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Mortgage Default Option Mispricing and Borrower Cost Procyclicality

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Abstract

This paper addresses the expansion and performance of non-traditional mortgage lending products to better understand the impact of such products on borrowers and the financial system. We show that *ex ante* measured credit risk of these instruments increased while loan rates decreased. We also examine why the lower lending costs and expanded lending box did not increase homeownership rates in the years 2004 to 2007. We conclude with policy implications.

Table of Contents

| | |
|--|----|
| I. INTRODUCTION | 4 |
| II. THE EXPANSION OF NONTRADITIONAL MORTGAGE INSTRUMENTS | 5 |
| III. A HUNT FOR BORROWER COST REDUCTION: EVIDENCE OF MIS-PRICED MORTGAGE RISKS..... | 11 |
| The Role of the Down-payment (Equity) | 10 |
| Credit Risk Under-Pricing | 13 |
| All-in Cost | 20 |
| Geographical Market Composition | 20 |
| IV. RELAXATION OF STANDARDS IN THE BUBBLE: LACK OF IMPACT ON ACCESS TO HOMEOWNERSHIP | 23 |
| V. PRICE EXPECTATIONS, NONTRADITIONAL MORTGAGE SUPPLY, AND PROCYCLICALITY..... | 25 |

I. Introduction

This chapter examines the impact of mortgage supply characteristics on both housing affordability and financial risk outcomes in the wake of the mortgage crisis. A hallmark of the crisis was a shift towards nontraditional mortgage lending products. What impact did this have on consumers, investors, and the financial system? 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 and neither expected nor priced, we also show that *ex ante* the credit risk was also mispriced.

The links among mortgage lending instruments, such as Alt-A (income not documented) 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 previous affordability- and credit score-constrained markets, and house 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 (NTMs) 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 NTMs occurs along with the easing of credit constraints and underwriting standards associated with increased default risk, resulting in increased 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 is also possible that an increase in NTMs occurs without an increase in risk but rather with a decrease in risk. That is, NTMs expand when prices expand, and this is rational because prices increase due to a decline in risk, for example, as a result of an innovation in mortgage lending technology, as discussed further below.

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: the combined 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.. This chapter examines the impact of the provision of NTMs on credit risk, affordability and systemic risk. In Part II, , we discuss the expansion and performance of nontraditional mortgages. We turn to a discussion of the cost of credit when combined loan-to-value ratios are accounted for, and we present results on the *ex-ante* pricing of risk for NTMs in Part III. In Part IV we discuss the implications of the expansion in NTMs for affordability and homeownership. Part V discusses how and why credit risk in mortgage lending is related to systemic risk and procyclicality, 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

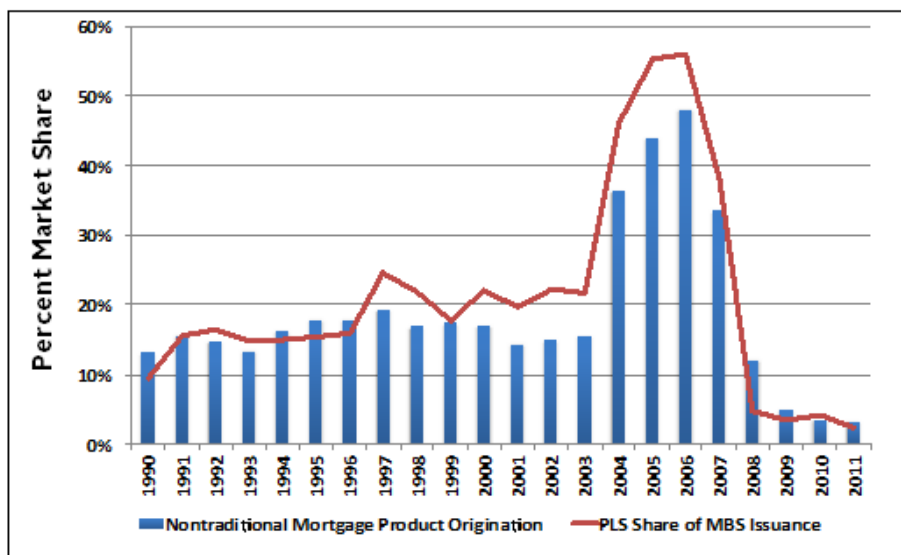
In this section, we provide data on the rapid expansion of NTMs in the years 2000 through 2005 and show their performance.¹ In the first half of the 2000s, subprime mortgages, interest only loans, negative amortizing, teaser rate ARMs, Payment (Pay) option ARMs, and Alt-A mortgages as well as second liens dramatically increased their share of the overall mortgage origination market (Figures 1 and 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”

¹ See Levitin and Wachter, (2011) 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 have monthly payments that are less than the 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.

rate if they could not refinance to lower interest rate loans, even though they were not able to shoulder the higher payments that were scheduled. Over time, such products were increasingly overlaid with 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

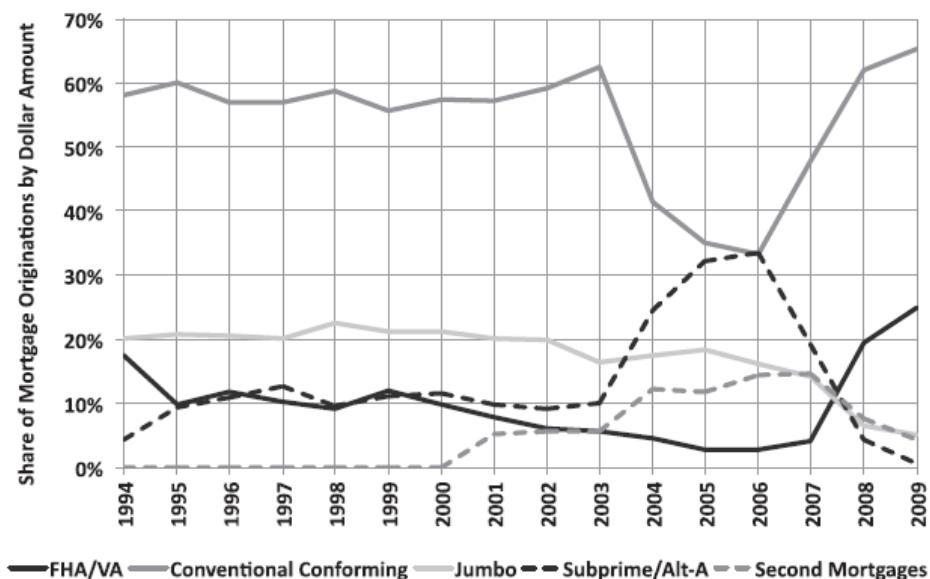


Source: Inside Mortgage Finance 2012 Mortgage Market Statistical Annual. Nontraditional mortgage products are subprime, Alt-A and home equity loans.

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 2000s, with conforming loans, Jumbo loans, and FHA representing a stable share of around 90 percent of all loans originated (as shown in Figure 2). As of 2003, subprime and Alt-A loans only accounted for about 10 percent of mortgage origination. Between 2003 and 2007 NTMs, such as subprime and Alt-A loans 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 percent of the market was made of NTMs in 2006 (Figure 2). 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 (Figure 1). After the housing bust, NTM products disappeared along with PLS.³

Figure 2. Origination Shares by Mortgage Type, 1990–2009



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

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, 2011). 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.. The relaxation of underwriting standards over the period was particularly concentrated in NTM products. In 2006, less than 20 percent of Alt-A mortgages had full documentation and nearly 90 percent were interest only. Investors represented 16.5 percent 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. For both subprime and Alt-A, there was sharp increase in CLTV and in the proportion of borrowers who use a second lien after 2003.⁴

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

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

The development of NTM products contributed to an increase in the supply of credit. Current empirical evidence points to a relationship in which greater 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.⁵

Housing prices and mortgage debt increased together from 1992 through 2005 with their ratio unchanged. What 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 constraints⁶ and an appropriate pricing of the risk associated with NTM. In a theoretical model, 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 lifecycle.

In fact, 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 3, which provides data on the quarterly rate of foreclosure by market segment, subprime ARMs had by far the highest foreclosure rate (almost 30 percent 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 may continue to pay the mortgage but they also have the choice to: (1) stop making payments and default, or (2) pay off 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-

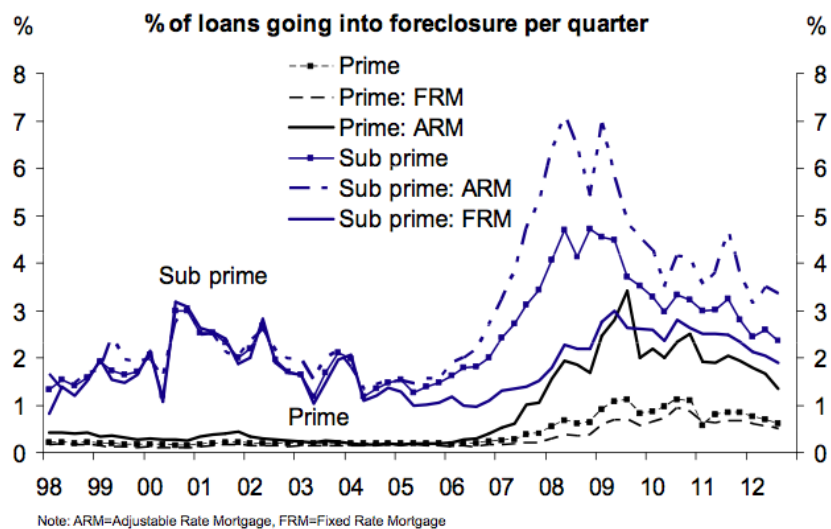
⁵ Recent studies such as Anundsen and Jansen (2012) and Berlinghieri (2010) use structural vector error correction models to identify whether mortgage expansion Granger-causes price rises or whether rising prices Granger-causes an expansion in mortgage credit. Their findings generally support bidirectional causality. See Levitin and Wachter (2013) 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.

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 towards riskier products that are more likely to be associated with borrower distress. The higher default rates in the subprime segment are 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 these higher returns and the question of whether they reflected *ex ante* credit risk.

Figure 3. Foreclosure by Market Segment



Source: MBA, Datastream, DB Global Markets Research

⁷ In many states, mortgages are non-recourse, in others they are effectively so, given costly and limited recovery.

⁸ Cutts and Van Order (2005) 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.

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

In this section, we examine borrower costs, mortgage returns and *ex ante* credit risk. We show the decline in all-in borrower costs (including the cost of the down-payment and the loan origination rate) and also the decline in risk adjusted loan origination rates for NTM loans from 2004 to 2007. In order to do so, for prime and non-prime home purchase loans, we first decompose total borrower cost, into two terms: the loan interest rate at origination and the cost of the down-payment. We then calculate *ex ante* (based on information available at the time) projected losses and compare risk-adjusted rates for prime, Alt-A and subprime loans.⁹ 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 in home prices to reveal the role contributed by each of the constituent components. Our conclusions generally agree with other studies that place 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., 2012).

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-payments), we may have a better gauge of what the loan really costs.

⁹ A pool of subprime loans that is projected to lose 20 percent of its principal over a five-year average life can be viewed as losing 4 percent per annum. If that pool has a 7 percent Weighted-Average Coupon, it will effectively be paying only 3 percent. For a borrower who is an investor (with a put option, that is with the option to default) such a loan may be appealing since the investor-borrower will retain the cash flow the property provides in the years prior to default and the upside potential if prices do not in fact decline. This example shows that an undervalued risk may lead to a strong demand to buy homes by investors. It is the loss-adjusted rate that matters for modeling these borrowers’ incentives. Creating financing privileges and loopholes for weak borrowers stimulates them and inflates demand for housing.

For example, combining a traditional 20 percent down-payment at a 20 percent return-on-equity (ROE) rate (20.08 percent payment rate assuming a 30-year amortization) with an 80 percent debt at a 6 percent rate (7.3 percent payment rate), gives us a 9.9 percent annual total cost measured off the full price of a home. If the loan rate drops to 4 percent (5.8 percent payment rate), the total cost will go down to 8.7 percent. In this example, loan payments fall by 20 percent, but the total cost declines by only 12 percent.

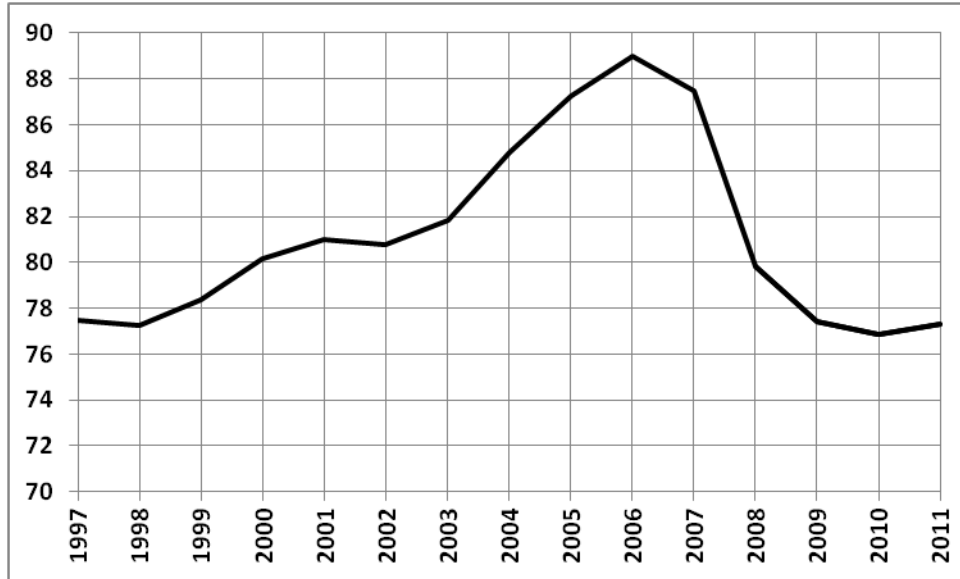
Naturally, a reduced requirement for a down-payment will be shown as a lower equity cost on a borrower's balance sheet - even with an unchanged loan rate. If, in the above example, we replaced the 20 percent down-payment with a 10 percent down-payment, the total cost would drop from 9.9 percent to 8.7 percent, or by 12 percent.

This in fact illustrates what happened in the 2000s. During the housing bubble, the CLTV ratio on non-agency *purchase* loans rose significantly. That trend was reversed in 2008–2011 (for that period, the data in Figure 4 (Panel A) reflects agency loans rather than non-agency loans, given the lack of new non-agency origination).

Using the concept of the equity cost, we show that the shift in down-payments moved the combined borrower cost down from 2000 to 2006 and up since 2006. The drop in mortgage interest rates in recent years was largely offset by the increase in down-payment cost. As is shown Figure 4 (Panel B), by the end of 2011, the loan cost constituted only about 50 percent of the blended cost of debt and equity.

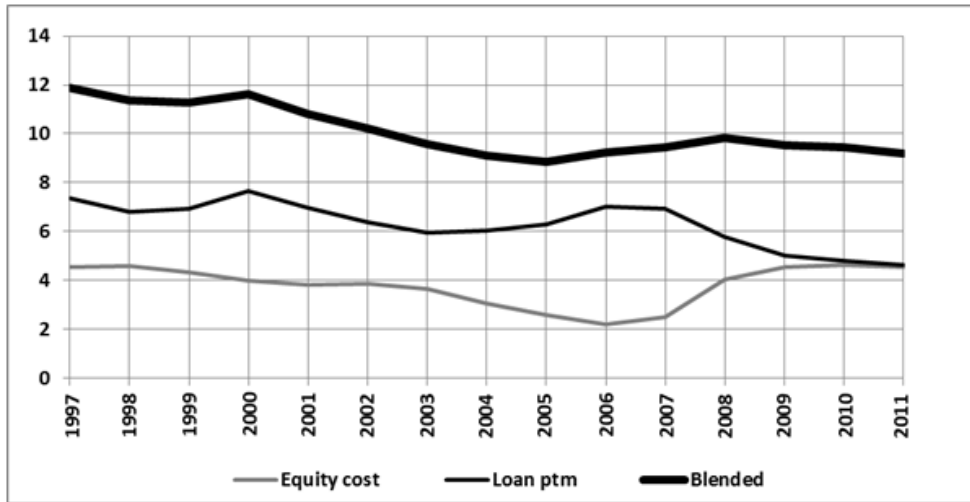
Figure 4. Historical CLTV and Loan Cost

A) CLTV at Origination (US average, purchase loans)



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

B) Loan Cost at Origination (US average, purchase loans)



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

Credit Risk Under-Pricing

An historical chart of blended financing rates would not yield information on whether *ex ante* credit risk was fairly priced without also considering loan quality. A pool of subprime loans that is projected to lose 20 percent of its principal over a five-year average life can be viewed as losing 4 percent per annum. If that pool has a 7 percent Weighted-Average Coupon, it will effectively be paying only 3 percent— (regardless of whether the investor is protected by loan insurance or not). In order to determine *ex ante* estimated credit risk, we conducted the following quantitative study. For each non-agency origination quarterly cohort, starting from 2000, we ran a Credit and Option Adjusted Spread (Credit OAS) model (see Levin and Davidson, 2008) to assess expected loan losses and (after dividing by the projected Weighted Average Life) annualized them. This approach utilized an empirical model of borrower behavior (the Andrew Davidson & Co., Inc (AD & Co. LoanDynamics™ Model) and a risk-adjusted Home Price Index (HPI) stochastic simulation model (see Table 1). For each of these analyses, we employed economic data (interest rates, home prices) that were available only at 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 hundreds of paths of 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 as home prices adjust to inflation imbedded in higher interest rates.

The second component is a forecast of month-by-month prepayments, defaults, and loss 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, the credit worthiness of the borrower, and the delinquency status of the loans at the start of the analysis. For this analysis we used the AD & Co. LoanDynamics™ Model.

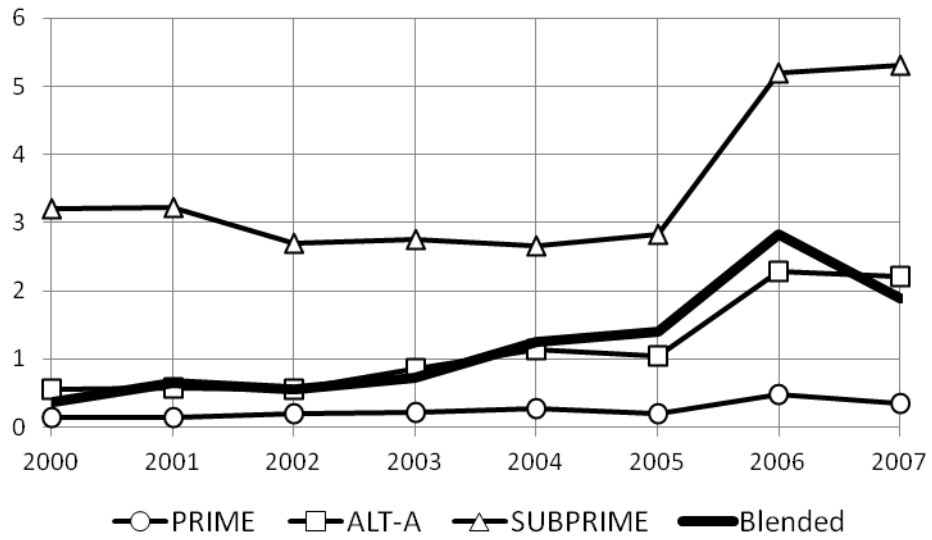
The form of the modeling is a dynamic transition matrix or Markov model. The model assumes that the state of the loan is determined by its delinquency status. A loan can be current, delinquent (2-5 months), seriously delinquent (more than six months), or terminated. The transitions between these states 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 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 not designed to vary as market conditions change. Results for US averages are shown in Figure 5.

Figure 5. Projected Credit Losses and Rates

A) Annual Loss Rate



B) Loss Adjusted Coupon Rate

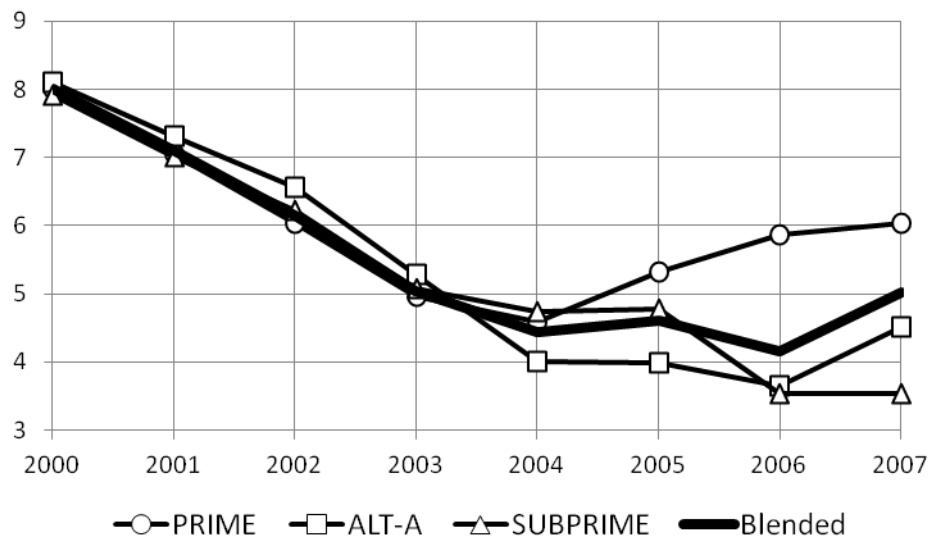


Figure 5 (Panel B) shows that, before 2004, loss-adjusted rates had been strikingly similar among prime, Alt-A and subprime loans. After 2004, the low-quality loans' loss-adjusted rate fell below that of top-quality loans.¹⁰

We have further examined this phenomenon. We found that the credit-risk mispricing is related to:

- a) Low loan origination rates for Alt-A and subprime loans,
- b) The growing percentage of ARMs and Option ARMs, and
- c) The increase of CLTV,

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

A critical economic driver, the Home Price Appreciation (HPA) outlook, is shown in Table 1. In forming the HPA outlook, the 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 low down-payment regime ended (Figure 4).

Table 1. 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 |

¹⁰ 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.

* 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.

Table 2 lists results of the analysis by market segment and loan type. 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 products and lower loss-adjusted rates.

Table 2. 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 |
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |

*Excluding Option ARMs

| | | | | | | | | | |
|-------------------------|---------------|------|------|------|------|------|------|-------|------|
| 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 |

| | | 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 the 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 the HPA outlook.

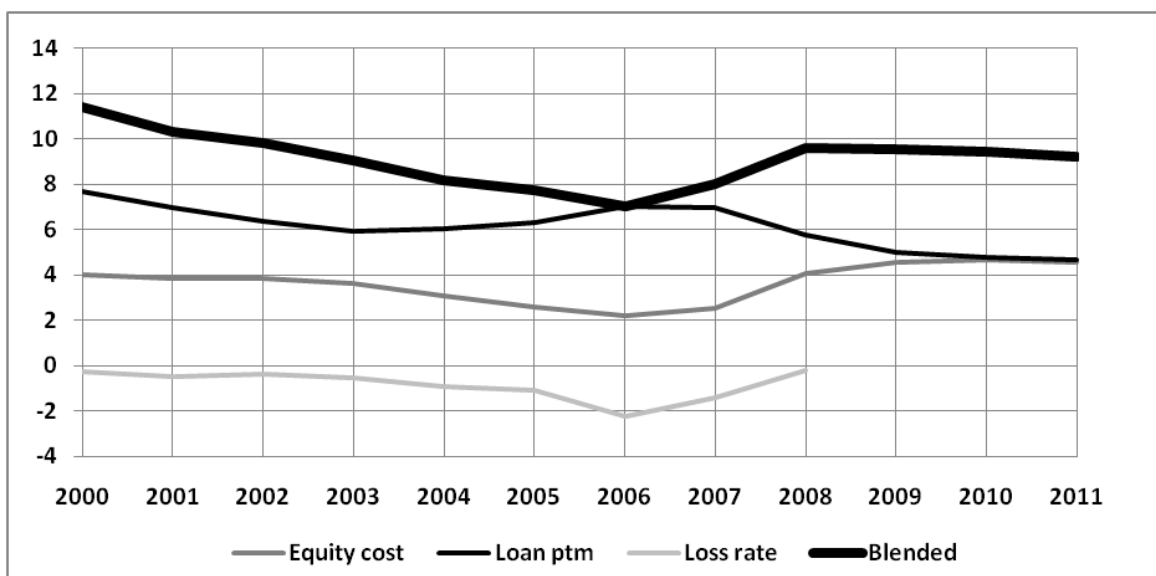
In addition a rising share of non-prime ARMs and Option ARMs offered below-market introductory rates. Even with comparable FICO and LTV levels, ARMs are proven to be riskier products relative to FRMs due to both the reset-related payment shocks and the way borrowers are self-selected and qualified for 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 6) combining the loan origination rate with the impact of down-payment and mispriced credit risk.

Figure 6. All-in Cost of Borrowing (US, non-agency loans, percent of property value)



$$\text{All-In Borrower Cost} = \text{Loan payment} + \text{Loss rate (negative)} + \text{Equity cost}$$

The blended lines in Figure 6 clearly depict the mid-2000s “dent” in effective cost despite an increase in loan rates. 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 3 summarizes the dynamics of mortgage market origination for the US (bubble), California (stronger bubble), and Texas (no bubble). Due to the lack of GSE and Ginnie Mae (GNMA) data, we do not separate loans by purpose.

Table 3. 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 in California – rather there were much fewer of them.

In California, the history of the negative-amortization poison repeated itself. Origination of Cost of Funds Index (COFI) ARMs (coincidentally, up to 20 percent 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 “neg-am” innovation in Option ARMs was flawed by design: homeowners-to-be were provided a mechanism to increase their debt in hopes of selling homes later at a higher price and paying off the loan.

In each case, the “neg-am” 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. 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 rates, 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 7, 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 7. Total Home Financing 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 consider the potential role of credit-risk underpricing on actual homeownership outcomes. The research literature has established that credit standards can result in lower homeownership rates 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 affect 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.

Given the relaxation of credit standards between 2003 and 2007, along with the expansion in mortgage products (subprime, Alt-A, and other non-standard 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 that were initially more affordable, from 2004 through 2007, the

homeownership rate did not increase over the period. In fact, the homeownership rate decreased after 2004.¹¹

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 between 2003 and 2007, 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 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, which is consistent with new borrowers being disproportionately investors.

The easing of mortgage lending underwriting by relying on the collateral's value and its expected appreciation did, however, enable single-family residential real estate investors to take advantage of a less expensive put option to increase leverage. 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

¹¹ The rate of homeownership reached its maximum of 69 percent 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 percent combined LTV (CLTV) loans were available. Several factors may have contributed to the persistence of the wealth constraint. First, in order to obtain a 100 percent CLTV loan, a borrower needs 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. Secondly, borrowers would still need to have disposable savings to cover closing costs, moving costs, and fix-up costs, even if they are able to finance 100 percent of the purchase price. Third, wealth might remain binding in situations where the asking price for the home is higher than the appraised value used to underwrite the loan.

(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 returns 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 these findings that if the lending environment allows unconstrained investors to enter markets and to increase their leverage lowering the cost of the put option, these actors may buy into and support the formation of asset bubbles. But in efficient markets such price rises would ordinarily be countered by short-selling to bring prices back in line with fundamentals.

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 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

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)

¹⁴ Herring and Wachter (1998) develops a model of land prices, 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.

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:

$$P^*u = P (rf + \rho + tx + d - g)$$

Where, P represents price in dollars; P^*rf , foregone interest (at the risk-free rate); $P^*\rho$, the risk premium for housing; P^*tx , annual property taxes; P^*d , annual depreciation; and P^*g , the expected appreciation in house prices.

With frictionless arbitrage:

$$R = P^*u$$

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

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

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 forecasts. 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 ρ term, which represents the risk premium (or cost of capital) for housing lending. As demonstrated in country data analysis by Pavlov and Wachter (2009), the symptom of a bubble is the negative correlation between lending spreads (that is, the risk premium, ρ) and real estate price appreciation, g , all else equal. Underpriced financing induces borrowers not only to over-pay for assets because they obtain cheap

financing, but also to borrow more. The interplay of these two effects magnifies price increases, especially in markets that are more supply-constrained. If this occurs, housing prices will be inflated through increased demand (dampening default risk during the period of rising prices) and these price rises may result in higher price growth expectations with expectations capitalized into higher prices. When the NTMs 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 transparency so that increased risk can be monitored. A market and a formal trading exchange for buying and short selling real estate securities could be helpful in bringing about increased transparency and price discovery. 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, lenders in the U.S. mortgage market, who made non-investment grade loans, were forced to keep the mortgages—and the credit risk—on their books. . Mortgage markets in the U.S. began to change in the mid-1990s, and a rapid transformation occurred after 2000. Lenders discovered that they could securitize mortgages through private conduits managed by investment banks.

Investors assumed the credit risk on these MBS, which meant on the underlying mortgages. Because private label MBS do not have the GSE payment guarantee (with implicit or explicit government backing) 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 firm's leveraged private label MBS by using these as collateral for additional debt, in the form of collateralized debt obligations (CDOs). CDOs² 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.

But the extent of this systemic increase in leverage was not known. 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.¹⁵ The race for market share fueled the extension of these increasingly risky loans 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, increasingly, participants are likely to be short-termers. Aggressive lenders gained market share and fees by offering loans with low upfront costs, attracting 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 for many lending institutions and the historic fiscal and monetary bailouts. Another result was the seizing up of NTM lending through the implosion of institutions that had been

¹⁵While 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 additional 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.

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.¹⁶ The after-the-fact identification of risk caused lenders to restrict access to lending across the board, resulting in procyclical lending terms. Despite the unprecedented Fed support for low interest rates, the all-in costs of homeownership have increased. 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 a new housing finance structure, whatever form it takes, will itself affect the volatility of housing prices and thus the lending standards necessary for systemic stability.

¹⁶ 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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