which rather than being an objective trend may have been a scoring system's compromise.

***All-in cost***

With the loss component detected, we now can compute the all-in cost rate (Figure 9) combining the loan origination rate, impact of down payment and mispriced credit risk.

**Figure 9. All-in Cost of Borrowing (US, non-agency loans, % of property value)**




All-In Borrower Cost = Loan payment + Loss rate (negative) + Equity cost

The blended lines in Figure 9 clearly depict the mid-2000s "dent" in effective cost despite an increase in loan rates. It was caused by the plummeting equity cost and the increased credit risk under-pricing. The existence of the dent in financing cost history matched the actual HPI dynamics fairly well. The effect was even stronger in those regions such as California, which originated more ARMs, Option ARMs and non-standard loans in general (next section).

***Geographical Market Composition***

Levin, 2010 and Pavlov and Wachter (2012) show that the peak-to-first-trough of HPI measured across US states closely followed the proliferation of non-standard loans. Understanding mortgage market compositions is critical in explaining the geographical dynamics of housing markets. Compositional factors contributing to the mid-2000s run-up of home price indices were concentrated geographically in states with large shares of (a) non-conforming loans, (b) non-prime loans, and (c) ARMs in general and Option ARMs in particular. Naturally, the difference in the presence of factors (a), (b) and (c) could be used to explain the difference of borrower cost across geographical regions. Table 5 summarizes the dynamics of mortgage market origination for US (bubble), California (stronger bubble) and Texas (no bubble). Due to the lack of GSE and GNMA data, we do not separate loans by purpose.

**Table 5. Comparison of Origination Shares in 2000, 2006 and 2011 (all loans)**

| | US | | | California | | | Texas | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000 | 2006 | 2011 | 2000 | 2006 | 2011 | 2000 | 2006 | 2011 |
| GSE % | 47.2 | 33.2 | 66.4 | 29.9 | 15.4 | 70.2 | 74.5 | 53.8 | 59.1 |
| GNMA % | 11.0 | 2.7 | 21.6 | 2.0 | 0.1 | 14.3 | 4.7 | 9.2 | 29.9 |
| Non-Agency % | 41.8 | 64.1 | 11.9 | 68.1 | 84.5 | 15.5 | 20.8 | 37.0 | 11.0 |
| Non-Prime % | 21.3 | 53.1 | 6.7 | 26.3 | 67.3 | 3.6 | 11.1 | 31.9 | 8.0 |
| Non-Agency ARMs* % | 10.1 | 33.0 | 1.1 | 21.6 | 43.6 | 0.8 | 3.7 | 15.3 | 0.0 |
| Non-Agency Option ARMs % | 0.2 | 9.7 | 0.1 | 0.5 | 20.4 | 0.0 | 0.0 | 0.9 | 0.0 |

*Excluding Option ARMs

Shares of loan types associated with underpriced credit risk rose prominently by 2006 and declined or disappeared as the crisis began. While these loan types dominated the California market in 2006, they were not prominent in Texas, which mostly borrowed conventionally. It is not that subprime loans in Texas were much better than those ones in California – rather there were much fewer of them.

In California, the history of the "negam" poison repeated itself. Origination of COFI ARMs (coincidentally, up to 20% of market share) in the second half of 1980s caused some decline in home prices in the upcoming years. Back then, negative amortization was an innocent by-product feature arising from the mismatch between frequent rate resets and less frequent payment resets. In contrast, the second wave of "negam" innovation in Option ARMs was flawed by design: Homeowners-to-be were provided a mechanism to increase their debt in hopes to sell homes later at a higher price and pay off the loan.

In each case, the "negam" volume had a remarkable coincidence with HPI booms and busts, although it remains a chicken-and-egg dilemma. Option ARMs could only be offered with confidence that home prices would grow. The low-cost financing they offer propels the HPI further. Once it reaches its peak, Option ARMs stop being offered. Their death caused the HPI

to decline more deeply as new homebuyers could not afford prices paid by previous owners who used Option ARMs. Nevertheless it is unlikely that home prices could be sustained without the presence of Option ARMS and other low down payment loans.

Share of non-standard loans fell sharply in recent years which the increase in the conforming loan limit helped. However, loan origination also notably shifted from GSEs to GNMA, the Federal Housing Administration (FHA), in particular. This GNMA-sponsored, high-LTV, origination has grown to approximately 22% of total.[10] It is evident that the low down payment requirement made those loans popular.

Using the origination market's composition, we computed and compared the total cost of borrowing that blends loan payment, the cost of down payment, and credit risk under-pricing. Computations are carried first for each loan type, and then weighted by market shares. Results are shown in Figure 10, which demonstrates a remarkable mirror-reflection of the respective home price dynamics. It is worth mentioning that regional elasticity of supply was also a factor in dampening spikes of demand.

**Figure 10. Total Cost as Percent of Property Value**

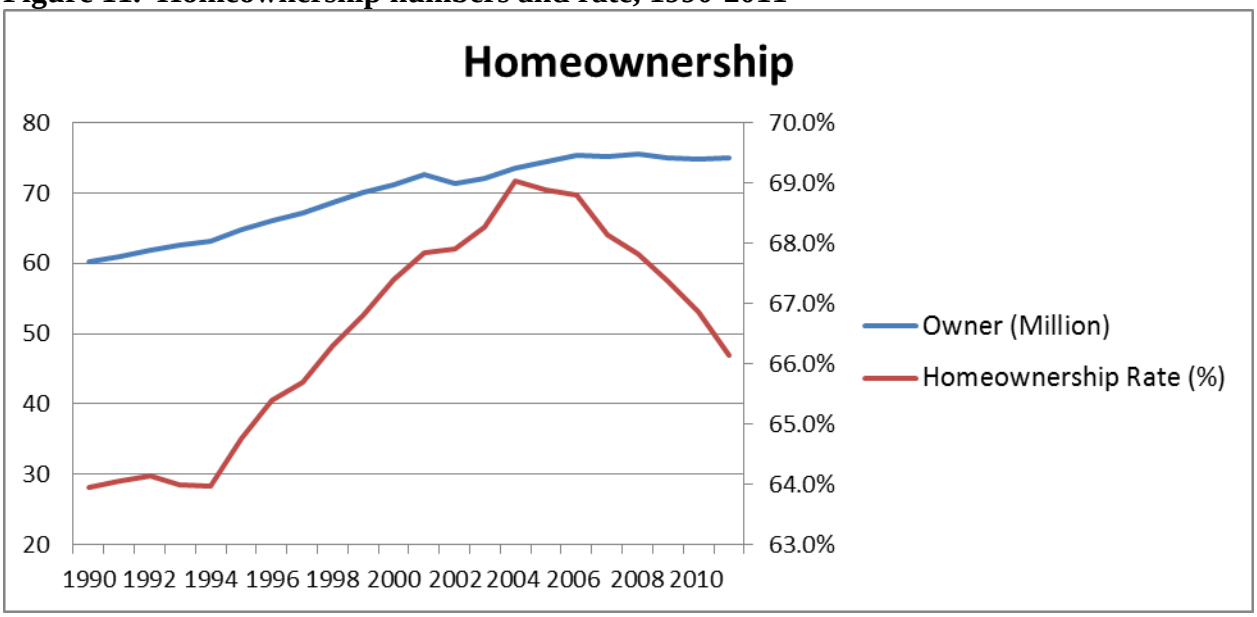

## IV. Relaxation of Standards in the Bubble Years: Lack of Impact on Access to Homeownership

In this section, we provide evidence of the impact of the expansion of NTMs on the credit constraints to homeownership and on the potential role of the underpriced put option in NTMs on actual homeownership outcomes. The research literature has established that credit standards can represent a barrier to homeownership for those who are subject to borrowing constraints (Linneman and Wachter, 1989; Haurin et al., 1996; Haurin et al., 1997, Rosenthal, 2002; Barakova et al., 2003) especially among low-income and minority households. Three types of constraints have been identified that restrain the access to mortgage and the probability of homeownership: credit, income and wealth. Of these, the wealth constraint is the most likely to prevent a household from obtaining a mortgage to finance a home purchase.

[10]This is a rough estimate. Weighted average LTV of GNMA loans has been 91%; combined LTV is not available.

Given the relaxation of credit standards between 2003 and 2007, along with the expansion in mortgage products (subprime, alt-A, and other non-traditional mortgages) the expectation is that borrowing constraints became less of a barrier to homeownership, increasing the affordability of homeownership for households previously unable to obtain financing. Despite the increase in the supply of mortgage lending and the shift in the supply towards products which were initially more affordable, homeownership did not increase over the period (Figure 11). In fact the homeownership rate decreased after 2004.[11]

**Figure 11. Homeownership numbers and rate, 1990-2011**




Source: Current Population Survey

To address the question of why this was so, Barakova et al. (2013) measure the impact of constraints on homeownership using data from the National Longitudinal Survey of Youth. The study finds that over the period, income and credit barriers are largely eliminated, which means that through the changes in credit supply, households are not constrained by their income or credit history in the purchase of a target valued home. But one constraint does remain binding, as prices dramatically increased over the period, the wealth constraint continues to impact homeownership.[12] It may have been that the high CLTV lending figure shown in Figure 4–with

[11] The rate of homeownership reached its maximum of 69% in 2004 and the number of homeowners reached a peak of 75.5 million in 2006 and as of 2012 has not increased. Source: Current Population Survey

[12] The finding of the persistence of the negative effect of the lack of wealth on homeownership may seem surprising given that during this period 100% combined LTV (CLTV) loans were available. Several factors can have contributed to the persistence of the wealth constraint. First, in order to obtain a 100% CLTV loan, a borrower need to combine a first and second lien, generally through a 80-20 piggyback loan, which would come with a relatively high blended rate due to risk-based pricing, acting as a disincentive. Second effect, even if a borrower is able to finance 100% of the purchase price, he would still need to have disposable savings to cover closing costs, moving costs, and fix-up costs. Another reason wealth might remain binding are situations where the asking price for the home is higher than the appraised value, used to underwrite the loan, in this case, the borrower needs to have cash available to close the "appraisal gap." Despite remaining wealth constraint, through simulation, Gabriel and Rosenthal

CLTV above 100% going from 5% to 30% of the market—went to people for whom wealth was not a binding constraint but for whom low-down payments enabled a cheaper put option. This is very different from the interpretation that these new borrowers were credit constrained.

The fact that the wealth constraint holds and discourages homeownership in 2003 through 2007 indicates that even with risk based pricing and loosened underwriting standards eliminating the impact of credit and income constraints, the impact of a collateral based wealth constraint remains. Despite a loosening of underwriting standards and the development of new mortgage products, homeownership did not increase over the bubble years. The tightening of standards limits the affordability of homeownership in the period since the bust, but the study by Barakova et al., shows that the loosening of standards and the development of NTM during the bubble years, while removing income and credit constraint, did not lead to higher homeownership rates. Without engaging the debate on the sustainability of homeownership for the borrower who financed using some of the NTM instruments, this study shows that the lack of standards is not a guarantee of greater affordability and homeownership.

The easing of mortgage lending underwriting by relying on the collateral's value and its expected appreciation enabled single-family residential real estate investors to take advantage of the put-option. This is consistent with findings by Haughwout et al. (2011) on the role played by real estate investors in the boom. They show that in states that experienced the largest volatility in house prices over the boom and bust, almost half of the purchases at the peak of the market were associated with investors. These investors used higher leverage and in the bust period exhibited higher delinquency rates, which is consistent with their exercise of the put option. In addition, Chinco and Mayer (2012) examine the role played by second homebuyers in particular markets. They hypothesize that these buyers are more likely to be reliant on capital gains than on return from rent income and less knowledgeable about local market conditions. They find that the share of the purchase made by these "distant speculators" is correlated with higher house price increases and higher implied to actual price-to-rent ratios that can be used as a proxy for mispricing. They also find that these distant speculators had a particularly large impact in sand state markets like Las Vegas, significantly contributing to the increase in prices in these areas during the boom, concluding that second home buyers in these markets behaved like overconfident or uninformed speculators. It appears from their findings that if the lending environment allows investors to enter markets with limited costs for their put option, these actors may play a significant role in pushing prices up and in the formation of asset bubbles more generally if they are able to finance their purchases with significant leverage.

## V. Price Expectations, Nontraditional Mortgage Supply and Procyclicality

Due to limits to arbitrage in real estate markets, property markets are prone to booms and busts. The creation of cycles in real estate is worsened by the fact that supply is inelastic in the short run. The fundamental cause of bubbles, however, is the inability to sell real estate short, thereby limiting downward pressure on prices[13]. As a result, prices can be bid up by "optimists" and become

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(2011) find that if underwriting standards similar to those in place in 2000 had been used in 2005, homeownership would have been about 6 percentage points lower, but the change in demographic between 2000 and 2005 had a negative contribution of about 3 percentage points.

[13] While vehicles exist for short-selling such as REITs and futures markets, they are limited in their impact. See Levitin, Pavlov, and Wachter. (2009). "Securitization: Cause or Remedy of the Financial Crisis?" http://ssrn.com/abstract=1462895

disconnected from fundamentals with an absence of downward pressure either in the form of increased supply or short selling.[14]

Due to the presence of optimists and the absence of effective action due to the limits of short selling by countervailing "pessimists", the price of real estate is pushed beyond its fundamental value. The potential for overvaluation derives from the heterogeneity of expectations. The key role of expectations in the determination of real estate prices is made clear from the user cost equation which links asset prices to rents. A common approach is to compute the user cost, defined as:

$$\mathbf{P^*}u = \mathbf{P^*}rf + \mathbf{P^*}\rho + \mathbf{P^*}tx + \mathbf{P^*}d - \mathbf{P^*}g$$

Where:

- P represents price in dollars
- P*rf represents foregone interest (at the risk-free rate)
- P*ρ represents the risk premium for housing
- P*tx represents annual property taxes
- P*d represents annual depreciation
- P*g represents the expected appreciation in house prices.

With frictionless arbitrage:

$$R = \mathbf{P^*}u$$

Where R represents the rent in dollars for an asset priced at *P*, which implies:

$$\mathbf{P}/R = 1/u = 1/[rf + \rho + tx + d - g]$$

The equation above can then be compared with the observed price-to-rent ratio to determine whether observed house prices are out of line with fundamentals.

There are two core issues in the above methodology that make real estate prone to credit induced bubbles. First, the expected appreciation term, g, must be based upon the modeled change in prices as opposed to the actual change in prices, since we are talking about future values. If the model is based on historical price appreciation, this will lead to incorrect conclusions whenever there is a shift in fundamentals. Moreover, after a price rise when expectations on future prices correct, the result will be a decline in prices rather than a leveling off of prices. This is because price expectations are capitalized into current house prices.

The second core issue is with the $\rho$ term, which represents the risk premium (or cost of capital) for housing lending. What we commonly observe in credit induced asset bubbles is a decline in this risk premium. This decline is associated with a rise in the appreciation rate, which again may be based on past history, and reinforces the perceived decrease in user cost of home ownership, temporarily. While rents reflect fundamentals, with optimist driven price expectations, the rate of appreciation that becomes capitalized into values is neither market justified nor rational. Under these circumstances one would expect that the risk premium for lending into this market would rise.

But on the contrary, the risk premium in credit induced bubbles falls. Consequentially, as demonstrated in country data analysis by Pavlov and Wachter (2009), it can be shown that the

[14] In research with Richard Herring (1998) we develop a model of land prices, based on earlier work by Carey (1990), which serves as a straightforward framework for evaluating price cycles in the presence of fixed supply. This model helps to demonstrate the role of "optimists" in determining real estate prices.

common symptom of credit risk underpricing is the negative correlation between lending spreads, that is, the risk premium, and real estate price appreciation. When compressed lending spreads are associated with rising prices, all else equal, the subsequent price collapse is greater, thereby reinforcing the procyclical nature of the housing market. The increase in price due to underpriced lending is magnified in a market with credit-constrained borrowers, since lending terms ease, as NTM expands. Underpriced financing induces borrowers not only to over-pay for the assets because they obtain cheap financing, but also to demand more assets because they are now less constrained. The interplay of these two effects magnifies the price increases, especially in supply-constrained markets.

If this occurs, housing prices will be inflated through increased demand (dampening default risk for the period of rising prices) and these price rises may result in higher price growth expectations with expectations capitalized into higher prices. When the NTM expansion comes to an end, in the absence of a fundamental cause for an increase in prices, prices will decline, as the expectation of future price increases is not ratified, with a turn to higher lending standards and a higher cost of lending in response to defaults.

While it is clear that systemic risk can derive from the procyclical erosion of lending standards, there is no consensus on how to avoid this. While no system is perfect, fixed-rate long-term mortgages with robust, standardized securitization historically have been consistent with financial stability. Standardization promotes liquidity, ensures suitability, and enhances system stability. A market and a formal trading exchange for standardizing and, if necessary, short selling real estate securities could be helpful in bringing increased liquidity, decreased heterogeneity, and the ability to recognize and prevent credit mispricing.[15]

Securitization has become an essential component of consumer finance and of real estate finance in particular. But to make securitization work, clear rules of the game are needed that help achieve transparency and assure against counterparty risk, as well as data provision to inform trading. Markets can price and expose risk, but the tools and information must be there to do so.

Historically, the U.S. mortgage market was dominated by savings and loans and commercial banks. Both of these types of entities either held mortgages in portfolio or securitized them through government-sponsored entities (GSEs): Fannie Mae, Freddie Mac, and Ginnie Mae. Historically the GSEs only securitized "investment-grade" that is prime mortgages. This meant that lenders who made non-investment grade loans were forced to keep the mortgages—and the credit risk—on their books. The balance of the mortgage market in the U.S. began to change, however, in the mid-1990s and a rapid transformation occurred after 2000. Lenders discovered that rather than securitizing mortgages through the GSEs, they could securitize them through unregulated, private conduits managed by investment banks. These private-label MBS did not carry the GSE's guarantee of timely payment of principal and interest; instead, investors assumed the credit risk on these MBS, which meant on the underlying mortgages. The

[15] The central question is how to prevent excesses that inevitably lead to liquidity crises. Bernanke and Gertler (1999) argued that asset bubbles are not destructive enough to systemic stability to warrant monetary intervention. Their model, however, did not account for the possibility that credit would dry up, bringing about the historical banking system panic scenario. Asset bubbles that affect the payment mechanism have repeatedly led to liquidity crises. Because real estate is especially prone to asset bubbles, financial intermediaries like banks which are heavily exposed to residential and commercial mortgages make the entire financial system susceptible to real estate booms and busts.

origination demand of these private conduits was fed heavily by thinly regulated mortgage banks and mortgage brokers. With the refinancing boom of traditional agency-guaranteed mortgages concluding in the early 2000s, the profit center of securitization found that fees and the market could be extended by lowering credit standards and securitizing nonprime loans, through private label MBS.

Because private label MBS do not have the payment guarantee (with implicit or explicit government backing) of the GSEs, they were designed with other forms of credit enhancement, most notably the division of the securities backed by a pool of mortgages into a cash flow waterfall that allocated default risk on the mortgages by a hierarchy of "tranches." The result was the creation of AAA securities from risky underlying mortgages. The riskiest tranches received the lowest ratings from the credit rating agencies and therefore paid the highest yields, and they were the first to lose value if borrowers fell behind on their payments. On top of this, financial firms leveraged private label MBS by using these as collateral for additional debt, in the form of collateralized debt obligations (CDOs). CDOs$^2$ were constructed by pooling and tranching CDOs themselves. Leverage on top of leverage left the system vulnerable to even the slightest decline in prices or increase in loan defaults.

The rating agencies did not analyze the valuation of the underlying collateral of the securities to identify the probability of default or price fluctuation. Instead, they accepted market values as accurate. This creation of AAA securities permitted the proliferation of non-investment grade mortgages. Because of the higher yields they offered relative to GSE MBS, the market appetite for the resulting private-label MBS led to a boom in their production. As we have seen, from the mid-1990s to 2006, nontraditional (nonprime) mortgages grew from virtually zero to nearly 50 percent of originations.

While it may have been possible to identify the decline in credit quality of the private label MBS real time, the declining credit quality did not result in higher losses because the declining loan quality was masked by the fact that the looser standards and the lowered price of the imbedded put option buoyed housing prices in the short term.

In particular CDOs retained strong buyers of private label credit risk throughout this period as CDO managers relied on ratings rather than the underlying credit characteristics of the loans. In addition, this reliance led to deterioration in the underwriting process and a substantial increase in fraud and misrepresentations, the magnitude of which was not fully understood at the time. [16]

The race for market share fueled the extension of these increasingly risky loans eventually to borrowers without the capacity to repay. This race was likely exacerbated by short term fee seeking. While long-term performance would be an important metric for those whose profits were tied to long term results, in a market where the put option is in the money, all are short-termers.[17]

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[16]While some investors may have recognized the declining credit quality, just like in physical real estate, it was difficult to take short positions in these securities as there was no effective mechanism to short private label MBS, until the development of the pay as you go credit default swap (CDS) mid-2005. The introduction of the ABX index in early 2006 provided an additiona mechanism to short private label MBS. The CDO bid was stronger than the CDS/ABX short through 2006. See Levitin and Wachter (2012) for discussion.

[17] See Pavlov and Wachter (2006). "The Inevitability of Marketwide Underpricing of Mortgage Default Risk" http://papers.ssrn.com/sol3/papers.cfm?abstract_id=944969 for a discussion.

The expansion of these aggressive loans beyond their suitable use was the source of the new unsustainable demand. Alt-A loans and option ARMs, were originally designed for the self-employed and individuals with irregular income, not as a general market product. Aggressive lenders piled on by offering loans with low upfront costs, attracting first-time homebuyers previously unable to afford houses, repeat buyers buying pricier homes and second homes, as well as speculators. The result was a rise in housing prices that could not be sustained and, with an end to the price rise, one that would be followed by a price decline. This would call into question the solvency of the lending institutions that relied on the collateral behind these loans.

But the very complexity of the loans and the securities through which they were funded made it difficult to determine solvency implications. The result was a liquidity crisis in which all lending institutions were called into question and the historic fiscal and monetary bailouts. Another result was the seizing up of NTM lending through the implosion of institutions that had been providing NTMs. In response, credit constraints have been set at historically high levels which despite the Federal Reserve's persistent support of low interest rates, results in a high cost of homeownership, as shown above.[18] Moreover, the right level of credit constraints is currently the subject of rule-making to implement the Dodd-Frank provisions around the provision of credit. At the same time, the form of the emergence of the GSEs from conservatorship is under discussion. What should be clear is that the new housing finance structure, whatever form it takes, will impact the volatility of housing prices and the lending standards necessary for systemic stability.

[18] See Bernanke's comments reported in "Fed to Maintain Stimulus Efforts Despite Jobs Growth," http://www.nytimes.com/2013/03/21/business/economy/fed-maintains-rates-and-strategy.html?ref=bensbernanke

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