BELOW THE LINE
Estimates of Negative Equity among Nonprime Mortgage Borrowers

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Abstract

This paper provides some estimates of negative equity mortgages – mortgages whose balances exceed the value of the collateral housing unit - among non-prime borrowers. By combining house price indexes with loan information from the FirstAmerican CoreLogic LoanPerformance database, we provide estimates of the prevalence of negative equity across a variety of dimensions, including the location of the collateral housing unit and the year in which the mortgage originated. Our findings indicate that the prevalence and magnitude of negative equity are closely associated with the time and place the mortgage was originated, and with the existence of subordinate liens against the property. We also discuss the characteristics of borrowers who have a negative equity position, and explore the connection between negative equity and default behavior among subprime borrowers. We find that borrowers whose mortgage is worth more than their house are approximately twice as likely to be seriously delinquent, or in default, on their first lien mortgage than borrowers who have positive home equity. Using estimates of future house price changes, including information from futures markets, we provide estimates of how negative equity will evolve through 2009.

1. Introduction

The boom in nonprime mortgage lending during 2004 to 2006 was quickly followed by rapid increases in the rate of delinquencies and foreclosures on these loans. This pronounced deterioration created alarm among investors, the public and policy makers. Uncertainty about the source of this decline in loan quality has played a role in the credit crunch that has developed over the last year. In this paper, we provide estimates of borrower equity, an important correlate of the deterioration in the performance of these loans.

Nonprime loan originations rose sharply after 2003, (Figure 1) and became delinquent far more quickly than had earlier vintages.[1] By 12 months following origination, the 2005 vintage had a 90 day or more delinquency rate that was not reached by the 2003 vintage for 20 months, and the 2006 vintage at 12 months had a rate that was not reached by the 2003 vintage after even 30 months.[2] Moreover, this sharp decline in loan performance was a surprise to investors in these loans in that to a large extent it seemed unexplained by the borrowers' observed risk characteristics. Demyanyk and van Hemert (2008) and Haughwout, Peach and Tracy (2008; HPT) document these facts about early delinquency and default and provide some evidence of their correlates.

The mortgage industry's standard view of default risk has historically focused on four key underwriting characteristics at origination of a new mortgage: borrower credit rating, loan to value ratio, debt to income ratio, and the extent of third-party income and asset verification. Yet these factors alone seemed insufficient to explain the severe and rapid deterioration in the

[1] For the purposes of this study, the non-prime market consists of both subprime and alt-A loans. Compared with prime mortgage loans, **subprime** mortgages are typically of smaller value and made to borrowers with some blemish on their credit history. **Alt-A, or "near prime",** mortgages are typically larger value loans made to borrowers who, for a variety of reasons, may not choose to provide the documentation of their income or assets typically required to obtain a prime mortgage.

[2] These figures include loans at least 90 days delinquent, in foreclosure, or in REO.

status of these loans (Demyanyk and van Hemert, 2008; HPT). While some underwriting criteria deteriorated as the nonprime market share expanded, others changed little or even improved. For example, mean credit bureau scores of nonprime borrowers increased steadily after 2001, largely but not entirely as a result of a shift in composition of the nonprime pool toward alt-A loans (Figure 3).

In light of this mixed record on credit standards, some analysts turned to the economy to explain poor mortgage performance. Yet since economic growth during 2005-2007 was fairly steady--real GDP grew 3.1, 2.9 and 2.2%, respectively, for those three years and the unemployment rate fell below 5%--sharp income declines seemed an unlikely source of widespread increases in nonprime delinquencies and foreclosures.

Of course, aggregate statistics may mask changes in individual circumstances. As we discuss below, when a borrower experiences a deterioration in her personal finances, her home equity is a key determinant of what she will do, and one underlying economic factor that did deteriorate concurrently with mortgage performance was house price appreciation. After peaking at an annualized growth rate of 9.68% in the third quarter of 2005, the OFHEO national purchase only House Price Index began to lose steam, and ultimately began to decline. By 2008Q1, the annualized quarterly growth rate was -6.9%, and the reversal was even sharper in some of areas of the country.

Observers in both the popular media and among researchers quickly pointed to the confluence of house price declines and mortgage defaults as more than coincidence (Gerardi, Shapiro and Willen, 2008; HPT; Demyanyk and van Hemert, 2008). Indeed, a large body of previous research on mortgage defaults indicates that declines in house prices – or more precisely reductions in borrower equity – are fundamental to default (Vandell 1995, Elul 2006),

and limited evidence from the current downturn confirms this hypothesis (see, for example, Foote, Gerardi and Willen, 2008).[3]

Borrower equity and mortgage options

The typical mortgage can be thought of as a loan contract that confers several options on the borrower in addition to making the scheduled payments to maturity. One option is to pre-pay the mortgage, either through selling the home for a price at or above the mortgage balance or by refinancing into a new mortgage. Transactions fees may be especially large in the case of a sale of the property, which may involve relocation costs, payments to real estate brokers, taxes and legal costs that can easily amount to 6-8 percent of property value. Transactions fees for prepayment of any sort, whether sale of the property or refinance, may be especially high for nonprime mortgages, about 75% of which included a prepayment penalty with an average duration of about thirty months from origination.[4] Both selling the property and refinancing the mortgage will, of course, be less attractive options when house prices have fallen since the mortgage was originated.

A second option retained by the borrower is default. Here, the borrower may simply decide to stop making payments on the mortgage, which will lead the mortgagee to take

[3] In what follows equity is defined as the book equity of the loan where the balance of the mortgage is subtracted from the value of the home. This is not to be confused with the difference between the home and mortgage value. Due to the fact that the market value of the mortgage will neither be larger than its balance, since the loan is discounted for risk, nor greater than the underlying asset of the home, it is possible to have both positive equity and negative book equity. This distinction is particularly relevant when predicting default behavior since a borrower who is in a true negative equity position – after accounting for all the costs and benefits of the mortgage - would have already defaulted on his loan. The value of such a loan is thus simply the value of the underlying collateral. While market equity is an important concept, we focus on the difference between the balance on the mortgage and the value of the house and therefore throughout the remainder of the paper, we refer to book equity as equity.

[4] Our data reports the presence and duration, but not the size, of prepayment penalties. CRL 2005 http://www.responsiblelending.org/pdfs/ib008-PPP_in_Subprime_Loans-0604.pdf reports that prepayment penalties are frequently equal to about six months worth of interest due.

possession of and/or sell the house to recover the balance due on the mortgage. In most cases, residential mortgages are effectively non-recourse loans, meaning that mortgagees cannot – or do not – pursue borrowers for any deficiency in the event that the house sells for less than the balance outstanding on the loan. Pence (2003) reports that while deficiency judgments are available in all but a few states, they are frequently limited.

Like the prepayment options, evaluating the default option is complex, since the borrower must form expectations as to the value of the home in the future (Kau, Keenan and Kim, 1995). Refinancing or continuing to pay on the current mortgage entitles the borrower to capture any expected future gains in this value. Exercising the default option means losing the option to sell the house in the future – either to another buyer, or back to the lender through default – and also includes relocation costs and potential damage to the borrower's credit rating. All told, default costs for a typical borrower with zero equity can total up to 15-30% of the house value (Vandell, 1995).

Other things equal, the expected value of defaulting on a non-recourse loan rises as the borrower's equity in the property falls. When equity falls to zero (or becomes negative), lost equity is no longer a consideration and the option to default becomes much more likely to be "in the money". Still, the option to capture future house price increases, transactions costs and credit rating effects may keep a borrower from defaulting even when she is "upside down". When equity becomes very negative, however, the benefits of default become more likely to exceed the costs.

Since it has such a large effect on borrower default and prepayment costs, equity is an important element in the default decision. A long literature on the default option has led to the conclusion, nicely summarized by Foote, Gerardi and Willen (2008), that negative equity is a

necessary but not sufficient condition for default. That is, when faced with a shock to their income or a reset of their interest rate, borrowers in a positive equity position (net of all transactions costs) should generally be able to find alternatives to default: either refinance if credit is available at an affordable price, or sale of the collateral property.

For this reason, measures of housing units with *negative* equity have become a necessary component in crafting policies to address the current foreclosure crisis. In this paper, we estimate and study negative equity in the US nonprime mortgage market for the Spring of 2008 and beyond. We start in Section 2 by describing our methods, and then discuss how changes in mortgage underwriting and house price dynamics might be expected to affect borrower equity. Section 3 presents several tabulations of negative equity mortgages, and in this section we also examine the static relationship between negative equity and mortgage default. Section 4 discusses these results and, using information from other studies and futures markets, relates the evolution of house prices to borrowers' equity positions. Section 5 summarizes our major findings and concludes.

2. Data and methods

We combine information from several sources to provide our estimates of negative equity nonprime mortgages in the United States. Our primary source of information on individual loans and borrowers is FirstAmerican CoreLogic's LoanPerformance data set, which, as of February 2008, provided loan-level information at a monthly frequency on approximately seven million active, securitized subprime and alt-A loans, carrying balances of over $1.5 trillion. While LoanPerformance captures over 90% of securitized loans after 1999 and nearly 100% for the crucial 2003-2005 vintages, it excludes all loans held in bank

portfolios (Mayer and Pence 2008). Pennington-Cross (2002) argues that securitized subprime mortgages differ systematically from those retained in portfolio. Since our data are limited to securitized loans, any inferences should be limited to this set of loans.

The LoanPerformance dataset is a rich source of information on the characteristics of these loans. The dataset includes information on the date of origination and the zip code in which the collateral property is located, details of the mortgage contract, and underwriting information. Also included are monthly updates of dynamic information such as current interest rates, mortgage balances and the borrower's payment record.

We analyze a one percent random sample of the first-lien subprime and alt-A loans reported in the data as of April 1, 2008.[5] Our data set includes over 56,000 active (not yet paid off) loans with the information required for the analysis. We combine the loan-level data with aggregate data on house price dynamics for each MSA.

We use two sources of house price growth to estimate negative equity. The first is the widely-used Office of Federal Housing Enterprise Oversight House Price Index (OFHEO or OFHEO HPI), and the second is the S&P/Case-Shiller Home Price Index (CS).[6] Both of these indexes are based on repeated transactions on the same property over time, but they differ in several ways. For our purposes, the fact that OFHEO provides separate indexes for 381 metropolitan areas is a great benefit, as we can thus estimate house price changes for the great majority of the properties in our loan-level data set. Yet OFHEO is based on the sales prices or

[5] Since observations in the LoanPerformance dataset are loans coded to the zip code, we choose our dataset from the universe of first-lien loans only. This avoids the possibility of double counting subordinate lien loans on the same property. While the LoanPerformance data set also includes information on nonprime subordinate liens, it is impossible to match these loans to the first liens.

[6] See http://www.ofheo.gov/hpi.aspx and http://www2.standardandpoors.com/spf/pdf/index/SP_CS_Home_Price_Indices_Factsheet.pdf for more details.

appraisals of homes covered by prime, conforming mortgages, i.e., those securitized by one of the Government Sponsored Enterprises (GSEs).[7] Since the properties we study are by definition financed with a nonprime mortgage, OFHEO's focus on GSE mortgages introduces the possibility of measurement error in our estimate of house price appreciation, with the sign and magnitude of the error depending on how appreciation varies across different segments of each market.

The Case-Shiller index addresses this problem in two ways. First, it covers all sales, not just those of the prime market segment. Second, CS supplements the overall measure with separate indexes for three tiers in each of the markets it covers. The tiers break each market into thirds – low, middle and high - based on area house prices as of March 2008. For example, Los Angeles MSA properties with March 2008 prices under $417,721 are in the low tier, properties with prices between $417,721 and $627,381 are in the middle tier and those priced above $627,381 are considered high tier. Inspection of the house price dynamics in these tiers indicates that they are indeed different from the overall measure, suggesting that, for our purposes, measurement error using the OFHEO index is nontrivial; see Figure 2. This suspicion is confirmed by Leventis (2008) who finds that differences between Case-Shiller and OFHEO are importantly influenced by the treatment of lower-priced houses.

In order to estimate equity in properties, we perform a series of simple calculations. First, we use data from LoanPerformance to calculate the borrower's net equity in the property at origination of each first lien loan. This measure captures both the balance of the first liens as well as all subordinate liens, if any exist. An interesting feature of the data is that while first lien loans remained at relatively stable loan-to-value ratios (LTVs) throughout the 2000-2008

[7] Concerns have also been raised that appraisals during the "boom" years of nonprime lending were biased upward, and OFHEO publishes a national "purchase only" index that incorporates data only from actual sales. But this index is not available for individual metro areas.

period, subordinate liens became both more common and rose in value as a percentage of house value. Figure 4 shows "box and whisker" plots of combined (all liens) LTVs by vintage. For each year, the shaded box indicates the middle 50% of the data. Thus the top of each box is the 75th percentile value, while the bottom is the 25th. The line in the middle of the box shows the median value. The thin whiskers extending from the ends of the boxes are the upper and lower and lower adjacent range, which extend 1.5 times the interquartile range in both directions.

The net equity at origination provides a starting point for our estimates; we use it to calculate equity at origination, which house value at origination of the first lien loan (HV_o) minus total balances on all l liens $\sum_{l=1}^{L} M_o^l$ at origination. Equity at time t is then simply initial equity plus any house price appreciation, minus any increase in mortgage balances, after origination:

$$E_t = [HV_o - \sum_{l=1}^{L} M_o^l] + [\Delta HV_t - \sum_{l=1}^{L} \Delta M_o^l]$$

Net equity can change in three distinct ways:

- Principal amount on the first lien mortgage changes $\Delta M_t^1 \neq 0$ (typically mortgage balances will decline over time, meaning that $\Delta M_t^1 < 0$)
- Principal amount(s) on subordinate liens change $\sum_{l=2}^{L} \Delta M_t^l \neq 0$
- House value changes $\Delta HV_t \neq 0$

We have direct, micro-level evidence on only the first of these, since LoanPerformance tracks monthly balances on each first lien loan we observe. We use each metropolitan area's OFHEO and CS indexes to estimate changes in house values since origination of the loan. For balances on subordinate liens, we assume that the borrower makes regular interest payments,

but that principal amounts remain unchanged. Note that this is something of a "middle ground" assumption: borrowers may either make progress toward reducing the balances on subordinate liens ($\sum_{l=2}^{L} \Delta M_t^l < 0$), or may layer additional liens on top of those we observe ($\sum_{l=2}^{L} \Delta M_t^l > 0$). The need to make assumptions about the balances outstanding on subordinate liens is a limitation to our analysis to which we will return later.

3. Negative equity among nonprime borrowers

Two phenomena important for understanding homeowners' equity occurred after 2002. First, full loan-to-value ratios rose sharply, as junior liens became both more common and larger. This change is present throughout the post-2002 period, but is especially significant in 2006, when over 25% of nonprime originations had initial LTVs of 100 or more (Figure 4).

Second, starting in 2005, the house price environment, whether measured by OFHEO or CS, became much less favorable for building borrower equity. After peaking at an annualized growth rate of 9.68% in the third quarter of 2005, the OFHEO purchase only HPI began to lose steam, and reverted to decline. By 2008Q1, the annualized quarterly growth rate was -6.9%. This reversal was especially sharp in some of the areas that had experienced the highest growth prior to 2005. The Las Vegas, NV metropolitan area went from a house price growth rate, measured by the CS index, of over 42% in 2003 to -15% during 2007. An alternative story can be found in parts of the Midwest. In Cleveland, for example, the CS index house prices declined just 1.67% during 2007, but this followed a long period of relatively sluggish growth; the city's peak growth year was 2003 when prices rose just 5.4%.[8]

[8] Growth rates in this section are measured as December over December percentage growth.

This combination of many homeowners holding little or no equity at mortgage origination and a declining housing market is a perfect storm for generating negative equity. Note that for a mortgage with an apparently safe origination LTV of around 80, a 20% decline in house value – not uncommon in many metro areas during 2007 – has the potential to wipe out essentially all their home equity. We should not be surprised, therefore, to find that the incidence of negative equity grew substantially in 2006 and 2007. What remains to be seen is exactly how large and how common nonprime negative equity mortgages have become, where they are concentrated, and what their consequences are for borrower behavior.

Our OFHEO-based estimates of the aggregate number and percentage of nonprime borrowers in a negative equity position are reported in Table 1. The table reports two sets of figures: borrowers whose first lien mortgage balance exceeds our estimate of the value of their home, and those whose combined mortgage balances – including both first and subordinate lien balances – exceed that value. We estimate that, using the OFHEO indexes for 381 US metropolitan areas , one in eight subprime mortgages is "underwater" by this second definition. It is worth noting that subordinate liens are currently playing a major role in producing negative equity among nonprime borrowers – our OFHEO estimates indicate that only 3.2% of borrowers are underwater on their first lien.

Limiting the analysis to the 17 cities covered by the Case-Shiller low-tier index creates a more pessimistic picture (Table 2).[9] Using this measure of house price changes, we estimate that 45% of housing units covered by nonprime first lien mortgages - over 1.1 million households in these 17 cities alone - are in a negative equity position. Using the OFHEO measure for the same loans, just 13.7% - some 337,000 units – are upside down on their total

[9] Note that the OFHEO and CS definitions of these metropolitan areas differ slightly; for comparability we analyze metro areas tracked by both the Case-Shiller and OHFHEO Indexes.

nonprime mortgage balances. Since the geography is held constant, the stark difference between the CS and OFHEO results is here attributable to coverage differences *within* each MSA; the bottom tier CS index for each of these cities has fallen significantly more than the OFHEO index.

These large differences create a dilemma. On the one hand, OFHEO's national coverage is an enormous advantage in estimating the prevalence of negative equity in aggregate. Yet the results reported in Table 2 lead us to believe that the OFHEO results may be understating the extent of negative equity. We have opted to concentrate on what we believe to be the more accurate picture available for a restricted set of cities and we thus focus on the 17 cities for which we have CS low-tier information. Nonetheless, we also report OFHEO results at various points in what follows.

We estimate that nearly two-thirds (62.6%) of the 2006 nonprime vintage in these 17 metro areas was upside down by April 2008. Increases in full LTVs at origination, combined with the sharp reversal in house prices after 2005, suggest that borrowers who took out their mortgages later in the period would be more likely to find themselves without any equity in their property. The data clearly support this hypothesis, as shown in Figure 5. Very low proportions of nonprime mortgages originated before 2003 were upside down by April 2008, but negative equity rates are sharply higher in subsequent vintages. All told, we estimate that the difference between house values and nonprime mortgage balances in these cities totals over $66 billion.

Perhaps most striking is the fact that a third of the negative equity properties in the 17 Case-Shiller cities is located in one of the three California metro areas, with nearly 20% in Los Angeles alone (Table 3). In addition, negative equity *amounts* are much larger in the California

(and to a lesser extent Florida) cities than elsewhere in the country. LA's 20% share of negative equity properties, because of larger than average mortgages and a relatively large decline in housing prices, corresponds to nearly a third of all negative equity balances; San Francisco accounts for another 19% of the negative equity across these 17 cities. Our analysis of the data thus indicates that borrowers who took out high LTV loans during 2006 and 2007 in areas which experienced sharp reversals in house prices are very likely to find themselves in a negative equity position.

Borrower characteristics and behavior

Borrowers facing negative equity are not distinctly less creditworthy than their positive equity counterparts. Not surprisingly, the most striking difference between positive and negative equity loans is the combined (senior plus junior) loan to value ratio at origination; in each MSA, average initial LTVs are significantly higher on negative equity loans. Debt-to-income ratios are generally higher among negative equity borrowers as well. Interestingly, credit bureau scores are generally higher among the negative equity borrowers.[10] Thus the default response by borrowers in negative equity is more a function of their reaction to their equity status than the "borrowers' quality."

In understanding default behavior is it crucial to analyze the relationship between equity loan status and default behavior. Recent research on default has indicated the importance of house price appreciation in influencing nonprime mortgage outcomes

[10] Table 5 reports these results using OFHEO index on the broader set of metropolitan areas. While the estimated shares in negative equity are consistently lower, they demonstrate similar spatial patterns, with the bulk of negative equity properties concentrated in the boom states, especially California. In addition, the concentration of negative equity loans among borrowers with relatively high credit scores, high debt-to-income ratios and combined LTV at origination is true of the broader sample. Neither sample demonstrates a clear relationship between equity and documentation levels.

(Demyanyk and van Hemert, 2008; Gerardi, Shapiro and Willen 2007). Demyanyk and van Hemert (2008) find that borrowers whose houses have appreciated less (or depreciated more) tend to default more, other things equal. In this work, borrower default is treated as a continuous function of house value, while we analyze a sharp break at zero equity. The idea that borrower behavior might change markedly as properties pass into negative equity is supported by both theory and empirical evidence. Theory predicts that borrowers with positive equity will rarely default, but borrowers with little or no equity will sometimes determine that default is the best option. When equity declines enough (i.e., if house values fall enough after loan origination), borrowers reach a critical value where they will be certain to default (Vandell 1995).

Haughwout, Peach and Tracy, 2008 (HPT) study the probability that a borrower falls at least 90 days behind on scheduled payments within the first year of a nonprime mortgage's life. HPT report very large ceteris paribus jumps in this probability as LTVs rise above 100, particularly for non-owner-occupant borrowers. They find that negative equity adds approximately 7 percentage points to default probability for owner-occupants, and between fifteen and twenty percentage points for investors, compared to similar owners with slightly positive equity in their properties (ie, those with LTVs between 95 and 100).

In very recent work, Foote, Gerardi and Willen (2008; FGW) study ownership experiences for both prime and nonprime borrowers in Massachusetts beginning in the late 1980s. Their results indicate two things relevant for our analysis: subprime borrowers are much more likely to default in general than those in conforming mortgages, and borrowers with negative equity are more likely to default after five years (and less likely to sell their properties) than those with positive equity.

As expected, we find that the share of loans that are 90 or more days delinquent with positive equity is less than half the rate of loans with negative equity (Table 6). However, borrowers who have negative equity on their homes are just as likely to be one to two payments late on their loans, but more than three times as likely to be in REO (bottom panel of Table 6). Thus, a fall in home prices may not precipitate initial delinquency, but instead encourages a homeowner who is already having difficulty making payments to default. This is consistent with a model in which some borrowers experience shocks to their incomes and fall a month or two behind on their mortgages, then decide whether to prepay (sell or refinance) or default. When their equity is below zero, the tendency to default is relatively strong.

Table 6 also indicates that borrowers with additional liens and positive equity in their property have lower default rates than their single-lien counterparts. Even though these borrowers should have a larger financial burden due to the relative size of their loan, they have also experienced greater home price increases than the single-lien mortgagees and are more willing to make regular payments. This implies that expected home price appreciation may be of more importance that the current amount of equity a borrower has in her home.

Note that the majority (56%) of properties in foreclosure or REO are, by our estimates, in a positive equity position, in spite of the argument presented above that negative equity is a necessary condition for default. The high number of positive equity properties in foreclosure may reflect mismeasurement of housing equity, or the presence of transactions costs that make default a better option than foreclosure.[11] Table 7 details our estimates of borrower equity by loan status for those loans we estimate to be "above the line". We find that our estimates of borrower equity are lower for those properties which are 90 days delinquent, in foreclosure or

[11] Recall that we describe negative *book* equity. It may be the case that many loans that we measure as having positive equity have prepayment fees or other features that put the default option "in the money". It is also possible that we under-estimate house price declines for some of these loans.

in REO. When prepayment penalties and the possibility of mismeasurement of house values are considered, it is possible that these borrowers perceive themselves to be upside down on their mortgages, helping to explain their behavior.

These results are qualitatively consistent with both FGW and HPT, but a direct comparison is difficult. In particular, since our mortgage dataset consists entirely of nonprime loans, we observe the effect of negative equity on that subsample of the FGW population. In addition, we observe a single cross-section of properties in foreclosure at a point in time, as opposed to the FGW approach of observing the timing of entry into default and the HPT analysis of delinquency within the first year after origination. Our foreclosure rates thus reflect not only the prevalence of entering foreclosure (which is itself influenced by both borrower and lender behavior) but also the time that a property in default spends in foreclosure.

4. Looking ahead

Due to the important relationship between negative equity and default, it is valuable to develop an understanding of how negative equity will evolve. We provide two glimpses into the future of negative equity among nonprime borrowers. First, we explore three different house price appreciation scenarios for our national data. In a recent report, Lehman Brothers (Lehman Brothers 2008) envisions three scenarios for the evolution of the national OFHEO index. The base case assumes decline of 5 percent during 2008-2009, an optimistic scenario assumes that house prices stabilize, and a pessimistic case assumes a further 15% decline. Table 8 reports the effects of these assumptions on the prevalence of negative equity in both the Case Shiller cities and the larger OFHEO sample. Since Lehman does not provide

geographic detail for these scenarios, we assume that that the declines are uniform across MSAs, an assumption that is sure to be incorrect.[12]

In looking into the future, one must project not only house prices but also payment behavior. In Table 8 we provide negative equity estimates that indicate the dominant effect of house prices: in panel (a) mortgage balances are allowed to decline according to the scheduled monthly payments, while in panel (b) balances are held constant at the April 2008 levels.[13] Note that assumptions about the evolution of mortgage balances is largely irrelevant to the calculation, as is demonstrated by comparing panels (a) and (b) in Table 8. This is because the great majority of the loans at risk of slipping into negative equity are relatively new, and the scheduled monthly payments consist largely of amortized interest. We are thus able to simultaneously describe both panels of Table 8 in what follows.

We estimate that an additional 15% decline in the OFHEO index will result in over 2 million negative equity loans in the urban US by December 2009, an increase of approximately 1.5 million nonprime borrowers in a negative equity position over our estimate of 707,000 in April 2008. Such a house price decline would lead the aggregate value of mortgage balances on nonprime loans to exceed the value of the collateral houses by $80-90 billion; a typical negative equity borrower would have a mortgage balance $35,000-40,000 in excess of their house value. Even a substantially more favorable housing market (price declines of 5% through December 2009) would result in over a million nonprime borrowers in negative equity, and would increase the negative equity rate (to 18-20%) and the aggregate negative equity amount

[12] Note that we simulate 0, 5 and 15% declines from April 2008 through December 2009, which is slightly pessimistic relative to the Lehman scenarios since national OFHEO fell 1.7% in 2008Q1.

[13] In producing the Table 8a estimates we assume that all borrowers, including those currently in foreclosure, make the monthly principal and interest payments, calculated based on the loan-specific amortization schedule, current interest rate and current balance as of April 2008. We also assume no liens are added to the properties after origination and there are no prepayments of mortgages currently outstanding. The calculations exclude loans with missing interest rates. Panel b uses the same set of loans, and assumes no further payments are made.

(to $31-36 billion). A complete halt to price declines, or a rebound by December 2009, would suggest modest improvement in the number of outstanding mortgages whose balance is higher than the collateral house price; substantial increases in house prices would be needed to bring most of the currently upside down mortgages into positive equity.

A drawback of the results reported in Table 8 is that the price declines we simulate are somewhat ad hoc: we have little way to tell which line of the table is the most likely projection, and no way of distinguishing price dynamics across metropolitan areas. One advantage of using the Case-Shiller indexes is that there exists a market in predicting the future path of house prices in individual MSAs.[14] The contracts are traded on the Chicago Mercantile Exchange, and provide estimates of house price appreciation for 7 markets for each quarter through 2011.[15]

The Case-Shiller futures market currently forecasts further deterioration in home prices in these cities. In our April data, these 7 cities had a combined negative equity rate of 44.6%, very near the average rate for all 17 CS cities. We estimate that the trajectories implied by the CS futures market would increase that rate to 54% by early 2009 and would add an additional 132,000 borrowers to the ranks of those whose homes are worth less than their mortgage balances in these 7 cities. In Figure 6, the percent of borrowers with negative equity in their home continues to increase through February of 2009. These calculations were derived using the percent change in home prices predicted for the Case-Shiller composite index and applying

[14] See http://housingrdc.cme.com/index.html for information on this market.
[15] The included cities are Chicago, Las Vegas, Los Angeles, New York, San Diego, San Francisco, and Washington, DC; futures prices for Miami are available only through December 2008. While the market is relatively thinly traded, activity picks up following releases of the CS index. We thus use the futures prices for contracts which had "open interest" on June 24, 2008, the release date for the April 2008 Case-Shiller home price indexes.

them to the low-tier index, and assuming that borrowers fall no further behind on their mortgages.

5. Conclusion

Recent declines in house values have put hundreds of thousands of nonprime borrowers in a negative equity position, a situation we define as occurring when the value of the house is below the balance on the mortgage. Negative equity nonprime borrowers have several things in common: they took out loans near the peak of the housing market, at high loan to value ratios usually achieved with subordinate liens in addition to the first lien. While negative equity loans occur in most metropolitan areas, they are disproportionately concentrated in those housing markets which experienced especially large swings in house price appreciation, especially in California. We estimate that three California metropolitan areas account for over 1/3 of the negative equity mortgages in our sample, and, due to higher balances on these loans, nearly half of the overall difference between house value and mortgage balances.

Further house price decline will yield further increases in the number of nonprime mortgages with negative equity. We estimate that an additional 15% decline in house prices through December 2009 will result in 1.5 million new mortgages whose balances exceed the value of the collateral houses nationwide. The aggregate difference between these balances and house values could approach $100 billion.

While negative equity is a necessary condition for default, it is not sufficient. As emphasized in previous literature and as shown by our data, borrowers do not automatically default when their house value drops below the balance on their mortgage statement. Nonetheless, other research has demonstrated that negative equity borrowers are far less likely

to prepay their mortgages, and are in fact more likely to become seriously delinquent and to default. We find that, among our nonprime borrowers, the probability that an outstanding negative equity borrowers will be in default in April 2008 is twice as high as a positive equity borrower. Viewed in this light, the prospect of further deterioration in house prices bodes ill for the future payment behavior of the nonprime borrowing population.

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Table 1: OFHEO-based Negative Equity Estimates*

	Number of Loans	Percent
First lien	1,823	3.23
All liens	7,070	12.51
Total Loans	56,509	100

* House value changes estimated using the Case-Shiller bottom tier indexes for individual MSAs

Table 2: OFHEO and Case-Shiller Comparison

Case-Shiller Negative Equity Estimates*

	Number of Loans	Percent
First lien	7,503	30.45
All liens	11,083	44.98
Total Loans	24,642	100

OFHEO Negative Equity Estimates**

	Number of Loans	Percent
First lien	504	2.05
All liens	3,373	13.69
Total Loans	24,642	100

* House value changes estimated using the Case-Shiller bottom tier indexes for individual MSAs
** House value changes estimated using the OFHEO indexes for individual MSAs

Table 3: Negative Equity by MSA*

MSA	% Negative Equity	Average Difference between mortgage balance and house value	Total Amount Underwater
Atlanta	43.4	$ 13,995	$ 873,314,832
Boston	37.3	37,364	930,366,090
Chicago	27.1	13,602	650,183,248
Cleveland	88.0	30,565	1,188,987,447
Denver	61.5	30,068	1,419,194,968
Las Vegas	58.2	45,541	3,329,022,977
Los Angeles	55.4	96,880	20,247,995,240
Miami	41.1	39,532	4,028,316,914
Minneapolis	67.9	36,009	1,688,829,604
NewYork	17.7	22,507	1,334,646,717
Phoenix	57.0	43,491	4,510,011,515
Portland	1.6	6,156	4,925,147
San Diego	69.5	105,573	7,559,005,320
San Francisco	68.7	142,508	12,540,677,600
Seattle	13.4	12,487	134,856,468
Tampa	44.9	29,024	1,236,422,400
Washington D.C.	49.4	54,183	4,334,608,000
17-City Composite	45.0	59,529	66,011,364,487

* House value changes estimated using the Case-Shiller bottom tier indexes for individual MSAs
Mortgage balances on junior and senior liens combined

Table 4: Underwriting Characteristics by Equity Status and MSA*

MSA	Equity Status	DTI	FICO	LTV	Fully Documented
17 City Composite					
Positive Equity	55.0%	38.1	671.2	73.3	43.0
Negative Equity	45.0%	40.5	677.3	92.1	36.0
Atlanta					
Positive Equity	56.6	35.5	667.7	81.1	56.0
Negative Equity	43.4	39.7	672.6	98.7	59.0
Boston					
Positive Equity	62.7	38.5	661.2	68.5	40.0
Negative Equity	37.3	42.1	668.3	94.9	47.0
Chicago					
Positive Equity	72.9	39.5	644.3	81.6	51.0
Negative Equity	27.1	42.1	666.0	98.3	40.0
Cleveland					
Positive Equity	12.0	34.7	637.4	68.8	62.0
Negative Equity	88.0	38.9	636.8	89.9	67.0
Denver					
Positive Equity	38.5	36.9	672.6	74.7	53.0
Negative Equity	61.5	41.2	670.3	96.3	59.0
Las Vegas					
Positive Equity	41.8	36.2	679.8	75.3	39.0
Negative Equity	58.2	40.4	682.5	93.3	30.0
Los Angeles					
Positive Equity	44.6	38.0	691.6	62.3	35.0
Negative Equity	55.4	40.6	687.8	88.8	22.0
Miami					
Positive Equity	58.9	38.3	658.3	73.5	37.0
Negative Equity	41.1	39.8	669.8	93.3	33.0
Minneapolis					
Positive Equity	32.1	36.5	671.6	74.8	52.0
Negative Equity	67.9	40.9	666.8	94.3	53.0
New York					
Positive Equity	82.3	39.3	663.4	73.8	38.0
Negative Equity	17.7	43.3	674.5	98.3	30.0
Phoenix					
Positive Equity	43.0	36.6	679.0	74.4	46.0
Negative Equity	57.0	40.2	671.2	91.0	40.0
Portland					
Positive Equity	98.4	38.3	684.7	83.0	45.0
Negative Equity	1.6	43.7	693.6	100.0	50.0
San Diego					
Positive Equity	30.5	36.6	702.4	58.2	36.0
Negative Equity	69.5	40.3	695.3	87.6	26.0
San Francisco					
Positive Equity	31.3	35.5	721.9	56.5	39.0
Negative Equity	68.7	39.3	696.8	85.4	24.0
Seattle					
Positive Equity	86.6	39.2	677.2	82.8	50.0
Negative Equity	13.4	40.8	691.3	99.0	47.0
Tampa					
Positive Equity	55.1	36.4	661.3	75.5	48.0
Negative Equity	44.9	39.4	662.8	91.6	41.0
Washington D.C.					
Positive Equity	50.6	38.7	674.5	71.8	45.0
Negative Equity	49.4	41.2	676.7	93.3	34.0

* House value changes estimated using the Case-Shiller bottom tier indexes for individual MSAs

Table 5: Underwriting Characteristics by Equity Status and State**

	Underwater Status	DTI	FICO	LTV	Fully Documented
			Non-Boom and Non-Bust States		
43 State Composite					
Positive Equity	97.6	38.7	655.0	84.1	55.0
Negative Equity	2.4	42.7	678.1	99.7	35.7
			Boom		
Arizona					
Positive Equity	83.1	38.1	671.8	79.9	45.0
Negative Equity	16.9	41.7	676.5	98.9	35.0
California					
Positive Equity	70.8	38.3	688.3	72.0	34.0
Negative Equity	29.2	41.4	683.8	95.5	26.0
Florida					
Positive Equity	80.6	38.2	659.2	79.1	42.0
Negative Equity	19.4	40.6	669.9	96.2	32.0
Nevada					
Positive Equity	65.2	37.0	680.3	78.5	36.0
Negative Equity	34.8	41.7	682.3	97.2	32.0
			Bust		
Indiana					
Positive Equity	99.7	37.4	638.3	87.2	70.0
Negative Equity	0.3	38.4	684.0	99.9	50.0
Michigan					
Positive Equity	73.2	37.9	633.9	81.8	64.0
Negative Equity	26.8	40.6	651.1	97.9	65.0
Ohio					
Positive Equity	96.2	38.3	636.4	86.8	68.0
Negative Equity	3.8	41.7	648.4	99.8	75.0

** House value changes estimated using the OFHEO indexes for individual MSAs

Table 6: Loan Status by Equity*

		Days delinquent:			Foreclosure	REO
First lien	30	60	90+			
Positive Equity	6.12	3	5.09	6.66	3.09
Negative Equity	6.7	4.13	7.5	10.87	6.61
All liens					
Positive Equity	6.11	2.85	4.45	5.15	2.03
Negative Equity	6.53	3.96	7.49	11.34	6.76

* House value changes estimated using the Case-Shiller bottom tier indexes for individual MSAs

Table 7: Loan Status and Equity, Positive Equity Borrowers

	Current	Days delinquent:			Foreclosure	REO
		30	60	90+		
Average Difference between Mortgage Balance and House Value	$136,844	$81,383	$96,356	$73,805	$70,879	$39,434
Averge Difference as a Percentage of House Value	28.0%	21.1%	20.8%	18.9%	17.6%	12.4%

Table 8: Negative Equity Mortgages in December 2009

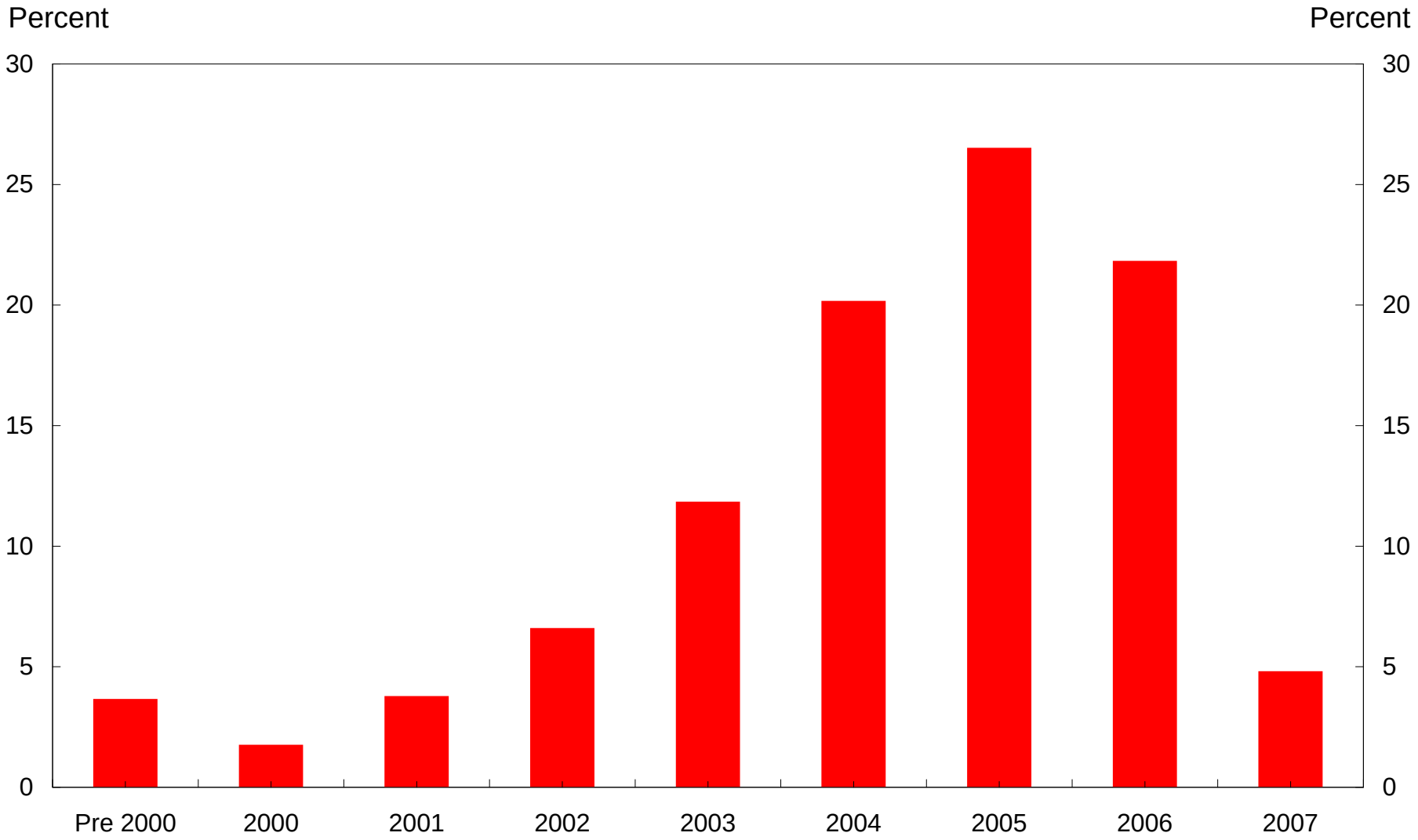
a. Mortgage balances decline as scheduled

	Negative equity mortgages			*Amount underwater*	
House prices decline:	Number	%	Δ from 4/08	Average	Total ($B)
0%	635,100	11.2%	(71,900)	29,047	18.4
5%	1,013,000	17.9%	306,000	32,359	32.8
15%	2,114,900	37.4%	1,407,900	39,554	83.7
Memo: April 1,2008 data	707,000	12.5%		28751.59	20.3

b. Mortgage balances remain constant at April 2008 levels

	Negative equity mortgages			*Amount underwater*	
House prices decline:	Number	%	Δ from 4/08	Average	Total ($B)
0%	707,000	12.5%	-	28,752	20.3
5%	1,177,300	20.8%	470,300	30,926	36.4
15%	2,316,300	41.0%	1,609,300	40,005	92.7

Figure 1: Nonprime Loan Originations by Year



Source: FirstAmerican CoreLogic LoanPerformance

Figure 2: Spread Between Case-Shiller Peak and Trough Post 2003 Index

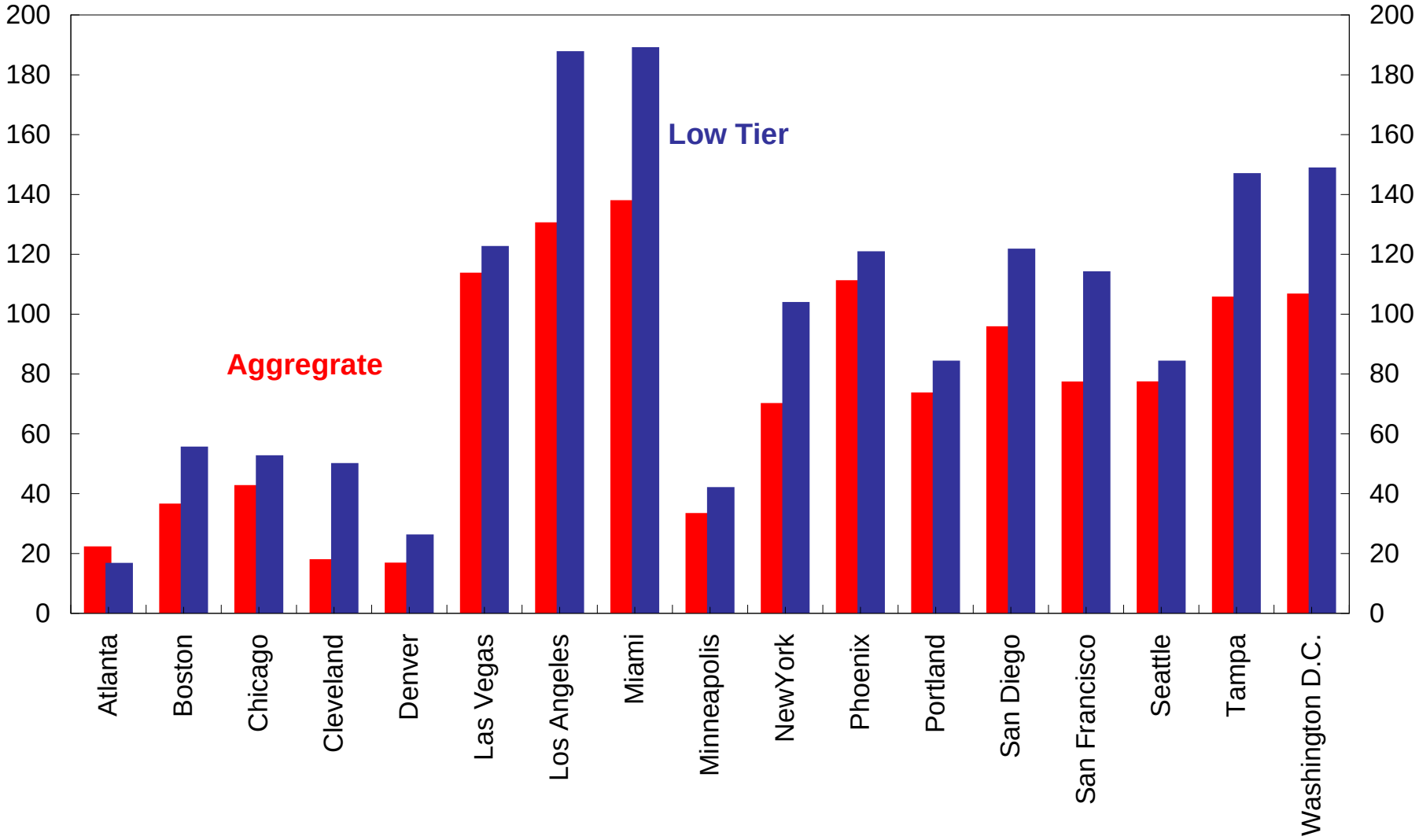
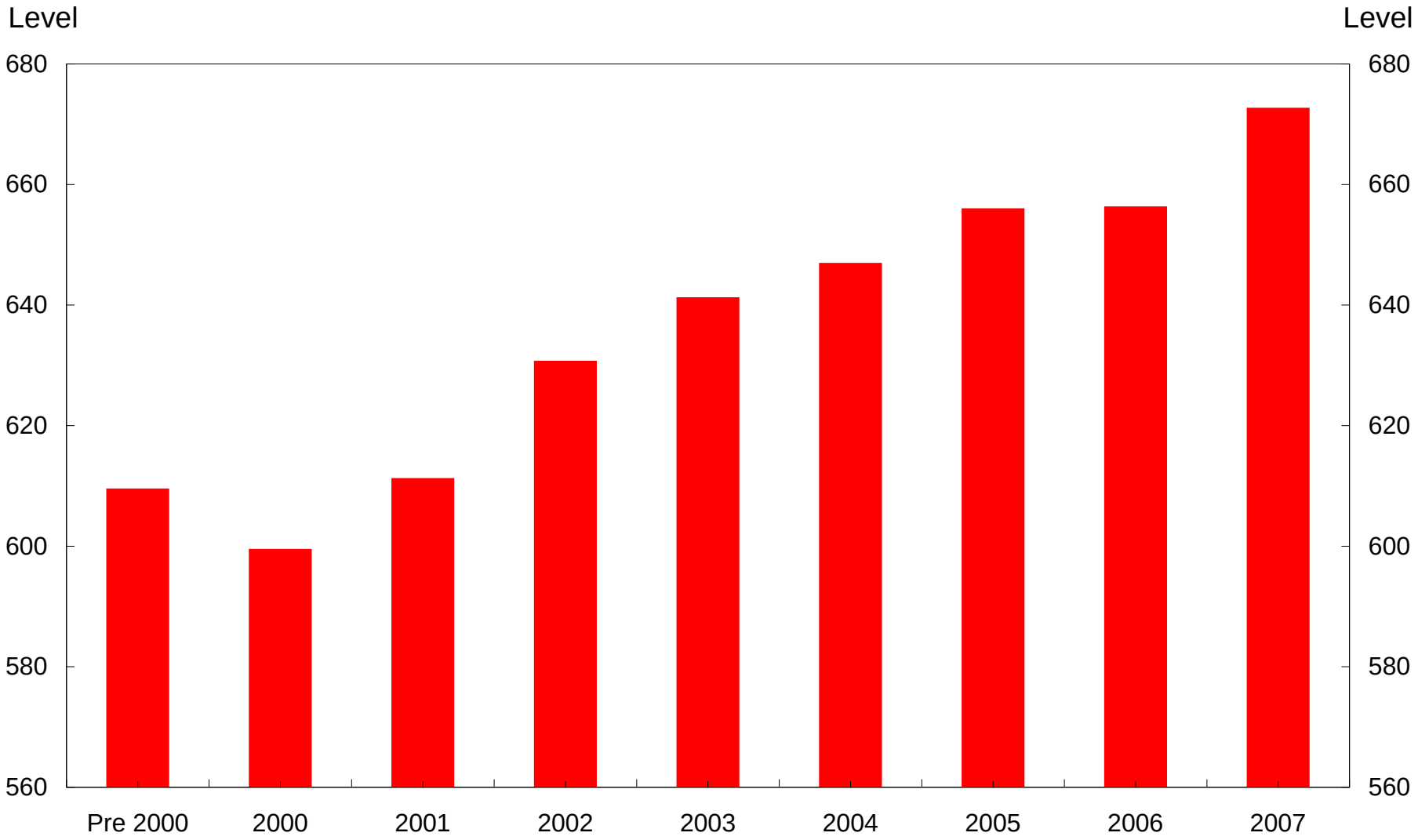


Figure 3: Mean FICO by Vintage



Source: FirstAmerican CoreLogic LoanPerformance

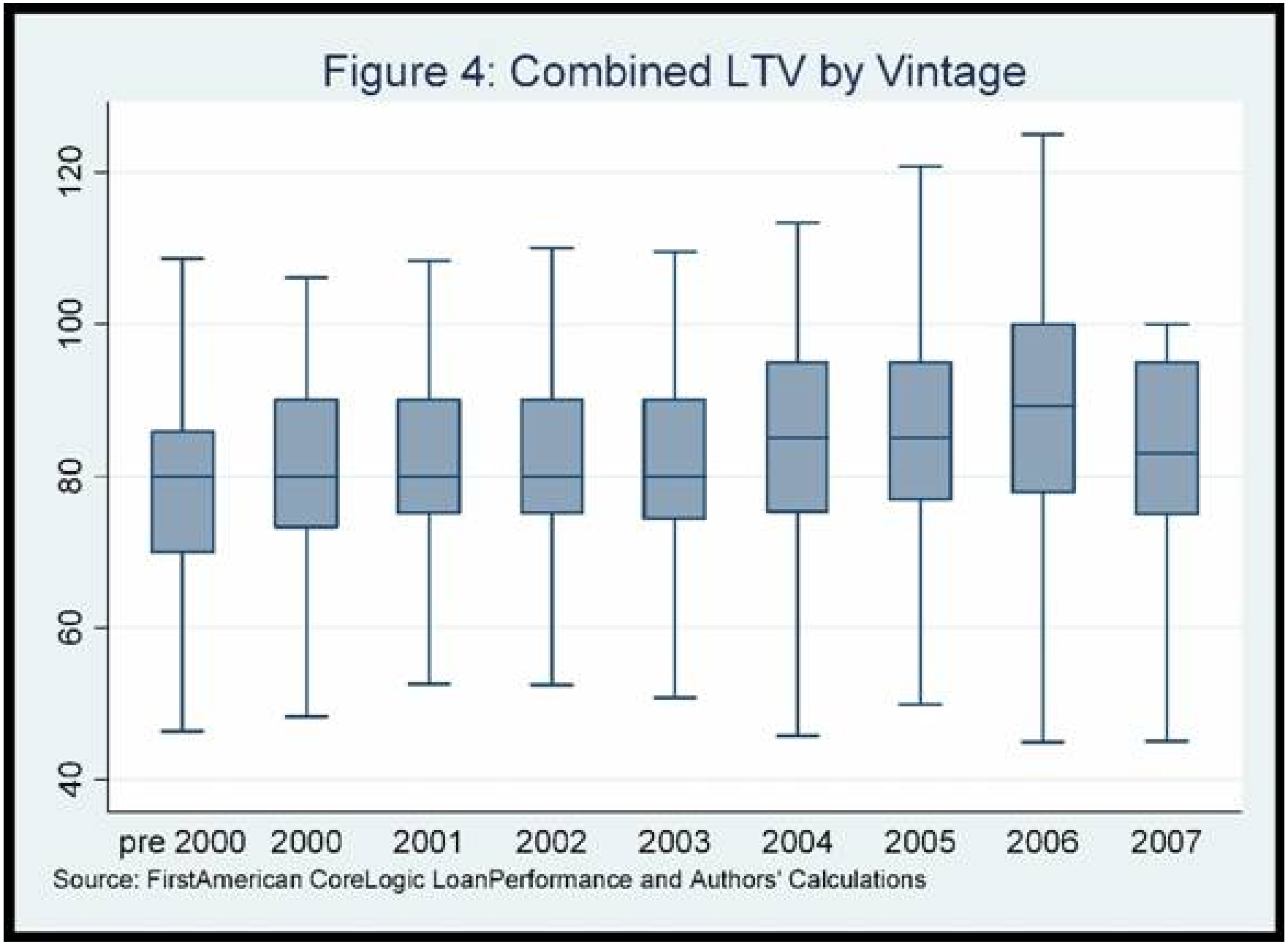
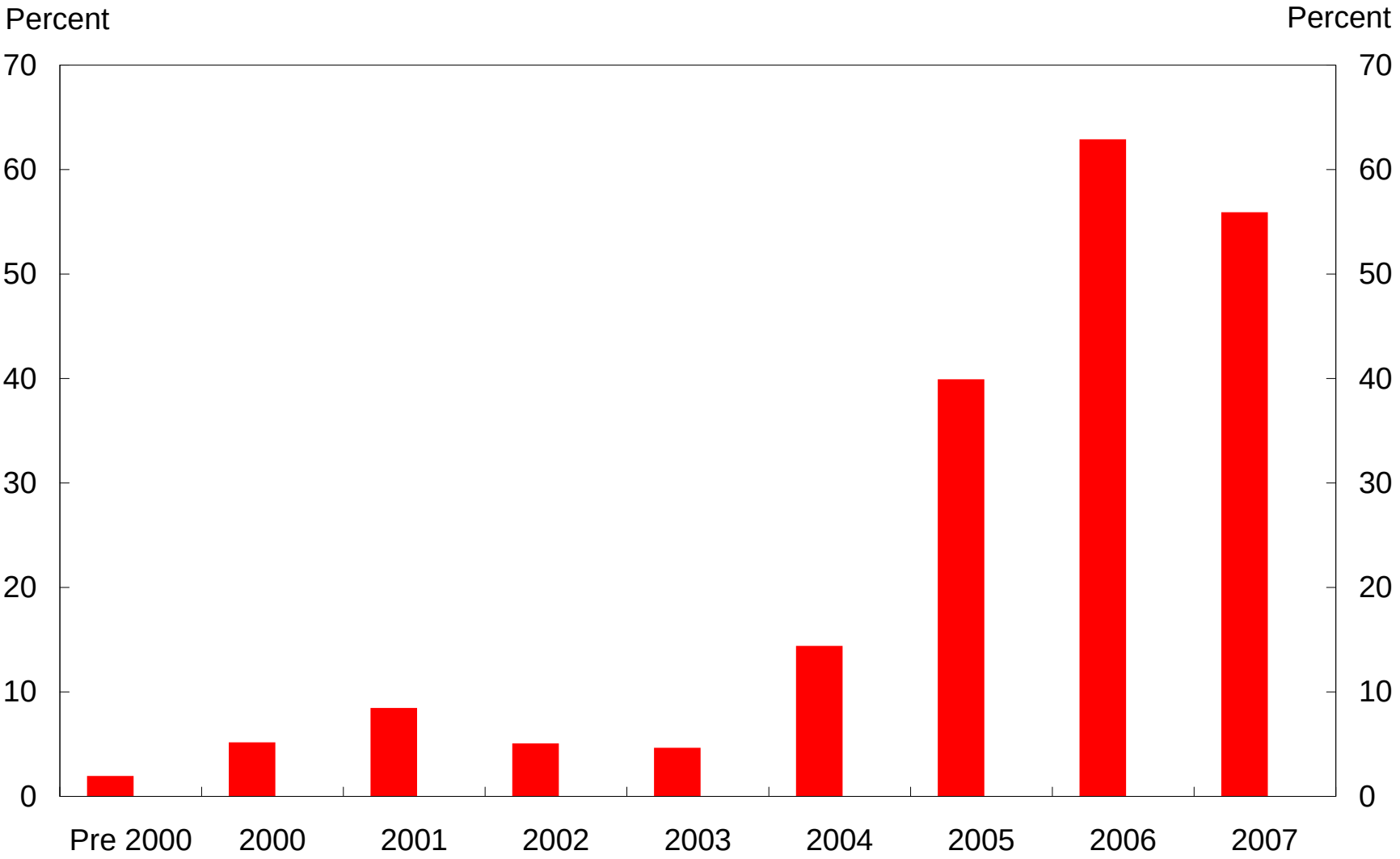


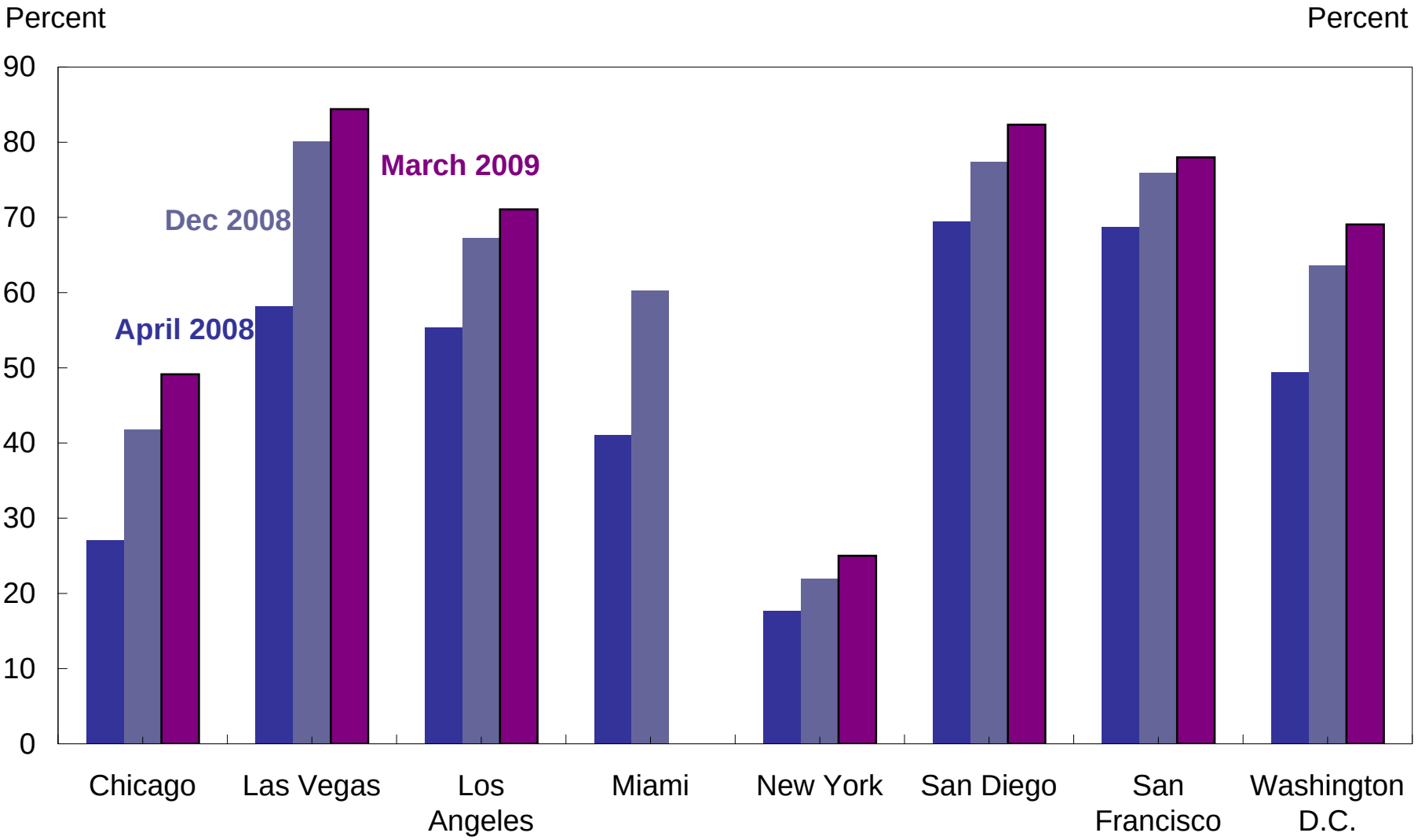
Figure 4: Combined LTV by Vintage
120
100
80
60
40
pre 2000
2000
2001
2002
2003
2004
2005
2006
2007
Source: FirstAmerican CoreLogic LoanPerformance and Authors' Calculations

Figure 5: Nonprime Negative Equity by Vintage



Source: FirstAmerican CoreLogic LoanPerformance

Figure 6: The Future of Negative Equity



Source: FirstAmerican CoreLogic LoanPerformance and S&P/Case-Shiller Home Futures from CME