Follow the Money:

A Close Look at Recent Southern California Foreclosures

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Abstract

The conventional wisdom is that households unfortunate enough to have purchased at the top of the market during the recent housing bubble are those most at risk of default due to recent price declines, upward re-sets of adjustable rate mortgage instruments, the economic downturn, and other factors. Here we use public record data to study three cohorts of Southern California borrowers facing foreclosure in 2006, 2007, and 2008. We estimate property values as of the date of the scheduled foreclosure sale with the automated valuation model of a major financial institution and then track sales prices for those properties that actually sold, either at auction or later as REO. We find that borrowers did not, in general, buy at the top of the market and virtually all had taken large amounts of equity out of the property through refinancing and/or junior lien borrowing. Given sales prices of collateral thus far, aggregate losses to lenders will reach almost $1.0 billion dollars compared to almost $2.0 billion dollars of equity previously extracted by property owners.

Key words: mortgage, default, foreclosure

Introduction

The current foreclosure crisis has prompted a variety of policy prescriptions. Many market interventions contemplated focus on borrowers who have current mortgage debt in excess of their homes' value, the classic definition of negative equity. It is widely recognized that negative equity dramatically increases foreclosure probability (Follain and Follain [2007], Kelly [2009]). But how large is the amount of negative equity in a typical foreclosure and what are its causes? These are the fundamental questions we address here.

Our competitive advantage is data: we have the nearly the entire borrowing history for each property contained in our three samples. The approach then is to closely examine three relatively small cohorts of Southern California borrowers facing foreclosure during 2006, 2007, and 2008. In late 2006, housing prices had just begun to decline in most markets. By late 2007, housing prices had been declining for more than a year and the current recession was about to commence. Moreover, the market events of August 2007 had prompted many to label the situation a crisis, as subprime and alternative mortgage credit became difficult to obtain. By late 2008, a series of disasters had unfolded with default rates and foreclosures reaching record levels.

The plan for the balance of the paper is as follows. In the next section, we review the research on mortgage default including recent papers that seek to explain current market conditions. In the third section, we sketch out the relationship between equity, house price movements, and debt usage. In the fourth section, we describe our data and empirical methodology. In the fifth section we present results of our analysis. The final section concludes and offers suggestions for further research.

Literature Review

Researchers have long recognized that contingent claims methodologies can provide important insights into the mortgage market. Under this view, a mortgage loan may be treated as a fixed income instrument combined with American put and call options held by the borrower and written by the lender. The right to prepay the mortgage at any time is a call option at par; the ability to default on the mortgage at any time is a put option in which the mortgage is "sold" to the lender for the market value of the property[1]. A number of papers develop a unified theory of mortgage valuation based on this option theoretic approach (Kau, Keenan, Mueller, and Epperson [1992]; Kau, Keenan, and Kim [1994]; Kau, and Kim [1994]; see Kau and Kennan [1995] for a summary).

Empirical work on mortgage default has tended to find that borrowers do not default immediately when the value of the collateral property falls below the value of the loan. In an early study, Foster and Van Order (1984) found default probabilities of less than 10% using FHA data even when equity was estimated to be quite negative. Similarly, Quigley and Van Order (1995), using a large data set of conventional loans originated between 1975 and 1989, find that at low levels of negative equity the option to default is not exercised immediately. This fact of under-exercise of the default option generated a significant debate as to whether such behavior constituted non-rational behavior on the part of borrowers. Vandell (1995) addresses the evidence on the ruthlessness of mortgage default, where default is said to be ruthless if occurring as soon

[1] Although from a legal perspective, these two options are quite different. Prepayment is an option explicitly granted to the borrower by the lender in the contract whereas post-default forfeiture of the property is a remedy for breach of the contract by the borrower and exercised by the lender. Moreover, mortgage debt is not truly non-recourse in most jurisdictions.

as the value of the collateral falls below the value of the loan, a pattern not typically observed in empirical data. Vandell summarizes the arguments in favor of a trigger event-based theory, in which negative equity may be a necessary, but not sufficient, condition for default. He also raises the issue of lender-specific influences, since it is the lender who initiates foreclosure as a remedy to default. For more recent work on trigger-event theory, see Elmer and Seelig (1999), who argue that default decisions must be considered in the context of the households' entire financial position.

Alternatively, junior lien borrowing has surged over recent years, implying that many borrowers' negative equity position may be due, not to house price declines, but to equity dilution occurring subsequent to home purchase (LaCour-Little [2004]). Some argue that simultaneous close second liens ("piggybacks") have played an important role, too (Calhoun [2005]; Jackson [2008]). Another factor may be the role of speculative investment in housing in recent years. During the 2002-2004 period low short term interest rates encouraged a flow of funds out of money market instruments and into residential real estate investments, resulting in an increase in the percentage of home purchase loans to non-owner occupants to as high as 17% in 2005 (Avery, Brevoort, and Canner [2007])[2].

Another view holds that the apparent under-exercise of the default option (or, for that matter, under-exercise of the prepayment option) is simply due to borrowers' rational delay since exercise today forfeits the right to exercise the option in the future. Support for this view may be found in Kau, Keenan, and Kim (1994), Kau and Kim (1994), and Ambrose, Buttimer, and Capone (1997).

[2] Home Mortgage Disclosure Act data indicates that the percentage of loans to non-owner occupants has increased every year since 1996, reaching a peak of 17% in 2005.

More recent work has focused on the role of securitization, the relaxation of lending standards, and the development of alternative mortgage loan contract designs to help explain the surge in recent defaults and foreclosures. Pavlov and Wachter, in a series of papers (2004, 2006a, 2006b), develop and test models that examine the implications of aggressive non-recourse asset-based lending that under-price default risk. LaCour-Little and Yang (2007) trace the history of recent mortgage contract innovations and set out a formal model of the choice of alternative mortgage products, such as interest-only and pay-option ARMs, showing that such products are rationally preferred by households with lower risk aversion and in markets with greater expected house price appreciation. Gramlich (2007) provides a detailed discussion of the rise of subprime lending, its role in increasing home ownership rates among traditionally under-served households, and the risks associated with this development. Keys, Mukherjee, Seru and Vig (2008) exploit credit score threshold rules used for securitization in an argument that securitization leads to more defaults. Mian and Sufi (2008) argue that a rapid expansion in the supply of mortgage credit in areas with high latent demand explains a large fraction of recent U.S. house price appreciation and subsequent mortgage defaults. Reinhart and Rogoff (2008) document that a liquidity and asset price boom followed by financial collapse and economic slowdown is a trademark of crises in many developed countries, including Japan, Spain, UK, and Norway. Demyanyk and Van Hemert (2007) argue that the rise and fall of the subprime mortgage market follows a classic lending boom-bust scenario, in which unsustainable growth leads to the collapse of the market. And empirically document a continuous decline in loan quality for six consecutive years before the current crisis. Coleman, LaCour-Little, and Vandell (2008) explore the connection between

lending patterns and house price increases over the period 1998-2006, generally finding the surge in non-owner occupied lending to be of greater importance than the growth in subprime and also noting the pull back of government-sponsored enterprises during the period of most torrid growth in 2004-2005.

Close in both emphasis and approach to this paper, Foote, Gerardi, and Willen (2008) focus on the relationship between negative equity and foreclosure using public record data. They estimate that of roughly 100,000 households in Massachusetts who had negative equity during the early 1990s, fewer than 10% lost their homes to foreclosure. In contrast to our effort here, however, Foote, Gerardi, and Willen examine prior periods of housing downturns and estimate negative equity across all homeowners by constructing local market repeat sales house price indices from public record data and then compare to foreclosure experience. In contrast, we estimate the incidence and magnitude of negative equity use property-specific estimates for households actually facing foreclosure in 2006, 2007, and 2008.

Regardless of their cause, foreclosures are widely thought to have negative social and economic effects beyond the immediate ones to borrower and lender. Lin, Rosenblatt, and Yao (2008) document a decline in neighborhood house prices related to the distance to the property subject to a foreclosure. Clauretie and Daneshvary (2009) argue that many estimates of the foreclosure discount are biased upward and that, after correcting for spatial concentration, property condition, and time-on-market those discounts are about one third smaller than usually thought. Newer working papers further explore this effect, as well as the impact on home sales volumes and the possible simultaneity of house price declines and foreclosure rates (Leonard and Murdoch [2008],

Rogers and Winter [2008], Dubin [2008], Harding, Rosenblatt and Yao [2009]). One concern is a vicious cycle in which foreclosure discounts reinforce, or exacerbate, downward pressure on home prices.

In contrast to a focus on negative equity, Cutts and Merrill (2008) present evidence that for conforming conventional loans the primary reasons given by borrowers are loss of income; death or illness in the family; financial distress other than loss of income; and marital problems. These explanations fall into the trigger event category of explanation. Our objective here is not to advocate any particular theory of mortgage default but simply to carefully examine recent individual transactions, hoping the facts will shed some light on these controversies.

Negative Equity

We begin this discussion with the simple accounting identity:

$$E = MV - D \tag{1}$$

where E is equity, MV is market value, and D is total debt ($D=D_1+D_2+D_3...D_N$, where there are N liens against the collateral property). Over time, MV and D evolve, as house prices increase, or decrease, and as the borrower takes on, or pays off, debt over time. Adding subscripts for time, we have

$$E_t = MV_t - D_t \tag{2}$$

Clearly, $E_t < 0$ when $D_t > MV_t$. If borrowers had one and only one loan against their property and never refinanced, then with standard amortizing loan contracts D_t would be declining in t ; however, with the ability to refinance and take cash out or add junior liens, there is no assurance this pattern will hold. Adding subscripts for time, we can represent borrower equity at any point in time as follows:

$$E_t = (MV_t - MV_0) - (D_t - D_0) + E_0 \qquad (3)$$

where $E_0 = MV_0 - D_0 = MV_0$ (1 – *original LTV),* is the equity at origination. Consequently, we argue that both the probability and magnitude of negative equity at any point in time is a function both of house price changes ($MV_t - MV_0$,) where the latter term represents the purchase price of the property, hence the difference represents capital gain or loss) and changes in total debt outstanding ($D_t - D_0$). We can represent the probability of negative equity then as:

$$\text{Prob}\ (E_t < 0) = f\ (MV_t - MV_0,\ D_t - D_0,\ \boldsymbol{X_M},\ \boldsymbol{X_P},\ \boldsymbol{X_D}) \qquad (4)$$

Likewise, the magnitude of negative equity can be represented as:

$$\left|\ 0 - E_t\ \right| = f\ (MV_t - MV_0,\ D_t - D_0,\ \boldsymbol{X_M},\ \boldsymbol{X_P},\ \boldsymbol{X_D}) \qquad (5)$$

In both (4) and (5), $\boldsymbol{X}= \boldsymbol{X_M}, \boldsymbol{X_P}, \boldsymbol{X_D}$ represents a vector of control variables that may affect E_0 *or* E_t. Conceptually, we can think of these as of three types of observables: (1) market related factors ($\boldsymbol{X_M}$) such as when the property was purchased, geographic location, and local housing cycle; (2) property-specific factors ($\boldsymbol{X_P}$), such as type, original price paid, size, maintenance, and year built; and (3) debt-usage related factors($\boldsymbol{X_D}$), such as original LTV, whether piggyback financing was used, whether the property has already been refinanced, and current usage of junior liens.

In the empirical analyses that follow, we will estimate the probability and magnitude of negative equity, as functions of housing capital gains and losses, changes in total debt usage (including junior liens), and market, property, and debt utilization factors, as specified above.

Data and Empirical Methodology

Data

We initially obtained from public records a complete list of notice of trustee sales filed during the month of November 2006 in five Southern California counties[3]. We then replicated this process with analogous data for November 2007 and November 2008. We will refer to these as the 2006, 2007, and 2008 cohorts. This public record information is extremely complete on some dimensions, including a listing of all recorded liens against the property, their dates, and the purchase date of the property. In addition, some basic

[3] The five counties are Los Angeles, Orange, Riverside, San Bernardino, and San Diego. Together they had a 2007 population of a little over twenty million people. Riverside County, in particular, is generally cited as having one of the highest foreclosure rates in the United States.

information about the property itself is available, including address, parcel number, property use (raw land, commercial or residential use, condominium or detached single family, number of units, square footage, lot size, and room counts), year built, and current assessed value. The data also contains the names of the borrower, lender, and trustee administering the foreclosure sale; the location and date of the sale, minimum bid, and so forth. What the data does not contain, on the other hand, is detailed information about the loan and borrower; the sort of data typically used in mortgage default research. Such data would normally include loan amount and term, contract type, and risk measures such as loan-to-value ratio, and borrower credit score. We also do not know whether properties were purchased for investment versus residency, although with an average holding period of about six years, these do not appear to be short-term house flippers.

Next we obtained automated valuation model (AVM) values for the property in the three cohorts as of November 2006, November 2007, and November 2007, the months of the scheduled foreclosure sales. The AVM model used was developed by a major financial institution that prefers anonymity. AVM models are widely used by financial institutions and mortgage market participants (Calhoun [2001], Clapp [2003]), generally as a supplemental tool to estimate collateral value during loan underwriting. McDonald (2006) provides a brief assessment of the several freely available online AVM models that allow virtually instant property valuation, finding that "the basic estimate of market value can be quite accurate" (page 220). With improvements in data and computing technology, a large AVM industry has developed in recent years and its

spokesmen often note "At least one category of non-traditional valuations, automated valuation models (AVMs) - are immune to transaction pressures".[4]

Our final step was to search public records for sales of the properties at, or after, the date of the foreclosure sale. At this time we also captured the purchase price of the property (price paid by the defaulting borrower). Where available we recorded sales price and sales date. Many, perhaps most, of these properties were taken back as REO by the lenders at the foreclosure sale since there were relatively few sales to third parties. At this point relatively early in the cycle, lenders were setting minimum bids at the amount owed (plus costs) and these relatively high values discouraged third party bidding. Since that time, we are told, lenders have been more aggressive in setting opening (minimum) bids leading to a greater number of sales to third parties on the auction date[5]. An additional data element ("status") is available for the 2008 cohort, from this variable we can determine whether the property sold to a third party or to the lender, or whether the sale was postponed during to borrower bankruptcy, loan workout, etc. We scrubbed each of the cohorts using a consistent procedure to delete observations with missing values of key variables, loans secured by vacant land, commercial, or multifamily property, and dropped observations at the 1st and 99th percentile of value (roughly those selling for over two million or under fifty thousand dollars).

Beginning with the 2006 cohort, we have a total of 161 foreclosure sales across the five counties scheduled during the first two weeks of November 2006. The average purchase price across properties was about $380,000 with a mean acquisition year of

[44] Collateral Assessment & Technologies Committee, Press Release, June 28, 2005. See also *AVM News* Volume 8, Issue 0304.

[5] During 2008, sales increased significantly in Southern California albeit at lower prices including many heavily discounted REO properties.

2002. As of the date of the foreclosure sale, the property had total debt outstanding of $469,000. According to the AVM, as of the foreclosure date the mean property value was about $519,000, implying some positive equity in the property, on average, and a CLTV of 91%. However, subsequent sales occurred at an average price of approximately $405,000, suggesting the AVM over-estimated property value on a distressed sale basis, consistent with findings in the literature that foreclosed properties sell at a discount. Eighty percent of borrowers have a second lien, fifteen percent have a third lien, a five percent have a fourth lien. For those who have not already refinanced their first, we can calculate the mean original LTV as 88%.

The 2007 cohort is considerably larger, totaling 1,739 properties purchased at an average cost $357,000, also in 2002, on average. Total debt on the properties averaged $507,000 as of the date of the foreclosure sale; as of that same debt, the AVM estimated value to be $436,000, consistent with accelerating decline in property values during 2007. The CLTV is now 117%. The average sales price for those properties which have sold was about $325,000, again consistent with a foreclosure discount. Seventy eight percent of borrowers had a second lien, twelve percent had a third lien, and one percent had a fourth lien as of the foreclosure sale date. For those who have not already refinanced (a little less than half the sample), the average original LTV was 91%.

The 2008 cohort is larger still, totaling 2,358 properties purchased at an average cost $354,000, also in 2002, on average. Total debt on the properties averaged $551,000 as of the date of the foreclosure sale; as of that same debt, the AVM estimated value to be $317,000, consistent with accelerating decline in property values during 2008. The implied CLTV is now 180%. The average sales price for those properties which have

sold was about $271,000, again consistent with a foreclosure discount. Seventy nine percent of borrowers had a second lien, nineteen percent had a third lien, and five percent had a fourth lien as of the foreclosure sale date. For those who have not already refinanced (a little less than half the sample), the average original LTV was only 76%, well into the range of what would be considered a low-risk loan at time of origination. Descriptive statistics for each of the three cohorts are shown in Table 1.

In the next section, we describe our calculation of new variables to address two main questions of interest: (1) to what extent did borrowers have negative equity at the date of foreclosure sale; and, (2) what caused that negative equity? We are particularly interested in the relative contribution of house price declines versus outstanding debt increases.

Empirical Methodology

The first question we wish to address is whether and to what extent these defaulting borrowers facing upcoming foreclosure sales have negative equity. Negative equity exists when the value of the debt secured by the home equals or exceeds market value of property. Some argue that mortgage values should be marked to market value as well (Capozza, Kazarian, and Thomson [1998]. Without details regarding contract terms, however, we are able to estimate neither book nor market value of the mortgage liens; hence, we must be content with original recorded lien amount. Since, as we will see, most of these liens were recorded quite recently, this is probably not a bad approximation. To the extent these liens represent home equity lines of credit, however,

we really have no direct evidence as to the amount currently outstanding; however, logic would suggest that borrowers facing foreclosures would fully utilize equity lines to service debt in advance of such an event.

To begin with, we construct a number of new variables from the raw data by simple calculation and application of the logic of the mortgage lien recording process. When the purchase date and the date of the first lien are identical, we infer that the borrower has not yet refinanced the senior debt. In such cases we can calculate an original loan to value ratio (LTV); otherwise, we cannot. When the date of the first lien, the second lien, and the purchase date are identical, we conclude that the borrower used piggyback financing and include that junior debt in calculation of the original LTV or combined LTV at origination. We sum existing liens to estimate total mortgage debt and divide that quantity by the AVM estimate of market value to obtain current LTV or mark-to-market LTV (MLTV). We calculate two variations of negative equity, with and without selling costs estimated at 7%, to include brokerage commission at 6% and miscellaneous title and closing costs at 1%. We also calculate duration of property ownership and appreciation, total and the average annual rate given the holding period. We define a capital loss as a current AVM value of less than original purchase price, before transaction costs. We also create indicator variables for the various types of junior liens that may encumber the property.

In Table 3, we tabulate totals by cohort and sum these to characterize the overall pattern in the data. Across the three cohorts, borrowers acquired properties at a total purchase of about $1.5 billion, putting about $262 million (17%) in equity[6]. By the time

[6] Here we assume that the time of origination LTV that we can calculate also represents the average for those for whom we cannot calculate it (those who have already refinanced, about half of each cohort).

of the foreclosure sale, they had borrowed about $2.3 billion, implying equity extraction of about $2.0 billion, almost eight times their initial equity investment. Assuming the average realized prices on liquidation of the collateral applies to all properties (including those not yet sold), total recoveries should be about $1.3 billion, producing aggregate losses to lenders in all lien positions of almost one billion dollars. These rough calculations ignore timing effects, carrying costs, and transaction costs.

Given these aggregate results, we now turn to regression analysis to better understand the determinants of negative equity.

Regression Analysis

This far it appears that negative equity, however defined, has resulted from high starting loan to value ratios (though not for the 2008 cohort), often financed by piggyback lending, followed by rapid house price appreciation, and multiple rounds of borrowings to extract accumulated appreciation. Are capital losses resulting from purchase at the top of the market in 2005-2006 or incremental borrowing relatively more important in explaining negative equity? To address this issue, we estimate several specifications of a Logit model of the incidence of negative equity, focusing on the first definition described (before transaction costs)[7]. Tables 4 present results. Several specifications are presented with each repeated for each of the three cohorts to facilitate comparison.

The first of the four model specifications is the simplest one, focusing on market factors alone, when the house the purchased, whether it was purchased at the top of the

[7] All models were also estimated using the second definition of negative equity (after transaction costs) will qualitatively similar results. In the interest of brevity, we do not report these results.

market (in 2005-2006), and in which of the five counties. In the second specification, we add property specific characteristics, including property type, size, age, and original price paid. In the third specification, we add variables describing borrower financing decisions. The fourth specification uses the subset of the data for which original LTV is available and includes an indicator variable for use of piggyback financed at purchase.

Results are fairly consistent across the first two specifications, with property purchase in 2005-2006 a statistically significant predictor of negative equity. Property characteristics, however, appear to be relatively less important. For example, the size of the house, as measured by square footage, is statistically significant (with a negative sign) only for the 2007 cohort and the indicator for attached housing (a rough proxy for condominiums units) is statistically significant only for the 2006 cohort. The year the property was constructed is not statistically significant for any cohort.

As mentioned previously, in the third specification we add borrower debt usage variables. Here we note that coefficients on debt usage variables are generally larger in magnitude than those measuring the time of property purchase. For example, for the 2006 cohort, the coefficient on purchase in 2005-2006 is 1.44 whereas the coefficient on the indicator for having already refinanced is 1.58 and the coefficient indicating junior lien debt is 1.47. Likewise, for the 2007 cohort, the coefficient on purchase in 2005-2006 is 1.65, while the coefficients for having already refinanced and having junior lien debt outstanding are 1.37 and 1.76, respectively. This pattern is reversed for the 2008 cohort, as the coefficient on purchase in 2005-2006 is 1.68 whereas the coefficients on having already refinanced and having junior lien debt outstanding are 0.63 and 1.14,

respectively. This pattern suggests a change in the relative importance of home price environment vs. debt usage in explaining negative equity.

In the fourth specification, we examine only those borrowers who have not already refinanced their first lien debt, allowing calculation of time of origination LTV and observation of piggyback use. Unfortunately, both the 2006 and 2008 cohorts have too few observations to allow estimation without quasi-complete separation problems; however, the 2007 cohort is more cooperative. Remarkably, the coefficient on original LTV here is negative, but not statistically significant. Use of piggyback financing is positive and statistically significant at the 90% level.

We now turn to the question of the magnitude of negative equity. Which is more important: house price declines or levels of debt? To address this question, we estimate three specifications of an OLS model of negative equity (expressed as a percentage), again, providing separate estimates for each cohort. Results appear in Table 5. The first specification simply controls for the change in house prices and the change in debt level. The second specification adds original LTV, where available. The third specification adds county indicator variables. Since property characteristics proved largely uninformative in the Logit models, we omit them in this analysis.

Results are generally consistent across cohorts and specifications and support the tradeoff between home price decline and excessive borrowing in explaining the magnitude of negative equity. Debt usage is more important than home price decline in explaining negative equity for 2006 cohort; they are almost equal for 2007 cohort; house price declines appear more important for 2008 cohort. The majority of 2006 homebuyers still had some degree of positive equity if they put down a reasonable down-payment at

origination. Post-origination, most markets were still appreciating, while by 2007, most markets had begun to decline. In addition, stricter underwriting by lenders, mortgage insurance companies, and the secondary market starting in late 2007 reduced the availability of loans with zero down and/or reduced documentation. As a result, it was more difficult for low credit score borrowers to further leverage their positions. We conclude that excessive borrowing and home price declines are equally important factors in explaining the level of negative equity. Before 2007, debt usage is more important while after 2007, house price declines were more important.

Also of some interest in is the effect of original LTV. While only calculable for those who have not already refinanced their purchase money loans (a little over half the sample), we find that original LTV has a negative sign in all cases. Thus, it is not high initial loan to values ratios coupled with declining house prices that produce negative equity. Rather, high starting loan to value ratios may actually constrain additional borrowing and the equity extraction that is actually the more important cause of negative equity. The result suggests a simple tool (already widely used in the commercial mortgage market) available to lenders to reduce risk: simply prohibit post-purchase junior lien borrowing through a due-on-further-encumbrance clause.

In summary, it appears that more recent house purchases and properties on which the borrower refinanced and took out junior lien debt are at greater risk of negative equity. Some caveats are in order. Our estimates of negative equity at time of foreclosure sale are dependent on the accuracy of the AVM employed. And for those properties that have sold, it appears the AVM over-estimates value or at least fails to include the appropriate foreclosure sale discount. But what we have done is to go beyond

the use of house price indices to estimate collateral values based on property specific characteristics. Moreover, we have documented the extensive use of junior liens among those facing upcoming foreclosure sales in Southern California.

Robustness Tests

As previously mentioned, we considered two measures of negative equity, before- and after transaction costs (estimated at 7% of sales price to include a 6% commission plus 1% closing costs). All qualitative results hold with this alternative definition of negative equity. In the interest of brevity, we do not report all of these results here.

It might be objected that our results are entirely dependent on the AVM value employed, since it is from that value that we derive our measure of negative equity, both incidence and magnitude; moreover, we have already admitted that the AVM appears to have over-estimated the value of those properties which have actually sold. From this it follows that we have a conservative measure of negative equity. Suppose, however, that we want to use only those observations where we have a highly accurate AVM value, where accuracy is measured by the difference between AVM value and ultimate reported sales price, whether in percentage or absolute magnitude.

To address this issue, we re-ran all of the models estimated restricting the set of observations to those with highly accurate AVM values. Again, all qualitative results continue to hold, even with substantially fewer observations. For example, if we restrict the sample to those where the AVM value is within 10% of the actual post-foreclosure sales price and re-run the Logit model of the probability of negative equity, we reduce the

sample size to 470 observations. Controlling for cohort and county (some of which are statistically significant), the only other variable that is statistically significant is the indicator for junior lien presence. If we are even more restrictive, requiring the AVM to be within $2,000 of actual sale price (reducing observation count to 214) and re-run the OLS model, the coefficient on change in debt is large and statistically significant and roughly five times the magnitude of the coefficient on change on house value. Again, in the interest of brevity, we do not report all of these results here, but believe they demonstrate that all results are highly robust.

Conclusions

We have shown that in Southern California the majority of borrowers facing foreclosure in late 2006, 2007, and 2008 had substantial negative equity, with the problem growing worse over time with the further decline of house price levels. Many of these households had experienced very rapid house price growth during their tenure as homeowners and had already extracted most of the accumulated appreciation through either refinancing or junior lien borrowing. Total equity extracted was nearly a billion dollars. Even after these foreclosure events, the return on equity invested for these property owners is very high: at least 40% over their average six year holding period[8].

While capital losses resulting from the house prices declines that began, in most cases, in 2006 contributed to incidence of negative equity, excessive borrowing was clearly an equally important contributory factor. In addition, while house price declines

[8] An equity investment of $262 million dollars that multiplies to $2.0 billion over a six-year period yields a 40% internal rate of return, assuming no intermediate cash flows. The real rate of return is almost surely greater, since refinancing and equity extraction would have occurred gradually over the holding period.

were important in explaining the incidence of negative equity, its magnitude was strongly influenced by increased debt usage. Hence, borrower behavior, rather than housing market forces, seems to be the predominant factor affecting outcomes.

Other research should examine whether the patterns found in this relatively small data set from Southern California apply to other markets in the U.S. The economic losses documented here have been incurred by lenders, not by borrowers, whose extensive use of debt in response to rising house prices and liberal credit availability appears to have led to the foreclosures examined here.

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Table 1: Descriptive Statistics

	2006 Cohort			2007 Cohort			2008 Cohort		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev
Explanation of Variable									
Year Property Purchased	160	2002	4.0	1,718	2002	4.8	2,304	2002	5.3
Purchase Price	161	$380,254	$247,611	1,739	$357,286	$209,486	2,358	$354,016	$219,639
Number of Years Owned	160	4.9	4.0	1,718	5.2	4.7	2,304	6.6	5.3
Amount of First Trust Deed	161	$345,622	$200,189	1,739	$376,876	$191,704	2,358	$384,059	$609,283
Amount of Second Trust Deed	161	$103,802	$115,729	1,739	$109,476	$326,879	2,358	$130,162	$257,851
Amount of Third Trust Deed	161	$ 12,480	$ 52,560	1,739	$ 16,661	$ 72,480	2,358	$ 26,805	$ 88,990
Amount of Fourth Trust Deed	161	$ 6,924	$ 56,074	1,739	$ 4,406	$ 41,408	2,358	$ 9,888	$ 83,777
Amount of Fifth Trust Deed	161	$ 2,588	$ 19,832	1,739	$ 807	$ 16,713	16	$137,693	$147,249
Market Value Based on AVM as of Foreclosure Sale Date	161	$518,895	$273,658	1,739	$435,707	$212,219	2,358	$316,923	$171,625
Total Debt Outstanding as of Foreclosure Sale Date	161	$468,826	$270,325	1,739	$507,418	$415,580	2,358	$550,915	$744,265
Indicator that Current AVM Value < Purchase Price	161	0.16	0.36	1,739	0.45	0.50	2,358	0.61	0.49
Indicator of Negative Equity Before Transaction	161	0.31	0.46	1,739	0.80	0.40	2,358	0.97	0.18
Indicator of Negative Equity After Transaction Costs	161	0.45	0.50	1,739	0.88	0.33	2,358	0.98	0.15
Year of Second Trust	128	2005	1.3	1,356	2005	1.3	1,862	2005	2.5
Year of Third Trust Deed	24	2005	1.5	207	2005	7.5	451	2006	2.6
Year of Fourth Trust Deed	8	2005	0.7	27	2002	20.4	121	2006	2.8
Year of Fifth Trust Deed	3	2006	0.6	9	1994	35.3	40	2006	2.7
Indicator that Second Exists	161	0.80	0.40	1,739	0.78	0.41	2,358	0.79	0.41
Indicator that Third Exists	161	0.15	0.36	1,739	0.12	0.32	2,358	0.19	0.39
Indicator that Fourth Exists	161	0.05	0.22	1,739	0.01	0.12	2,358	0.05	0.22
Indicator that Fifth Exists	161	0.00	0.00	1,739	0.00	0.00	2,358	0.00	0.00
Year Property Build	161	60	31	1,739	54	32	2,358	53	31
Square Feet of House	160	1755	743	1,690	1701	725	2,286	1,663	777
Appreciation Since Purchase	161	0.65	0.84	1,739	0.54	0.96	2,358	-0.003	0.952
Appreciation Since Purchase in Dollars	161	$138,641	$164,108	1,739	$ 78,421	$183,577	2,358	$(37,094)	$181,566
Indicator of Piggyback at Purchase	161	0.40	0.49	1,739	0.32	0.47	2,358	0.24	0.43
LTV at Purchase for Those Who Have Not	95	0.88	0.25	792	0.91	0.22	1,044	0.76	0.34
Current LTV Based on AVM	161	0.91	0.28	1,739	1.17	0.35	2,358	1.80	1.60
Indicator that First Lien Has Already Been	161	0.40	0.49	1,739	0.54	0.50	2,358	0.55	0.50
Indicator that Property is a Attached Unit (Condominium)	161	0.07	0.25	1,739	0.05	0.22	2,358	0.05	0.21
Lot Size for Detached Single Family Units	136	8,027	8,598	1,516	7,377	8,841	2,092	7,983	18,079
Percent Negative Equity Based on AVM Before Transaction Costs	161	0.06	0.16	1,739	0.21	0.31	2,358	0.81	1.60
Percent Negative Equity Based on AVM After Transaction Costs	161	0.09	0.20	1,739	0.29	0.34	2,358	0.95	1.72
Sold price, if sold at auction or as REO	154	$404,786	$345,472	1,530	$325,383	$225,823	953	$270,608	$151,366

Table 2: Geographic Distribution

By County By Cohort	2006 Cohort		2007 Cohort		2008 Cohort	
County	Count	%	Count	%	Count	%
Los Angeles	55	34.2	432	24.8	811	34.4
Orange	12	7.5	198	11.4	307	13.0
Riverside	50	31.1	502	28.9	574	24.3
San Bernardino	12	7.5	273	15.7	202	8.6
San Diego	32	19.9	334	19.2	464	19.7
Total	161	100	1,739	100.01	2,358	100.0

Table 3: Totals

Totals by Cohort	2006	2007	2008	All Cohorts		%
Total Purchase Price Paid	$61,220,852	$621,319,624	$834,770,011	$1,517,310,487		
Total Borrower Equity Invested	$7,099,464	$56,760,841	$198,487,272	$262,347,577	Equity/Price	17%
Total Debt as of Foreclosure Date	$75,481,049	$882,400,215	$1,299,057,405	$2,256,938,669	Borrowing Over Purchase Price	149%
Total Equity Extracted	$68,381,585	$825,639,374	$1,100,570,133	$1,994,591,092	Multiple of Equity Extracted	7.6
Total Liquidation Recoveries	$65,170,533	$565,841,089	$638,094,230	$1,269,105,852	Lender Recovery as Percent of Loans	56%
Total Lender Losses	$10,310,516	$316,559,126	$660,963,175	$987,832,817	Lender Loss Rates	-44%

Notes:		Extraction at End	Extraction Over Time
Equity Investment Assumes All			
Properties OrigLTV Equal to Those		$ (262,347,577)	$ (262,347,577)
That Can Be Calculated		$ -	$332,431,849
(88% for 2006; 91% for 2007; 76% for 2008)		$ -	$332,431,849
		$ -	$332,431,849
Liquidation Recoveries Assumes All		$ -	$332,431,849
Properties Eventually Sold for Current Average		$ -	$332,431,849
Sold Price by Cohort	Total Extraction	$1,994,591,092	$332,431,849
All Calculations Ignore Timing and Tr	IRR=	40%	126%

Table 4: Logit Models

Dependent Variable is Negative Equity Before Transaction Costs	2006 Cohort Estimate	2006 Cohort Pr > ChiSq	2007 Cohort Estimate	2007 Cohort Pr > ChiSq	2008 Cohort Estimate	2008 Cohort Pr > ChiSq
Specification 1 - Market Factors Only						
Intercept	-37.19	0.76	-5.7	0.85	-152.8	<.0001
Year property purchased	0.02	0.76	0.00	0.82	0.08	<.0001
Indicator property purchased in 2005-2006	0.87	0.05	1.34	<.0001	1.69	0.00
County dummy variables	NR	NR	NR	NR	NR	NR
c-statistic	0.71		0.71		0.81	
pseudo-rsq	0.18		0.14		0.15	
Specification 2 - Adding Property Factors						
	Estimate	Pr > ChiSq	Estimate	Pr > ChiSq	Estimate	Pr > ChiSq
Intercept	-113.80	0.4655	43.23	0.2575	-159.2	0.001
Year property purchased	0.06	0.5	-0.02	0.2	0.1	0.001
Indicator property purchased in 2005-2006	1.09	0.0	1.17	<.0001	1.6	0.004
Year house was built	-1.9E-03	0.8	-1.8E-03	0.4	7.3E-03	0.139
Log of original sales price	-0.51	0.4	0.46	0.0	0.1	0.702
Square footage of house	-0.0002	0.6	-3.9E-04	0.0	-1.3E-04	0.372
Indicator for attached housing unit	-2.00	0.0	-0.33	0.3	-0.20	0.751
County dummy variables	NR	NR	NR	NR	NR	NR
c-statistic	0.76		0.73		0.81	
pseudo-rsq	0.17		0.16		0.16	
Specification 3 - Adding Debt Usage Factors						
	Estimate	Pr > ChiSq	Estimate	Pr > ChiSq	Estimate	Pr > ChiSq
Intercept	-147.70	0.4095	-14.99	0.7133	-200.7	<.0001
Year property purchased	0.07	0.4	0.00	0.8	0.10	0.0001
Indicator property purchased in 2005-2006	1.44	0.0	1.65	<.0001	1.68	0.005
Year house was built	-2.0E-03	0.8	-1.4E-03	0.6	6.1E-03	0.212
Log of original sales price	-0.38	0.5	0.51	0.0	0.09	0.79
Square footage of house	-0.0004	0.3	-5.0E-04	<.0001	-1.5E-04	0.345
Indicator for attached housing unit	-1.91	0.1	-0.32	0.4	-0.36	0.577
Indicator - first lien already refinanced	1.58	0.0	1.37	<.0001	0.63	0.124
Indicator - borrower has junior liens	1.47	0.0	1.76	<.0001	1.14	<.0001
County dummy variables	NR	NR	NR	NR	NR	NR
c-statistic	0.80		0.79		0.83	
pseudo-rsq	0.34		0.17		0.19	
Specification 4 - Subset Where Orig LTV Available						
			Estimate	Pr > ChiSq	Estimate	Pr > ChiSq
Intercept	NA	NA	-341.8	0.03	NA	NA
Year property purchased	NA	NA	0.17	0.04	NA	NA
Indicator property purchased in 2005-2006	NA	NA	1.32	<.0001	NA	NA
Year house was built	NA	NA	1.4E-03	0.73	NA	NA
Log of original sales price	NA	NA	0.19	0.63	NA	NA
Square footage of house	NA	NA	-1.2E-04	0.57	NA	NA
Indicator for attached housing unit	NA	NA	0.27	0.73	NA	NA
Original LTV	NA	NA	-0.31	0.63	NA	NA
Indicator - Original financing included piggyback	NA	NA	0.55	0.07	NA	NA
County dummy variables	NR	NR	NR	NR	NR	NR
c-statistic	NA		0.79		NA	
pseudo-rsq	NA		0.17		NA	

NA= not available, quasi-complete separation; NR=not reported

Table 5: OLS

Dependent Variable: Percentage Negative Equity Before Transaction Costs									
	Spec 1			Spec 2			Spec 3		
2006 Cohort									
	Est	T-value	Sig	Est	T-value	Sig	Est	T-value	Sig
Intercept	0.06	4.5	<.0001	0.16	3.2	0.00	0.18	3.6	0.00
Change in house value	-0.12	-6.9	<.0001	-0.08	-3.9	0.00	-0.07	-3.7	0.00
Change in debt level	0.17	9.8	<.0001	0.30	6.9	<.0001	0.30	6.9	<.0001
Original LTV				-0.12	-2.3	0.02	-0.12	-2.2	0.03
County dummy variables							NR	NR	NR
Adj Rsq	0.37			0.41			0.46		
N=	161			94			94		
2007 Cohort									
	Est	T-value	Sig	Est	T-value	Sig	Est	T-value	Sig
Intercept	0.14	29.4	<.0001	0.20	7.9	<.0001	0.21	8.6	<.0001
Change in house value	-0.39	-53.8	<.0001	-0.31	-19.1	<.0001	-0.28	-16.6	<.0001
Change in debt level	0.36	64.7	<.0001	0.36	31.1	<.0001	0.35	30.2	<.0001
Original LTV				-0.06	-2.3	0.02	-0.04	-1.4	0.17
County dummy variables							NR	NR	NR
Adj Rsq	0.71			0.56			0.59		
N=	1,699			770			770		
2008 Cohort									
	Est	T-value	Sig	Est	T-value	Sig	Est	T-value	Sig
Intercept	-0.28	-14.4	<.0001	-0.09	-3.1	0.00	-0.13	-4.2	<.0001
Change in house value	-1.56	-68.2	<.0001	-1.38	-50.3	<.0001	-1.52	-45.8	<.0001
Change in debt level	1.17	91.9	<.0001	1.10	58.0	<.0001	1.15	57.4	<.0001
Original LTV				-0.18	-6.45	<.0001	-0.22	-7.5	<.0001
County dummy variables							NR	NR	NR
Adj Rsq	0.79			0.79			0.80		
N=	2,310			1,022			1,022		