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Below the Line: Estimates of Negative Equity among Nonprime Mortgage Borrowers

- Evidence from the current downturn suggests that declines in borrower equity are fundamental contributors to the rise in delinquencies and defaults on nonprime mortgage loans.

- Measures of housing units with negative equity—in which the mortgage balance exceeds the value of the collateral property—have become a key component in crafting policies to address the foreclosure crisis.

- An analysis of the prevalence and magnitude of negative equity in the U.S. nonprime mortgage market finds that negative equity is closely associated with the time and place of mortgage origination and with the existence of subordinate liens against the property.

- Borrowers in negative equity are twice as likely as those in positive equity to be seriously delinquent, or in default, on their first-lien mortgage.

1. Introduction

The boom in nonprime mortgage lending that occurred in the United States between 2004 and 2006 was quickly followed by rapid increases in the rate of delinquencies and foreclosures on these loans.[1] This pronounced deterioration alarmed investors, the public, and policymakers.[2] Significantly, uncertainty about the source of the decline in loan quality has played a key role in the credit crunch that began in mid-2007.

Nonprime loan originations rose sharply after 2003 (Chart 1), and these loans became delinquent far more quickly than had earlier vintages. Indeed, loans originated in 2004 performed poorly compared with earlier vintages, and the 2005 and 2006 vintages became seriously delinquent within a year of origination at rates that the 2003 vintage took twenty and thirty months to reach, respectively.[3]

[1] In this article, the nonprime market consists of 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 income or assets typically required to obtain a prime mortgage.
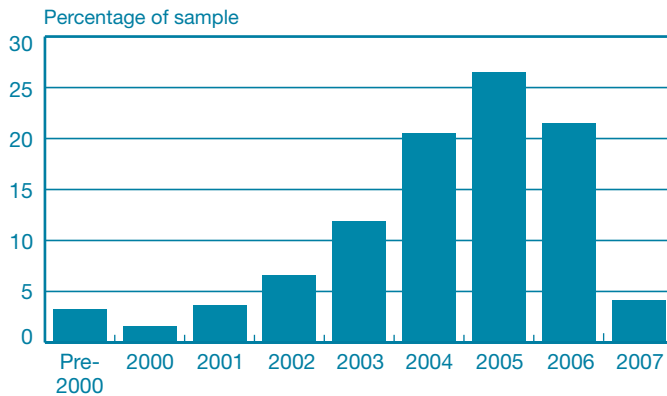
[2] As reported, for example, at CNNMoney.com (<http://money.cnn.com/2007/11/04/news/companies/citigroup_prince/index.htm>) and BBC News (<http://news.bbc.co.uk/2/hi/business/7070935.stm>). See also Bernanke (2008).

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CHART 1
Nonprime Loan Originations by Year

Percentage of sample

Source: FirstAmerican CoreLogic, LoanPerformance data.

CHART 2
Mean FICO Score by Vintage

Score

Source: FirstAmerican CoreLogic, LoanPerformance data.

The mortgage industry's standard view of default risk has historically focused on four underwriting characteristics at mortgage origination: borrower credit rating, loan-to-value (LTV) ratio, debt-to-income (DTI) ratio, and the extent of third-party income and asset verification. However, changes in these characteristics alone seemed insufficient to explain the severe and rapid erosion in the status of nonprime loans (Demyanyk and van Hemert 2008; Haughwout, Peach, and Tracy 2008). While some underwriting criteria deteriorated as the nonprime market share expanded, others changed little or even improved. For example, mean credit bureau (FICO) scores of nonprime borrowers increased steadily after 2001 (Chart 2), largely as a result of a shift in the composition of the nonprime pool to alt-A loans.

In light of these mixed developments, some analysts turned to the economy to explain the poor mortgage performance. However, because economic growth between 2005 and 2007 was fairly steady—real GDP expanded 3.1, 2.9, and 2.2 percent, respectively, in those three years while the unemployment rate fell below 5 percent—sharp income declines seemed to be an unlikely source of the widespread increases in nonprime delinquencies and foreclosures.

To be sure, aggregate statistics may mask changes in individual circumstances. When a borrower experiences a deterioration in personal finances, the borrower's amount of home equity largely influences his or her course of action. One underlying economic factor that did deteriorate concurrently with mortgage performance was house price appreciation. After peaking at an annual growth rate of 12.1 percent in

[3] These figures include loans that are at least ninety days delinquent, are in foreclosure, or are Real-Estate-Owned (REO)—that is, ownership of the collateral has been transferred to the lender.
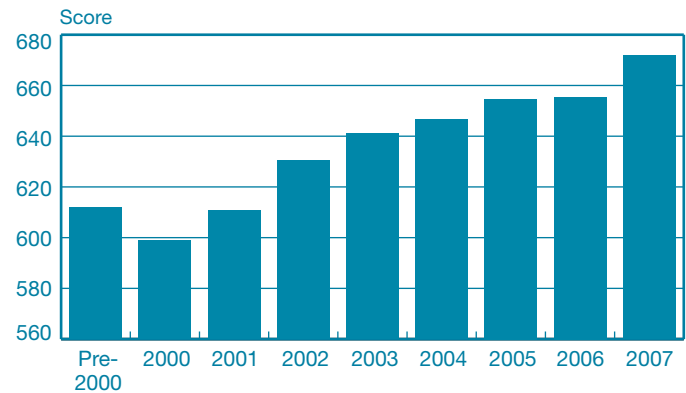
the second quarter of 2005, the Office of Federal Housing Enterprise Oversight's (OFHEO) national house price index began to slow, and ultimately declined. By the fourth quarter of 2008, the annual growth rate of the index was -4.5 percent (Chart 3), and the reversal was even sharper in certain areas of the country.

Observers in the popular media and in the research community quickly pointed to the confluence of house price declines and mortgage defaults as more than coincidence

Measures of housing units with negative equity . . . have become a necessary component in crafting policies to address the current foreclosure crisis.

(Gerardi, Shapiro, and Willen 2007; Haughwout, Peach, and Tracy 2008; Demyanyk and van Hemert 2008). Indeed, a large body of research on mortgage defaults indicates that declines in house prices—or, more precisely, reductions in borrower equity—are fundamental contributors to default (see, for example, Vandell [1995] and Elul [2006]); evidence from the current downturn, although limited, confirms this hypothesis (see, for example, Foote, Gerardi, and Willen [2008]).[4]

For this reason, measures of housing units with *negative* equity—that is, homes whose mortgage balance exceeds the value of the collateral housing unit—have become a necessary component in crafting policies to address the current foreclosure crisis. In this article, we estimate negative equity in

CHART 3
Home Price Indexes
Comparison of OFHEO and S&P/Case-Shiller

Year-over-year
percentage change
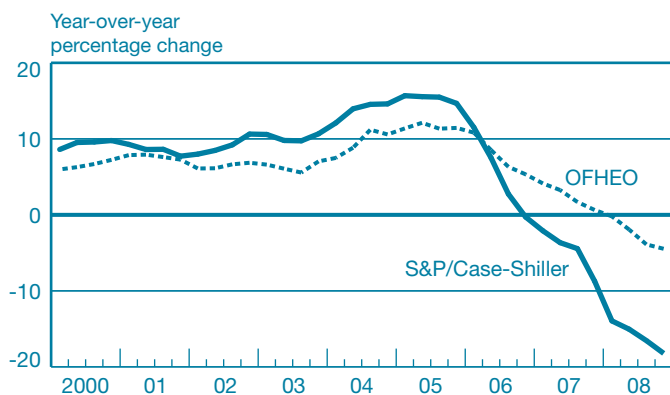
Sources: Office of Federal Housing Enterprise Oversight (OFHEO);
Standard and Poor's.

the U.S. nonprime mortgage market for 2008-09, and beyond, with the goal of describing the sources of the problem and the characteristics of borrowers in a negative equity position. Our results suggest that the prevalence and magnitude of negative equity are closely associated with the time and place of mortgage origination and with the existence of subordinate liens against the property. In addition, borrowers in negative equity are much more likely to be seriously delinquent, or in default, on their first-lien mortgage than borrowers in positive equity.

Our study is organized as follows. Section 2 describes our sample of mortgage data and our methods as well as discusses how changes in mortgage underwriting and house price dynamics can affect borrower equity. In Section 3, we present estimates of negative equity mortgages as well as examine the static relationship between negative equity and mortgage default. In Section 4, we discuss our results and use information from other studies and from housing price futures contracts to examine the relationship between borrower equity and house price dynamics. Section 5 summarizes our key findings.

[4] We define equity as the book equity of a loan, where the mortgage balance is subtracted from the home's value. This definition is not to be confused with the difference between mortgage value and home value. Because 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. While market equity is an important concept, we focus on the difference between the balance on the mortgage and the value of the house; thus, we refer to book equity simply as "equity."

2. DATA AND METHODS

We combine information from several sources to obtain our estimates of negative equity nonprime mortgages in the United States. Our primary source of information on individual loans is FirstAmerican CoreLogic's LoanPerformance data set. As of February 2009, the data set provided monthly loan-level information on approximately 4.8 million active, securitized subprime and alt-A loans with total balances of more than $1 trillion. While LoanPerformance captures more than 90 percent of securitized nonprime loans after 1999 and nearly 100 percent of the crucial 2003-05 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 portfolios; loans held in

> *We rely on two sources of house price growth to estimate negative equity: the widely used [Office of Federal Housing Enterprise Oversight] house price index and the S&P/Case-Shiller home price index.*

bank portfolios may look substantially different. Because our data are limited to securitized loans, any inferences should be limited to this set of loans.

The LoanPerformance data set offers a rich source of information on the characteristics of securitized nonprime loans, such as the date of loan origination, 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 1 percent random sample of the first-lien subprime and alt-A loans reported in the data set as of December 1, 2008.[5] Our data include more than 49,000 active, or not yet repaid, loans. We combine the loan-level data with aggregate data on house price dynamics for each metropolitan statistical area (MSA) in the sample. Because our data set is a sample, it is subject to sampling variation, but for ease of exposition we report only point estimates, not standard errors.

[5] Because observations in the LoanPerformance data set are loans coded to Zip code, we choose our data set from the universe of first-lien loans only. This approach 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. Nonetheless, as we discuss, we do observe the balance on subordinate liens at origination of the first lien.

We rely on two sources of house price growth to estimate negative equity: the widely used OFHEO house price index and the S&P/Case-Shiller home price index.[6] Although both indexes are based on repeat transactions on the same property over time, they differ in important ways. OFHEO, which provides separate indexes for 381 MSAs, enables us to estimate house price changes for the great majority of properties in our loan-level data set. However, the OFHEO index is based on the sale price or appraisal value of homes with prime, conforming mortgages, that is, those securitized by government-sponsored enterprises.[7] Because the properties we study are by definition

> *An interesting feature revealed by the data is that while first-lien loans remained at relatively stable [loan-to-value ratios] throughout the 2000-08 period, subordinate liens became more common and rose in value as a percentage of house value.*

financed with a nonprime mortgage, OFHEO's focus on these government-sponsored 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 market segments.
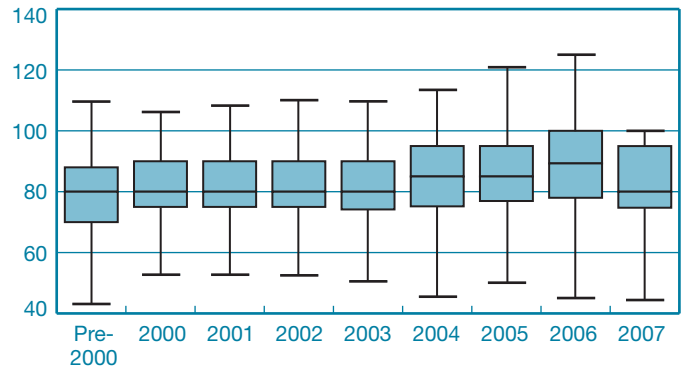
The S&P/Case-Shiller index addresses this problem in two ways. First, it covers all sales, not just those in the prime market segment. Second, it provides supplementary indexes for three tiers in each of the markets it covers. The tiers divide each market into thirds—low, middle, and high—based on area house prices as of December 2008. For example, Los Angeles MSA properties with prices under $309,184 are in the low tier, prices between $309,184 and $470,182 make up the middle tier, and prices above $470,182 are considered high tier. Inspection of the house price dynamics in these tiers indicates that they indeed differ from the composite measure, suggesting that, for our purposes, measurement error using the OFHEO index is likely nontrivial. This suspicion is confirmed by Leventis (2008), who finds that differences between the two indexes

CHART 4
Combined Loan-to-Value Ratios by Vintage

Sources: FirstAmerican CoreLogic, LoanPerformance data; authors' calculations.

Notes: For each year, the shaded box indicates the middle 50 percent of the data. Thus, the top of each box represents the 75th percentile value and the bottom the 25th. The line intersecting each box shows the median value. The thin lines extending from the boxes represent the upper and lower adjacent ranges, which extend at most 1.5 times the interquartile range in both directions.

are influenced importantly by the treatment of lower priced houses. Using the S&P/Case-Shiller price parameters as a guide, we determined that its middle- and high-tier indexes best estimate house prices for subprime and alt-A loans, respectively.[8]

To estimate equity in properties, we perform a series of basic calculations. First, we use data from LoanPerformance to calculate the borrower's net equity in the property at the origination of each first-lien loan. This measure captures both the balance of the first lien as well as the balances of all subordinate liens, if any exist. An interesting feature revealed by the data is that while first-lien loans remained at relatively stable LTVs throughout the 2000-08 period, subordinate liens became more common and rose in value as a percentage of house value. Chart 4 plots combined (all liens) LTV ratios by vintage. It shows that until 2003, LTVs were fairly steady, with a median of 80; after 2003, however, the median LTV began climbing. By 2006, the median origination LTV of nonprime loans was 89.3, and fully 25 percent of the loans had an LTV of at least 100. That is, a quarter of borrowers who took nonprime mortgages in 2006 had no equity at origination.

We calculate origination equity, which is house value of the first-lien loan (HV_0) minus total balances on all L liens $\sum_{l=1}^{L} M_0^l$ at origination. Equity at time t is then simply initial

[8] In each S&P/Case-Shiller MSA, the mean price of a home collateralizing a subprime mortgage was in the middle tier, while alt-A home prices were in the high tier.

equity plus any house price appreciation, minus any increase in mortgage balances after origination:

$$E_t = \left[HV_0 - \sum_{l=1}^{L} M_0^l \right] + \left[\Delta HV_t - \sum_{l=1}^{L} \Delta M_0^l \right].$$

Net equity can change in three distinct ways:

- principal amount on the first-lien mortgage changes $\Delta M_t^l \neq 0$ (typically, mortgage balances will decline over time, meaning that $\Delta M_t^l < 0$),
- principal amount(s) on subordinate liens changes $\sum_{l=2}^{L} \Delta M_0^l \neq 0$,
- house value changes $\Delta HV_t \neq 0$.

We have direct, micro-level evidence on only the first component, because LoanPerformance tracks monthly balances on each first-lien loan we observe. We use each MSA's OFHEO and S&P/Case-Shiller indexes to estimate changes in house values since loan origination. For balances on subordinate liens, we assume that the borrower makes regular interest payments, but that principal amounts remain unchanged. Note that this is somewhat of a "middle-ground" assumption: borrowers may either make progress reducing the balances on subordinate liens ($\sum_{l=2}^{L} \Delta M_t^l < 0$) or they may layer additional liens on top of those we observe ($\sum_{l=2}^{L} \Delta M_t^l > 0$).

3. NEGATIVE EQUITY AMONG NONPRIME BORROWERS

Two developments important for understanding homeowner equity occurred after 2002. First, full loan-to-value ratios rose sharply as junior liens became more common and larger. This change is present throughout the post-2002 period, but it is especially significant in 2006—when more than 25 percent of nonprime originations had initial LTV ratios of 100 or more (Chart 4).

Second, starting in 2005, the house price environment, whether measured by the OFHEO or the S&P/Case-Shiller index, became much less favorable for building borrower equity (Chart 3). This reversal was especially sharp in some areas that had experienced the highest growth prior to 2005. The Las Vegas MSA, for instance, saw its house price growth rate, measured by the S&P/Case-Shiller index, decline from more than 42 percent in 2003 to -15 percent in 2007. Parts of the Midwest experienced a similar phenomenon, but it resulted from a different set of dynamics. In Cleveland, for example, the S&P/Case-Shiller index declined just 1.7 percent in 2007. However, the decline followed a long period of relatively

TABLE 1
OFHEO-Based Negative Equity Estimates
December 1, 2008

	Number of Loans	Negative Equity (Percent)
First lien	10,144	21
All liens	13,766	29
Total loans	47,876	100

Source: FirstAmerican CoreLogic, LoanPerformance data.

Note: House value changes are estimated using the Office of Federal Housing Enterprise Oversight (OFHEO) indexes for individual metropolitan statistical areas.

sluggish growth: the city's peak growth year was 2003, when prices rose just 5.4 percent.[9]

The combination of a falling housing market and a large number of homeowners holding little or no equity at mortgage origination created a perfect storm for generating negative equity. Note that for a mortgage with an apparently safe origination LTV ratio of around 80, a 20 percent decline in house value—not uncommon in many metro areas in 2007—could potentially erase essentially all of the homeowner's equity. One should not be surprised, therefore, to find that the

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incidence of negative equity grew substantially in 2006 and 2007. What we now consider is exactly how large and how common nonprime negative equity mortgages have become, where they are concentrated, and their consequences for borrower behavior.

Our December 1, 2008, OFHEO-based estimates indicate that 21 percent of borrowers were in negative equity on their first lien while 29 percent were in negative equity when junior liens were included (Table 1). By comparison, the percentage of nonprime borrowers facing negative equity was 3 percent and 13 percent in April 2008, calculated using first and combined liens, respectively. At that time, borrowers

[9] Growth rates in this discussion are measured as December-over-December percentage growth.

Comparison of S&P/Case-Shiller and OFHEO Indexes
December 1, 2008

	Number of Loans	Negative Equity (Percent)
S&P/Case-Shiller negative equity estimates[a]		
First lien	7,150	34
All liens	9,989	47
Total loans	21,164	100
OFHEO negative equity estimates[b]		
First lien	4,945	23
All liens	7,367	35
Total loans	21,164	100

Source: FirstAmerican CoreLogic, LoanPerformance data.

[a]House value changes are estimated using the S&P/Case-Shiller high- and medium-tier indexes for individual metropolitan statistical areas.
[b]House value changes are estimated using the Office of Federal Housing Enterprise Oversight (OFHEO) indexes for individual metropolitan statistical areas.

Negative Equity by Origination Year

Source: FirstAmerican CoreLogic, LoanPerformance data.

with junior liens were more than four times as likely to be in negative equity, an incidence that demonstrates the importance of second liens in determining negative equity. However, home prices have dropped markedly since then, placing many more borrowers in negative equity—even those who had made a sizable down-payment or had just a single lien on their property.
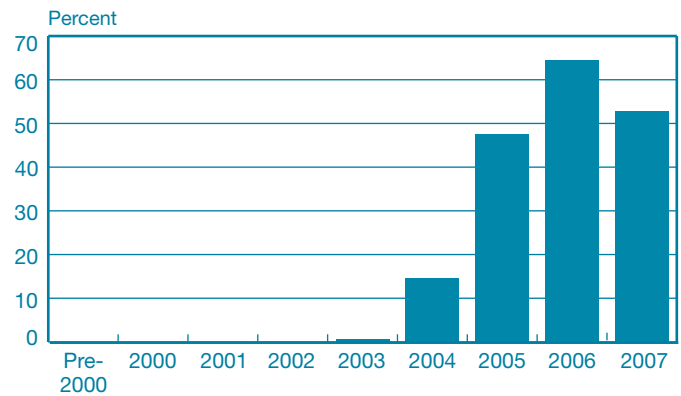
Limiting our analysis to the seventeen cities covered by the S&P/Case-Shiller tiered indexes paints a bleaker picture (Table 2). Using this measure of house price changes, we estimate that 47 percent of housing units with nonprime mortgages—nearly 1 million households in these seventeen cities alone—are in a negative equity position. However, application of the OFHEO index to this restricted set of cities produces a lower estimate of 35 percent, or 736,700 mortgages, in negative equity.[10]

This disparity highlights the difference in market segments tracked by both indexes. While neither measure exactly captures the nonprime securitized market, the S&P/Case-Shiller index includes properties covered by these loans, while the OFHEO's reliance on conforming mortgages prevents it from doing so. However, OFHEO's national coverage offers an enormous advantage when estimating the prevalence of negative equity in aggregate. We have opted to concentrate on what we consider the more accurate data set available for a

restricted set of cities; thus, we focus on the seventeen cities for which we have S&P/Case-Shiller tiered information. Nonetheless, we also report OFHEO results—especially when analyzing the entire United States—to provide a broader view of nonprime mortgages.

Recall that the time of loan origination is important for determining negative equity because the two determinants of negative equity—the value of the home and the ratio of the

The importance of vintage suggests that one would expect areas that experienced housing booms during 2004-06, especially locations where borrowers took loans with small down-payments, to have the highest prevalence of negative equity. Our data support this hypothesis.

loan to the initial value of the home—both correlate with vintage. Increases in full LTV ratios at origination, combined with the sharp reversal in home prices in 2006, suggest that borrowers who took mortgages later in the period would be more likely to find themselves with no equity in their property. As Chart 5 shows, very small shares of nonprime mortgages that originated before 2003 were in negative equity by December 2008, but negative equity rates were sharply higher in subsequent vintages. All told, we estimate that the difference between house values and nonprime balances in these cities totals more than $58 billion (Table 3).

[10] These figures are population estimates based on the sample information reported in Table 2.

Table 3

Negative Equity by Metropolitan Statistical Area

Area	Negative Equity (Percent)	Average Difference between Mortgage Balance and House Value (Dollars)	Total Amount in Negative Equity (Thousands of Dollars)
Atlanta	45	18,016	983,660
Boston	21	17,156	202,440
Chicago	35	18,201	964,670
Cleveland	32	9,865	114,440
Denver	33	12,607	267,280
Las Vegas	89	83,654	7,871,870
Los Angeles	52	80,484	13,593,690
Miami	69	68,357	10,417,590
Minneapolis	61	32,839	1,155,940
New York	13	22,119	822,840
Phoenix	80	73,314	9,024,990
Portland	24	18,676	190,500
San Diego	61	84,371	4,496,990
San Francisco	39	65,986	2,830,800
Seattle	21	17,125	236,330
Tampa	60	37,110	1,888,910
Washington, D.C.	47	52,113	3,397,760
Seventeen-area composite	47	58,496	58,460,690

Source: FirstAmerican CoreLogic, LoanPerformance data.

Notes: House value changes are estimated using the S&P/Case-Shiller high- and medium-tier indexes for individual metropolitan statistical areas. Mortgage balances on junior and senior liens are combined. The last column represents the population counts.

The importance of vintage suggests that one would expect areas that experienced housing booms during 2004-06, especially locations where borrowers took loans with small down-payments, to have the highest prevalence of negative equity. Our data support this hypothesis. Almost a quarter of the negative equity properties in the seventeen S&P/Case-Shiller cities are in one of the three California MSAs, with more than 15 percent in Los Angeles alone (Table 3). In addition, negative equity is much larger in the California (and to a lesser extent Florida) cities than elsewhere in the country. The California cities saw relatively large declines in housing prices and had larger than average mortgages—factors that led to a greater prevalence and intensity of negative equity. Thus, borrowers who received high LTV loans in 2006-07 in areas that experienced sharp house price reversals are very likely to find themselves in a negative equity position.

3.1 Borrower Characteristics and Behavior

An examination of borrower and loan characteristics by equity status shows that, not surprisingly, the most striking difference between positive and negative equity loans is the combined (senior plus junior) LTV ratio at origination; in each MSA,

average initial LTVs are significantly higher on negative equity loans (Table 4; Table 5 provides the same information for states, using the OFHEO index). Debt-to-income ratios are typically higher among negative equity borrowers as well. Interestingly, credit bureau scores are generally higher among the negative equity borrowers.[11] The fact that "borrower quality" at origination is roughly the same for positive and negative equity loans is a relevant consideration when interpreting default behavior.

To gain an understanding of mortgage repayments, it is crucial to analyze the relationship between equity status and default behavior. Recent research on defaults has shown the importance of house price appreciation in influencing nonprime mortgage outcomes (Demyanyk and van Hemert 2008; Gerardi, Shapiro, and Willen 2007). Demyanyk and van Hemert (2008) find that borrowers whose houses have

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[11] Table 5 reports these results using the OFHEO index of the broader set of states. While the estimated shares in negative equity in the broader sample are consistently lower than the shares in Table 4's more narrow sample of seventeen MSAs, they demonstrate similar spatial patterns—with the bulk of negative equity properties concentrated in boom states, especially California. In addition, the broader sample's concentration of negative equity loans among borrowers with relatively high credit scores, high DTI ratios, and high combined LTV ratios at origination is similar to the more narrow sample's concentration. Neither sample demonstrates a clear relationship between equity and documentation level.

TABLE 4
Underwriting Characteristics by Equity Status and Metropolitan Statistical Area

Area	Equity Status (Percent)	Debt-to-Income Ratio	FICO Score	Loan-to-Value Ratio	Fully Documented (Percent)
Seventeen-area composite					
Positive equity	53	38	673	73	43
Negative equity	47	40	678	91	36
Atlanta					
Positive equity	55	35	673	80	56
Negative equity	45	40	668	98	61
Boston					
Positive equity	79	39	662	72	42
Negative equity	21	42	678	98	42
Chicago					
Positive equity	65	39	641	80	53
Negative equity	35	42	667	97	40
Cleveland					
Positive equity	68	37	636	82	62
Negative equity	32	41	646	97	78
Denver					
Positive equity	67	38	675	82	57
Negative equity	33	42	671	99	61
Las Vegas					
Positive equity	11	34	689	65	39
Negative equity	89	39	683	88	33
Los Angeles					
Positive equity	48	38	692	63	35
Negative equity	52	41	690	89	22
Miami					
Positive equity	31	38	654	67	42
Negative equity	69	39	667	88	33
Minneapolis					
Positive equity	39	36	673	76	52
Negative equity	61	41	668	95	54
New York					
Positive equity	87	40	663	75	38
Negative equity	13	42	686	98	22
Phoenix					
Positive equity	20	35	693	70	48
Negative equity	80	39	673	87	41
Portland					
Positive equity	76	37	685	79	47
Negative equity	24	41	691	98	44
San Diego					
Positive equity	39	36	703	60	33
Negative equity	61	40	699	88	26
San Francisco					
Positive equity	61	36	716	65	32
Negative equity	39	40	693	91	24
Seattle					
Positive equity	79	39	678	81	50
Negative equity	21	39	694	97	44
Tampa					
Positive equity	40	35	659	73	49
Negative equity	60	39	666	90	40
Washington D.C.					
Positive equity	53	39	675	71	44
Negative equity	47	41	677	94	38

Source: FirstAmerican CoreLogic, LoanPerformance data.

Notes: House value changes are estimated using the S&P/Case-Shiller high- and medium-tier indexes for individual metropolitan statistical areas. Mortgage balances on junior and senior liens are combined. Details may not sum to totals because of rounding.

Underwriting Characteristics by Equity Status and State

State	Equity Status (Percent)	Debt-to-Income Ratio	FICO Score	Loan-to-Value Ratio	Fully Documented (Percent)
Non-boom and non-bust states					
Forty-three-state composite					
Positive equity	91	38	655	83	55
Negative equity	9	42	672	98	44
Boom states					
Arizona					
Positive equity	57	37	674	75	46
Negative equity	43	40	676	93	40
California					
Positive equity	43	37	695	64	37
Negative equity	57	40	685	88	28
Florida					
Positive equity	51	38	657	75	46
Negative equity	49	39	666	91	35
Nevada					
Positive equity	20	37	687	69	39
Negative equity	80	39	683	89	34
Bust states					
Indiana					
Positive equity	98	37	640	87	70
Negative equity	2	40	623	98	79
Michigan					
Positive equity	47	37	637	77	65
Negative equity	53	40	646	93	65
Ohio					
Positive equity	89	38	638	86	67
Negative equity	11	41	645	99	76

Source: FirstAmerican CoreLogic, LoanPerformance data.

Notes: House value changes are estimated using the Office of Federal Housing Enterprise Oversight indexes for individual states. Mortgage balances on junior and senior liens are combined. Details may not sum to totals because of rounding.

appreciated less, or depreciated more, tend to default more, all else equal. In much of this work, borrower default is treated as a continuous function of house value; in contrast, 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 those with little or no equity will sometimes determine that default is the best option. When equity declines by a particular amount—that is, if house values fall enough after loan origination—borrowers reach a critical value where they are certain to default (Vandell 1995).

Haughwout, Peach, and Tracy (2008) study the probability that a borrower will fall at least ninety days behind on scheduled payments within the first year of a nonprime mortgage. The authors report very large ceteris paribus jumps in this probability as LTV ratios rise above 100, particularly among borrowers who are not owner-occupants. They find that negative equity adds approximately 7 percentage points to default probability for owner-occupants and between 15 and 20 percentage points for investors, compared with similar owners with slightly positive equity in their properties (that is, those with LTV ratios between 95 and 100).

Loan Status by Borrower Equity
Percent

| | Days Delinquent | | | | |
	Thirty	Sixty	Ninety or More	Foreclosure	Real-Estate-Owned
First lien					
Positive equity	8	4	8	8	4
Negative equity	9	6	12	17	9
All liens					
Positive equity	7	4	7	7	3
Negative equity	8	5	11	16	9

Source: FirstAmerican CoreLogic, LoanPerformance data.

Note: House value changes are estimated using the S&P/Case-Shiller high- and medium-tier indexes for individual metropolitan statistical areas.

In related work, Foote, Gerardi, and Willen (2008) study ownership experiences of prime and nonprime borrowers in Massachusetts beginning in the late 1980s. They produce two findings of relevance for our analysis: subprime borrowers are much more likely to default in general than those holding conforming mortgages, and borrowers with negative equity are more likely to default after five years (and are less likely to sell their properties) than those with positive equity.

As expected, we find that the share of positive equity loans ninety or more days delinquent is a little more than half the rate for loans with negative equity (Table 6). However, borrowers with negative equity are just as likely to be thirty days delinquent—but twice as likely to be in foreclosure and three

> *We find that the share of positive equity loans ninety or more days delinquent is a little more than half the rate for loans with negative equity.*

times as likely to have passed through the foreclosure process and be in REO by the lender. Thus, a fall in home prices may not precipitate initial delinquency, but it may encourage default by a homeowner who is already having difficulty making payments. This outcome is consistent with results from a model in which some borrowers experience shocks to their income 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.

While only 10 percent of positive equity homes are in fore-closure or REO on all liens, we estimate that 31 percent of

properties in foreclosure or REO are in a positive equity position (Table 6). This conclusion may appear to contradict the argument 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

> *Our foreclosure rates . . . reflect not only the prevalence of entering foreclosure, which itself is influenced by both borrower and lender behavior, but also the time that a property in default spends in foreclosure.*

the presence of transaction costs that make default a better option than continuing to make payments on the loan.[12] We find that our estimates of borrower equity are lower for those properties that are delinquent ninety days or more, in foreclosure, or in REO (Table 7). When prepayment penalties and the possibility of mismeasurement of house values are considered, these borrowers may perceive themselves to be in negative equity on their mortgages, a factor that helps explain their behavior.

Although these results are qualitatively consistent with those of Foote, Gerardi, and Willen (2008) and Haughwout, Peach, and Tracy (2008), a direct comparison is difficult. In particular, because our mortgage data set consists entirely of nonprime loans, we observe the effect of negative equity on that subsample

[12] Recall that we describe negative *book* equity. It is possible that many of the 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 underestimate house price declines for some of these loans.

TABLE 7

Loan Status among Positive Equity Borrowers

		Days Delinquent				
	Current	Thirty	Sixty	Ninety or More	Foreclosure	Real-Estate-Owned
Average difference between mortgage balance and house value (dollars)	137,610	86,294	71,683	76,291	59,898	42,954
Average difference as a percentage of house value	28	22	20	17	15	13

Source: FirstAmerican CoreLogic, LoanPerformance data.

Notes: House value changes are estimated using the S&P/Case-Shiller high- and medium-tier indexes for individual metropolitan statistical areas. Mortgage balances on junior and senior liens are combined.

of the Foote, Gerardi, and Willen population. In addition, we observe a single cross-section of properties in foreclosure at a point in time, as opposed to the Foote, Gerardi, and Willen approach of observing the timing of entry into default and the Haughwout, Peach, and Tracy analysis of delinquency within the first year of origination. Our foreclosure rates thus reflect not only the prevalence of entering foreclosure, which itself is influenced by both borrower and lender behavior, but also the time that a property in default spends in foreclosure.

4. LOOKING AHEAD

Negative equity's important effect on borrower default underscores the value of understanding the potential future path of negative equity. Accordingly, we look at two possible relationships between negative equity and nonprime borrowing going forward.

We begin by using the S&P/Case-Shiller home price index. The index has the advantage of covering a large number of homes in the small number of markets for which it is available. Another advantage is that futures contracts on the index trade on the Chicago Mercantile Exchange.[13] As a result, the path of the indexes in individual MSAs can be predicted. The futures contracts currently provide estimates of house price appreciation in several cities for various months through November 2012.[14]

Our examination of futures contracts on S&P/Case-Shiller indexes points to further deterioration in home prices in the cities covered. As of December 2008, the five cities with

[13] See <http://housingrdc.cme.com/index.html> for more information.

[14] The cities are Boston, Denver, Las Vegas, Los Angeles, New York, San Diego, San Francisco, and Washington, D.C.; futures prices for Miami are available only through November 2010. While these markets are relatively thinly traded, activity picks up following release of the S&P/Case-Shiller home price index. We thus use the futures prices for contracts that had "open interest" on March 31, 2009: the release date for the January 2009 S&P/Case-Shiller index.

contracts expiring in November 2009 had a combined negative equity rate of 45 percent, very near the average rate of 47 percent for the seventeen cities tracked by the S&P/Case-Shiller index. We estimate that the trajectories implied by the futures contracts would increase the negative equity rate to 61 percent by late 2009 and add 135,500 borrowers to the ranks of those whose homes are worth less than their mortgage balances in

Negative equity's important effect on borrower default underscores the value of understanding the potential future path of negative equity.

these five cities. The contracts forecast the percentage of borrowers with negative equity in their homes to decrease by the end of 2010 (Chart 6). These calculations are derived using the percentage changes in home prices predicted for the S&P/Case-Shiller composite index and applying the changes to its high- and medium-tier indexes, assuming that borrowers fall no further behind on their mortgages.

A second potential relationship between negative equity and house prices is somewhat more general. Chart 7 presents the number of borrowers in various equity categories as of December 2008, where equity is expressed as a percentage of house value. Here we use the OFHEO index, which offers the broadest coverage. Assuming that no changes in mortgage balances occur, one can estimate the number of new negative equity borrowers by moving the chart's "zero line."[15] For example, the effect of a 10 percent decline in house prices can be estimated by moving this line two bars to the right. According to this scenario, approximately 1.5 million (719,600 plus 770,000) new nonprime borrowers would see their house

[15] Alternatively, if one believes that the OFHEO index is 10 percent overvalued, one might conduct a similar exercise to estimate current negative equity rates.

CHART 6
Potential Path of Negative Equity
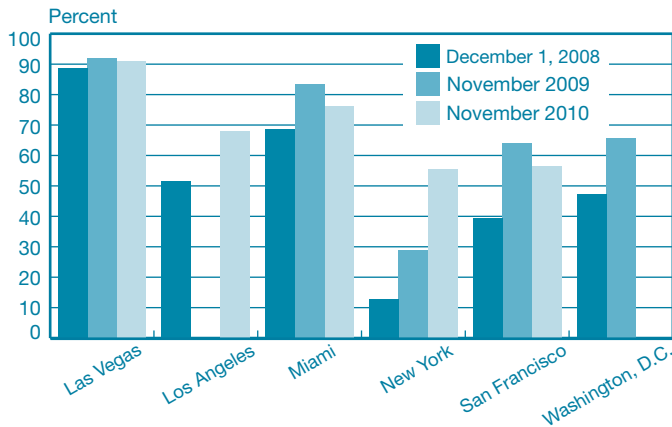
Sources: FirstAmerican CoreLogic, LoanPerformance data;
Chicago Mercantile Exchange.

CHART 7
Ratio of Equity to House Prices
As of December 2008
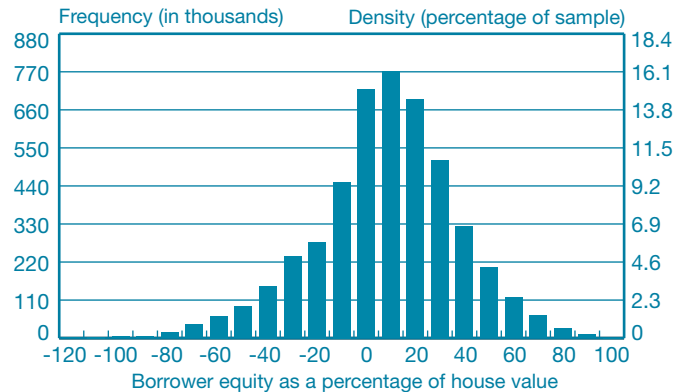
Sources: FirstAmerican CoreLogic, LoanPerformance data;
Office of Federal Housing Enterprise Oversight.

value fall below their current mortgage balance. This path of house prices would raise our OFHEO-based estimate of the negative equity share to roughly 45 percent. Conversely, a turnaround in the housing market that resulted in a 10 percent increase in house values would lift 729,200 borrowers into positive equity, reducing the rate to just 14 percent.[16]

These arguably plausible changes in the value of the OFHEO index have very large effects on the incidence of negative equity among nonprime borrowers because, as Chart 7 shows, many hundreds of thousands of borrowers are very near zero equity. Relatively small changes in house prices from this point forward can therefore have large influences on both the incidence of negative equity and, by extension, the risk of default by nonprime borrowers.

5. CONCLUSION

Recent declines in house values have put hundreds of thousands of nonprime borrowers in a negative equity position, that is, with a house value below the property's mortgage balance. Our study finds that nonprime borrowers in negative equity share several characteristics: for example, they took out loans near the peak of the housing market and their loans had high LTV ratios usually achieved with subordinate liens in addition to the first lien. We also find that while negative equity loans exist in most U.S. metropolitan areas,

they are disproportionately concentrated in housing markets that experienced especially large swings in house price appreciation, particularly in California. We estimate that three California metropolitan areas account for more than a quarter of the negative equity mortgages in our sample. Moreover, because of the higher balances on these mortgages, the loans account for nearly half of the overall difference between house values and mortgage balances.

Going forward, further house price declines will lead to continued increases in the number of nonprime mortgages in negative equity. If house prices fall an additional 10 percent from their December 2008 levels, we estimate that approximately 1.5 million new mortgages nationwide will carry balances that exceed the value of the collateral homes. The aggregate difference between these balances and house values could approach $135 billion.

Although negative equity is a necessary condition for default, it does not always *lead* to default. As other studies, including ours, have shown, borrowers do not automatically default when their house value drops below their mortgage balance. Nonetheless, research has demonstrated that negative equity borrowers are far less likely to prepay their mortgages and are more likely to become seriously delinquent and thus default. We find that among nonprime borrowers, the default probability of an outstanding negative equity mortgage is two to three times as high as that of a positive equity borrower. In this context, the future direction of house prices will be a critical determinant of the payment behavior of nonprime borrowers.

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[16] Note that these estimates are imprecise, as they do not account for changes in mortgage balances over time.

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