

Houses, Banks, and Financial Markets: Why the Crisis this Time?

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Abstract

The current global economic and financial crises are alarming in both severity and length. We study the anatomy of the collapse by comparing the current precipitant (housing crisis) with the previous U.S. housing crisis of the early 1990s. Our analysis suggests that the greater severity of this episode is driven by several factors: default proclivity (to typical triggers) and bank lending retrenchment are different across the previous and current episodes. Most importantly however, we document different linkages between the housing sector, the banking sector and stock market across the two episodes. We conclude that the duration of the current episode is likely to significantly exceed the duration of the prior episode.

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In recent decades U.S. housing markets have experienced two distinct boom-bust episodes, i.e. periods of large and persistent increases (booms) followed by significant declines (busts) in house prices. The earlier episode was concentrated over the late 1980s and early 1990s. The current housing episode appears to be as yet unfinished and is arguably unparalleled in U.S. history. It began with the subprime mortgage lending boom, followed by a significant rise in homeownership rates and a sharp appreciation in house prices.¹ The ensuing subprime mortgage crisis coincided with a real weakening of U.S housing markets beginning in the third quarter of 2006. Since the peak of U.S. housing markets in July 2006, the Standard & Poors/Case-Shiller Composite Home Price Index has declined by 33% in real terms (through December of 2008). This has been accompanied by widespread mortgage defaults.²

The resulting financial crisis began in August of 2007 but reached epic proportions in the fall of 2008. The potential depth of the crisis and the collapse or near collapse of major financial institutions have compelled central banks around the globe – led by the U.S Federal Reserve and the Treasury – to intervene using an assortment of tools at their disposal. Their stated goals have been: one, to recapitalize financial institutions and inject more liquidity into the financial systems to prevent even more severe disruptions in global financial markets; and two, to rejuvenate languishing economies around the world. In sum, it is now clear that the spillover effects of the housing crisis into other markets are deep and likely to be protracted.

We study this crisis from three new perspectives, all exploiting the existence of the prior housing-led downturn in the U.S. during the late 1980s and early 1990s. First, we look for differences in housing markets across the two episodes. Second, we focus particularly on the role of banks in propagating the housing crisis through other elements of the financial system. Banks can be expected to provide this link

¹ From 2001 to 2006 subprime mortgages grew from \$160 billion (or 7.2% of all residential mortgage originations) to \$600 billion (or 20.6%) of all mortgage originations). Homeownership rate rose from 65% to almost 70% by 2006. In nominal terms house prices appreciated by about 160% from the late 1990s to June 2006.

² Particularly on homes financed with subprime mortgages, though prime mortgage foreclosures are also at historically high levels. For example, in the second quarter of 2008, the foreclosure rate on subprime mortgages was about 5% compared to about 0.67% for prime mortgages. However, this .67% default rate on prime mortgages is over three times the national average over this decade.

via the lending channel.³ Moreover, central bank interventions to recapitalize the banking system also suggest that banks are a key protagonist. Our final new perspective is perhaps the most important. Even if we were to document no differences in housing markets or bank behavior between the current and prior episode, we might still expect to see differences in the severity of the current versus the prior housing-led recession. In particular, we recognize that housing markets, financial markets and bank behavior are all intertwined. If these relationships are now different than in the past, similar shocks to housing and/or banks might engender stronger responses in financial markets.

Our results suggest that all three of the above new perspectives are important. First we show that housing markets, particularly borrower behaviors, are different across the two housing episodes. Borrower proclivity to default, particularly the sensitivity of it to typical triggers is significantly higher in the current episode. Therefore, to the extent that banks, financial markets and the economy are exposed to housing defaults (and their associated effects), the current crisis' acute severity is not unexpected.

Second, banks curtailed their consumer lending behavior significantly more during the current downturn than during the prior one. Given that consumers' activity comprises roughly 70% of U.S. economic activity, we again expect a stronger negative effect on the economy during the current episode.

Finally, we show that stock returns, bank performance and housing markets exhibit very different linkages during the current episode relative to the prior episode. Using a simple Bayesian VAR specification, we find that housing leads banks in the current episode, but not in the previous episode. Further, banks lead the stock market in the current episode but not in the previous one. Taken together, our results suggest that the stock market is unlikely to recover its previous highs until both the housing market and banks' financial health stabilize. Impulse response functions provide confirmatory evidence. The influence of the housing collapse on banks and stock values appear to persist for far longer than the (impulse response function) projected effect in the previous episode.

³ This assumes that banks are "exposed" to declines in a real estate portfolio. While much ado has been made about the widespread securitization of mortgages, it's become clear that banks failed to completely insulate themselves from risks that the underlying asset (the mortgage) would underperform.

Our work is closely related to a few other papers studying the housing, financial and economic crises.⁴ Greenlaw, Hatzius, Kashyap and Shin (2008), Hatzius (2008), and Gerardi, Lehnert, Sherlund and Willen (2008) all make some reference to a prior housing episode as we do. However, there are several importance differences. Primarily, none of the above papers is focused on a comparison of the two episodes (throughout the paper) as the primary means for explaining the current crisis' duration and severity. There are also several specific differences which we highlight next.

The extant literature does not allow for differences in the *sensitivity* of housing default to triggers across the two episodes. If default proclivity varies across housing episodes, estimates that do not contemplate this will be less informative. Moreover, allowing for these differential sensitivities helps us sort between explanations for the higher default rates in the current regime. Specifically, the current episode is characterized by both higher loan-to-value (LTV) ratios and greater disintermediation. We show that the prime sector's default proclivities are rather more due to LTV while the subprime market default pattern is driven more by other factors (such as disintermediation).

Second, while some work has noted changes in bank lending behavior over time, there is little systematic evidence of differences in bank lending reactions across the two episodes. Specifically, Greenlaw et al. (2008) and Hatzius (2008) study the potential role of banks' lending in the propagation of housing difficulties throughout the financial system. However, their work presumes the relationship does not change while our evidence suggests it does.

Finally, prior work does not contemplate differential sensitivities of financial market and banking sector returns to housing returns across the two episodes. The exception is Frank, Gonzalez-Hermosillo, and Hesse (2008). They estimate a multivariate GARCH linking U.S. financial markets and document a change in the relationships during the last few months (August 2007 – January 9, 2008) of their sample period. However, their data begin in 2003, which does not allow a comparison with the prior housing-led

⁴ There are many papers on the topic. We discuss our position relative to those most closely related.

financial crisis. Also, they do not investigate causality (we do), and they do not directly study the influence of returns to housing (which we do via the Case-Shiller Index).

Notwithstanding the above closely related papers, our work contributes generally to several strands of literature. First, of the many studies of the current financial and housing crises, we are among very few to compare the current crisis with any previous housing crisis. Understanding the differences between them is important because it permits a more insightful analysis that helps to identify potential triggers that precipitated the current financial crisis.

Second, our detailed focus on banks' lending behavior and their role in propagating the crisis through the financial system is new for this crisis. Though prior work recognizes the importance of banks linking housing woes with other problems in the financial system,⁵ our work is among the first to provide large-scale detailed evidence comparing the current housing episode with the prior one.⁶

Third, our identification of stronger (than previous) relationships between financial and housing returns is relatively novel. This calls into question the effectiveness of both domestic and international diversification – at least in the short run – to reduce the impact of the current shock to housing on financial portfolios. Thus, our work has implications for portfolio managers.

Finally, the results of our analysis might be useful to policymakers concerned about appropriate design of mechanisms to mitigate a protracted recession. They may highlight why initial ad hoc attempts to calm financial markets using an assortment of monetary tools were less successful. In particular, the importance of healing the banking sector is highlighted by our results.

The remainder of the paper is organized as follows. Section 1 discusses anchoring the paper on a comparison of the current with previous housing episode. In this context, it also provides a review of the more closely related literature. Section 2 discusses our delineation of the two housing episodes, using business-cycle analysis on housing returns. Section 3 examines households' proclivity to default, focusing on whether the two housing episodes exhibit different sensitivities of default to typical triggers. Section 4

⁵ See for example, Rajan (1994) and Gan (2007).

⁶ Gan (2007) provides large scale evidence, but for Japan rather than the U.S.

studies banks in the context of the crises. The first part examines the impact of the current period's deterioration in housing and mortgage markets on the wealth of banks, in particular those with extreme exposure to residential mortgage markets. The second part shows the influence of both housing episodes on banks' lending behavior, with a particular emphasis on lending to consumers. Section 5 presents our Vector Auto-regression (VAR) results on the transmission of shocks from the collapse of housing markets through other asset markets. Section 6 concludes the paper.

1. The Current and Previous Housing Episodes

The key feature of our analysis is that we focus on both the current housing market episode and the 1980s housing boom-bust cycle. As intimated above, we do so for several reasons. First, it allows us to determine whether default proclivity was different during the two episodes. Second, to the extent that default behaviors are different, financial and economic sectors exposed to real estate investment performance should respond differently. This is particularly true of banks, and given their influence on the aggregate economy (through the lending channel), it's important to document differences in their responses to the two crises. Third, and perhaps most importantly, there is recent concern that financial developments have become less related to real economic activity compared to previous periods'. This is a contentious issue which suggests the U.S. and perhaps the rest of the world's advanced economies may be entering a new phase in which innovations in financial markets have made business cycles less reliable for gauging current and future economic activity. Our comparison of the current with prior housing episodes allows us to speak to this issue directly.

1.1. Why Might Default Proclivity Differ Across the Two Housing Episodes?

Mian and Sufi (2008) document a secular shift in the supply of mortgage credit during the early 2000s. Combined with evidence of contemporaneous rapid house price appreciation despite *declining* relative income and employment growth, they suggest that lenders were willing to make such loans because they quickly sold them off (disintermediation). The subsequent large increase in mortgage defaults from 2005

to 2007 suggests that disintermediation combined with moral hazard to form a key element of the current mortgage crisis.

Given the evidence in Mian and Sufi (2008) that moral hazard by the lender was a key contributor to the current crisis, we investigate whether borrowers may have similarly suffered from moral hazard. We study whether borrower defaults are differentially sensitive to triggers such as housing returns and interest rates, across the two episodes. The intuition is as follows. Much of the increase in mortgage lending occurred at high loan-to-value (LTV) ratios.⁷ With little to no equity in the home, borrowers own a put option that can very quickly move into the money. If house prices fall such that more is owed on the home than its market value, exercise of the put option (walk away from the mortgage and the house) carries a positive payoff. Combined with decreases in affordability that often accompany such declines in home value (because interest rates rose and many mortgages were ARMs), borrower default is likely to be very sensitive to both interest rates and house prices. Since the more recent housing episode carried much higher average LTV ratios than the prior episode, we expect to see greater sensitivity of default to interest rates and/or house prices. In sum, both disintermediation and borrower moral hazard may contribute to greater default proclivity in the current episode.

1.2 Why Might Banks Respond Differently Across the Two Housing Episodes?

Rajan (1994) studies why banks' credit policies fluctuate with changes in the credit quality of borrowers. In particular, the apparent tendency to grow credit during positive economic cycles and vice-versa (Wojnilower (1980)) is a puzzle in the context of rational profit-maximizing bank behavior. In a model with rational but myopic bank management, these managers adjust bank credit policy to manipulate earnings. During positive economic cycles credit is liberal,⁸ and during contracting economic cycles credit is tight. He provides evidence consistent with it.

⁷ Subprime Heat (CSFB), September 5, 2007, pp. 21. See also Demyanyk and Van Hemert (2007).

⁸ Mechanisms include extending the term of loans, lending new money to insolvent borrowers (allowing them to appear to be current) and weakening covenants. Contemporaneously, additional lending can also generate up-front fees, further boosting current earnings, but potentially engendering later concerns. This behavior is remarkably similar to the casual empirical evidence on subprime lending found in the popular press.

It is (by now) well-received that the upside version of Rajan's model was repeated during the subprime lending boom. During the positive economic cycle of the mid-2000s, mortgage lending occurred at a furious pace. Following Rajan's model and evidence consistent with it, we must surely expect significant contractions in bank credit policy during the current housing bust. Moreover, the magnitude of credit contraction during this episode is likely to exceed what we observed in the prior housing decline, simply because the mortgage credit expansion was much larger during this episode.⁹

Gan (2007) too suggests that bank credit policies might differ across the two housing episodes of the past few decades. He documents that the land market collapse of the early 1990s in Japan fed through bank capital to influence their lending behavior.¹⁰ Given bank exposures to real estate in this country, larger declines in such values should engender greater contractions in credit policy. The more recent housing episode has seen significantly larger declines in real estate values than the prior episode (see Table 1 below). Moreover, this may also affect corporate borrowing behavior. In Gan (2007), firms' investment was declining in their top lender's exposure to real estate. Overall, the lending channel is economically important. Housing can influence other financial markets and the economy because firm investment is affected through the bank lending channel.

Finally, The Federal Reserve has indicated that banks are at the center of the link between the housing and other crises. Importantly, their toxic-asset plan announcement (on Monday March 23, 2009), led to one of the largest single-day stock market rallies on record: 7.1% for the S&P500 accompanied by a 16% jump in its financial sector indicator. In addition, the credit crisis continues to be blamed for (at least a portion of) the lack of economic activity in the U.S.

Overall, we focus on the role of banks because they seem likely protagonists for propagation of the housing collapse through the financial system. As yet, banks' linkages between housing and financial markets are a relatively unexplored area of analysis in the current crisis. Moreover, as our results indicate, their role in the propagation is vastly different than in the prior crisis. This represents an

⁹ Again, homeownership rate rose from 65% to almost 70% by 2006.

¹⁰ Other evidence of bank credit curtailment tied to real estate exposure is found in Puri, Rocholl and Steffen (2009).

additional important contribution of our work. It suggests that regulators' concerns with systemic risk are well-founded. A long-term solution to large-scale systemic banking risks is an important goal.

1.3 Why Might Financial Markets, Housing Markets, and the Economy Exhibit Different Links Across the Two Housing Episodes?

There is a growing view that financial markets developments in recent decades have become less related to real economic activity compared to previous decades due extensive innovations and complexity of financial products.¹¹ Certainly U.S. mortgage markets and financial markets as a whole have witnessed numerous innovations in recent decades. The practice of securitization and its associated originate-to-distribute model of credit allocation, notwithstanding its benefits, appear to have led to a decline in underwriting standards, greater underpricing of credit risk, a huge infusion of easy credit and serious adverse selection concerns. Taken together mortgage market innovations may unwittingly have increased the value of options embedded in mortgages in recent decades, inducing borrowers to become more trigger happy with regard to their default proclivity. Mortgage defaults are of course the Achilles heel of MBSs, leading to deterioration of this asset class.

As suggested above, this thinking can be applied to more than just mortgage markets and their derivatives. It is more generally consistent with the literature on the links between housing markets, bank lending behavior and asset markets. In a framework of endogenous uncertainty Chichilnisky and Wu (2006) show that accelerated financial innovations increases the chance of default. The originate-to-distribute model of financial intermediaries may have contributed to the widespread defaults we are now experiencing, with a concomitant decline in lending behavior. Also, Allen and Gale (1998 and 1999), Herring and Wachter (2003), and Pavlov and Wachter (2008) show that underpricing of default risk leads to inflated asset prices and exacerbates asset market crashes. Indeed, empirical analysis at the zip code level by Mian and Sufi (2008) shows that areas that experienced large expansion of mortgage credit supply from 2001 to 2005 also experienced large increases in house prices and a sharp rise in mortgage

¹¹ As noted above, this view is contentious because it suggests the U.S. and perhaps the rest of advanced economies may be entering a new phase in which innovations in financial markets have made business cycles less reliable for gauging current and future economic activity

default. All of these results suggest the potential for different sensitivities between the three sectors we study: housing, banks and the aggregate stock market.

2. The Dynamics of House Price Behavior during the Current and Previous Episodes

We begin by identifying the current and previous housing boom-bust episodes using business cycle analysis. We define a housing boom-bust episode as a window over which house prices rise by at least 10 percent trough-to-peak, followed by a decline (peak-to-trough) of at least 10 percent. Given that the general trend of house prices over time is positive, we would end up with many more months in our boom samples than bust samples if we did not add an additional constraint. Therefore, we require that the boom period contain the same number of months as the bust period, in the first housing episode. This turns out to be two years (24 months). For comparability, we require that the second housing episode also contain two years of data.

Using housing price data from the S&P Case-Shiller Index to measure housing returns, the two respective house price boom-bust episodes are as follows: Boom1: January 1988 to December 1989, and Bust1: January 1990 to December 1991. Boom2: July 2004 to June 2006, and Bust2: July 2006 to June 2008. Case-Shiller house price indices are available from 1987 to 2008. The below figure provides a time-line picture of our two boom-bust housing episodes.

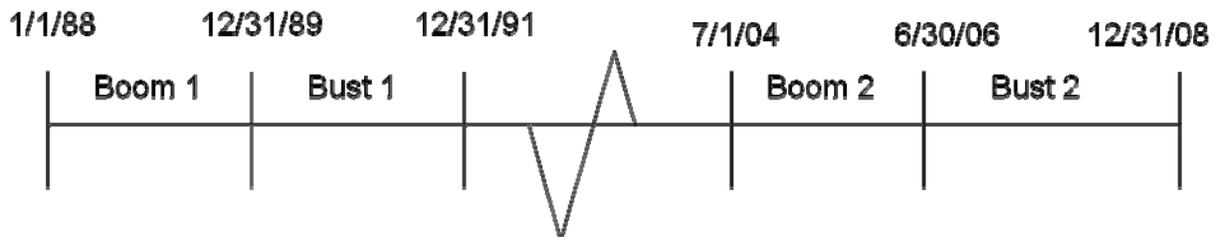


Table 1 illustrates the average behavior of housing assets during the two housing boom-bust episodes. From the beginning of the first episode's house price boom to its peak, house prices appreciated in real terms (in nominal terms) by 7.34% (17.27%), suggesting general inflation was an important component of the housing asset's return. The annualized return during this period was 8.29%, of which

3.60% was real appreciation. This was followed by a decline in real house prices of -13.45%, from peak to trough during the bust.

In contrast, during the current housing boom, 2004:Q3-2006:Q2, house prices in real terms (nominal terms) rose by 17.98% (21.07%) up to the peak. Thus, the majority of house price appreciation was independent of general inflationary pressures. On an annualized basis this translates into a real return of 8.62%, which is more than twice that of the previous housing boom-bust. The behavior of house prices during the bust (peak-trough) in the current boom-bust episode has been equally dramatic. During the equal-length interval, house prices have declined by 20% in nominal terms, which means that on average, nearly all the gains realized by households during the run up in prices were lost.

Table 1 also shows the Sharpe ratios associated with housing investments during the boom and bust for each housing episode. The Sharpe ratio during the recent housing boom (boom2) is much more positive than in the previous housing boom (boom1). On a risk adjusted basis the performance of the housing asset during the recent boom in house prices was another 50% as large as that in the previous housing boom. During the busts, the Sharpe ratios for both episodes were negative, with a slightly smaller difference in magnitude. Nevertheless, current housing markets continue to operate under significant stress and prices have not yet stabilized. In this regard, the results might also suggest that the decline in prices may protract. We shed light on this issue by estimating impulse response functions from Bayesian VARs in the later part of the paper.

Clearly, the behavior of house prices in the current boom-bust episode differs from that of the 1990 - 1991 house price crash in at least two important respects. First, two years into the current housing bust nearly all the gains in nominal terms that households realized during the run up (21%) have been lost, which is quite dramatic when compared with the previous housing price bust. Second, the price correction or contraction in house prices in the on-going house price bust is already nearly four times that from the previous housing crisis.

Table 2 presents information on the returns to other financial markets and instruments for the two boom-bust episodes. Specifically, we report returns to a portfolio of bank holding company (BHC)

stocks, the S&P500 index, and the Case-Shiller Housing Price Index. Again, we see that housing returns are much worse on average during the second bust (-95 bps per month) compared to the first one (-22.5 bps per month). Contemporaneously, stock returns are nearly an order of magnitude worse during the second bust (9 bps per month) compared to the first (81 bps per month). While such comparisons on a univariate basis are not without concern, they are suggestive and we confirm dramatic differences between the two housing episodes (boom and bust cycles) in our VARs.

3. Have Borrowers Shown Greater Proclivity to Default in the Current Housing Episode?

3.1 Data

We argue that both the originate-to-distribute model of mortgage lending and borrower moral hazard may have contributed to differential sensitivity of default to triggers, between the recent period and prior housing episode. To test these hypotheses we use data on residential mortgage defaults from the Mortgage Bankers Association (hereafter MBA). MBA data are based on a sample of more than 44 million mortgage loans serviced by mortgage companies, commercial banks, thrifts, credit unions and others, and are collected quarterly from reporting institutions. While the reporting is voluntary, MBA estimates that their coverage is approximately 80% to 85% of outstanding residential mortgage loans. We only have data from MBA through the second quarter of 2008.¹²

Our default variable is the percent of loans (outstanding) that entered the foreclosure process during the quarter.¹³ Foreclosure entrance measures are also broken out by loan type (prime, subprime, VA and FHA) and fixed and adjustable rate products. However, these break-outs are not available during the full sample period. Specifically, Prime/Subprime and ARM/FRM breakouts are available only beginning in 1998, and in 1992, respectively.

¹² While some of our other empirical work utilizes data through calendar-end 2008, we have not purchased MBA data for the final two calendar quarters of 2008 because the third quarter saw suggestions by legislators that may have influenced borrower tendency to default. In particular, the potential for loan forgiveness or re-written terms on troubled *but not defaulted* loans might discourage borrowers from entering foreclosure.

¹³ As a flow measure, it is provided on a seasonally-adjusted basis.

Prior research suggests that if households exercise the mortgage's embedded put option ruthlessly, defaults should be more prevalent during periods of declining house prices. To test, we require data on house price levels. We use the Case-Shiller Composite-10 housing price index, which has a longer time series of availability (starting in January 1987).¹⁴

The literature on mortgage defaults also shows that initial loan-to-value ratios are a key determinant of default proclivity. It's therefore important that we recognize the influence of LTV in our tests. Specifically, borrower moral hazard (the tendency to exercise the put option) is a bigger problem when the put option is more likely to be in the money. Very high LTV ratios encourage this. Our nationwide average LTV ratio data come from the Federal Housing Finance Board's Historical Summary Tables (tables 20 and 23).¹⁵

We also recognize that the originate-to-distribute model of mortgage lenders during the more recent housing episode may have played a role in exacerbating default incidence. We do not have detailed data on the fraction of mortgage loans securitized, so we proxy for the secular increase in this tendency using a dummy variable "Recent" that equals one for all quarters in the second (recent) housing episode we identified using business cycle analysis: [2004:3 – 2008:2]. It is worth noting that "Recent" is a workhorse proxy for any changes in mortgage markets between the two episodes.

Mortgage defaults are also influenced by interest rates. Particularly for ARMs, which were extraordinarily popular during the recent housing bubble, higher interest rates (post-reset) are expected to increase the proclivity of homeowners to default. We proxy for the typical mortgage interest rate using the average ARM rate for the quarter, as reported in the Primary Mortgage Market Survey conducted by

¹⁴ The Case-Shiller Indices are the standard for measuring house price levels. They are calculated using the repeat sales pricing technique, which collects data on single-family home re-sales, capturing re-sold sale prices to form sale pairs. The index family consists of 20 regional indices and two composite indices as aggregates of the regions. We use the Composite – 10 Index, which has a longer time series of availability (starting in January 1987). The Composite – 20 Index is only available starting in January 2000. Given our use of foreclosure data prior to calendar year 2000, we choose the Composite – 10 Index.

¹⁵ This data is available only through 2007. Thus, our analysis of default behavior in Table 3 ends in 2007. Given availability of the other data for default analysis through the second quarter of 2008, we re-run our tests on this sample without LTV controls. The general tenor of our results is similar. Details are provided below.

Freddie Mac.¹⁶ Again, we expect that the preponderance of “little-to-no money down” mortgages written during the bubble period will encourage earlier exercise of the put option implicit in a residential mortgage. Given that higher payments associated with rising interest rates (on ARMs) are a trigger event, we expect a greater positive sensitivity of defaults to interest rates during the more recent period.

Numerous studies also include some measure of employment and/or compensation to explain homeowner defaults. Given our macro perspective, we use the economy-wide unemployment rate as a determinant of homeowners’ abilities to meet mortgage payments. Moreover, the unemployment rate does influence demand for and thus house prices. Consequently, the unemployment rate is another workhorse proxy, in this case for borrower ability to make mortgage payments as well whether the option to default is in the money or out of money. Our data come from the Bureau of Labor Statistics. We use the quarterly unemployment rate among civilians, seasonally-adjusted.

3.2 Results

Table 3 presents results from time-series regressions of the percentage of mortgage loans entering foreclosure as a function of interest rates, house price returns and unemployment.¹⁷ We separately consider subprime and prime mortgages in additional regressions. We conduct our analysis on all mortgages that meet the panel’s criteria, and then separately FRM and ARM mortgages. To capture time variation in the sensitivity of homeowners’ proclivity to default to usual triggers, we interact the interest rate and housing return variables with indicators for the recent (and in column one of Table 3 for the previous) housing episode(s), and with the average nationwide LTV ratio. The general model is:

$$F = \alpha + \beta_1(I) + \beta_2(H) + \beta_3(I * Recent) + \beta_4(H * Recent) + \beta_5(I * LTV) + \beta_6(H * LTV) + \beta_7(U) + \varepsilon \quad (1)$$

F is the foreclosure percentage, I is the interest rate level, H is housing returns, LTV is the loan-to-value ratio and U is the unemployment rate. Recent is a dummy variable equal to one for observations in [2004:3 – 2007:4]. We suppress “t” subscripts for readability.

¹⁶ Our results are robust to using the 11th District Cost of Funds Index to proxy for interest rates on mortgages.

¹⁷ Given the nature of dependent variable (non-negative), we run our regressions controlling for censoring.

The results in the first column of Table 3, studying the full sample of loan foreclosures that MBA reports data on, are largely consistent with our expectations. Both housing episodes¹⁸ show greater sensitivity of defaults to interest rate rises and house price declines than the periods of less volatile housing markets. Interestingly though, the magnitudes of coefficients on the interest rate and housing return variables interacted with period dummies are very different across episodes: they are *twice* the magnitude in the recent episode compared to the previous housing event. This suggests real differences in borrower default proclivity across the two housing regimes.

What could cause such differences? We noted above the problems of originate-to-distribute incentive effects and borrower moral hazard. The latter's effect would seem to be picked up by LTV ratios interacted with the interest rate and housing return variables. This is because very high LTV ratios imply little to no equity in the home, exacerbating borrower moral hazard problems. For the full sample, this effect appears to be marginally important. The coefficients on the LTV interactive with interest rates and housing returns are statistically zero and marginally negative respectively. We therefore conclude that other elements unique to the current housing crisis are at work in the full sample, exacerbating default proclivity's sensitivity to typical triggers. Similar inferences emerge from columns 2 and 3. Though we lack the data to observe the influence of the prior housing episode on ARM and FRM default proclivities separately, we continue to observe significant coefficients on the interactive of the recent dummy with interest rates and housing returns.

We next sample on only prime loans and re-run our regressions. The results are presented in columns 4 through 6. Here we see that higher LTV ratios significantly raise the sensitivity of default proclivity to typical triggers like interest rates and house prices. For example, the coefficient on (I*LTV) in column four is positive and significant. When LTV is higher, implying less equity in the home and potentially greater borrower moral hazard, higher interest rates associate with greater default incidence.

¹⁸ The model in column one uses data that goes back to 1987, so we include effects of the previous housing episode which ran from 1988 through 1991 (see section 2 for details).

Also, the significantly negative coefficient on (H*LTV) indicates that when LTV ratios are higher, a reduction in house prices has a stronger effect on foreclosure incidence.

Also interesting is the lack of significance of the (I*Recent) and (H*recent) coefficients. In the prime loan samples, other characteristics unique to the current housing episode do not appear to exacerbate default proclivity's sensitivity to interest rates and house prices. Perhaps the originate-to-distribute model is less problematic when the loans are made to prime borrowers. Lenders need not monitor them so closely.

Turning to the final three columns of Table 3, we study model (1)'s results for subprime loans. Column seven's results appear to reflect an averaging of the disparate effects in the ARM and FRM samples. We therefore discuss the latter two columns individually. In column 8 (the subprime ARM sample), the coefficients on (I*Recent) and (H*Recent) are significant in the expected directions. The current housing episode is associated with greater sensitivities of default to interest rates and house price moves. This is despite controlling for the influence of LTV ratios on these sensitivities, which likely captures the influence of borrower moral hazard. In other words, the originate-to-distribute model is particularly problematic for default sensitivities to typical triggers among subprime loans – precisely where we would expect it. Little monitoring by the lender and greater adverse selection concerns are likely protagonists in the current subprime default crisis.

Nevertheless, the coefficients on the LTV interactives of I and H are also significant. Among subprime ARMs, it appears that both borrower moral hazard and other characteristics specific to the current housing episode affect default proclivity.

By contrast, for FRMs in the subprime sample, only (I*Recent) carries an obviously significant coefficient and it's negative. We interpret this result as follows. FRMs do not see interest rate increases even as market-wide rates rise. Subprime borrowers may find this particularly valuable as their other debt becomes more expensive. They have an incentive to maintain payments on the mortgage as they realize that default eliminates their ability to retain the favorable interest rate on future mortgage payments.

Overall, our results suggest that the current housing episode associates with greater sensitivity of default proclivity to typical triggers. Both borrower moral hazard and other elements (such as the originate-to-distribute model of underwriting) unique to the current housing episode encourage this.

3.2.1 Results without LTV Effects

Finally, we briefly discuss results from an alternative empirical model that does not separately identify the influence of LTV on default sensitivities to interest rates and house prices.¹⁹ By in large, our conclusions persist. In the full sample of mortgages, sensitivity of default to both triggers is stronger in the current housing episode. The subtle difference worth mentioning is as follows. For the sample of prime mortgages, default is more sensitive to interest rates and housing returns in the current episode, whereas they were not when we controlled for LTV ratios. Again, the current housing episode appears to be different in terms of default sensitivity to typical triggers.

4. The Role of Banks

We study banks' role in the propagation of the housing market's collapse through other financial markets from two perspectives. First, we conduct an event study of banks. To the extent that bank stocks responded to surprisingly negative news about housing and mortgage markets, this suggests exposure to declining assets. This exposure leads to reductions in capital and because banks are required to keep minimum levels of capital, this should affect their lending behavior. Therefore, our second perspective studies aggregate bank lending behavior and how it varies with the state of housing markets. In this latter stage, we pay particular attention to differences in banks' lending activities between the current and prior housing episodes.

4.1 Event Study

While lenders specializing in subprime mortgages are obvious candidates to suffer from the decline in that market segment, our previous results also suggest that prime loans' default sensitivities

¹⁹ We are able to estimate this model using data through the second quarter of 2008, because that is the end of our MBA data series, and we no longer require data on LTV ratios (which end in the fourth quarter of 2007).

also changed in the recent period. Thus, the negative wealth effects could have been more widespread, particularly among banks who are traditional lenders in the residential real estate market.

To investigate this issue, we conduct an event study on banks. The events we study are the first days when markets were likely surprised by the severity of losses in the mortgage sector. We focus on the third quarter of 2007, which is when a number of indicators of credit market financial stress emerged. Our specific sample of events is comprised of days when the AAA tranche of the ABX index (which measures the performance of MBS) dropped by at least 1%. Our focus on days when the safest tranche of the index declines significantly is deliberate. It further focuses attention on days when the market was most likely surprised by the extent/breadth of mortgage market problems. Our sample of banks is all those with publicly traded equity and bank holding company data available via the Federal Reserve's Y-9 forms.

We calculate abnormal returns using both the standard market model methodology and also employing Scholes-Williams beta estimation methodology. The parameter estimation window is $[t-250, t-51]$, where t is the event date. Table 4 presents our results.

Panel A reports results offering conflicting views of banks' exposure to problems in the mortgage market. Raw returns on events days are significantly negative (-1.038%) on average, suggesting banks are exposed to mortgage market difficulties. By contrast, the market model abnormal returns are significantly positive and the abnormal returns using Scholes-Williams betas are statistically zero. One possible explanation for these conflicting results is that they reflect averaging across all publicly-traded banks, rather than focusing on those with likely the greatest exposure to mortgage markets.

Therefore, in Panel B we split our sample into two subsamples: those with "high" residential mortgage lending activity (upper quintile of residential mortgage lending / total lending during the previous fiscal year), and the remaining commercial banks. We expect that banks with greater exposure to the residential real estate market (through their mortgage lending to that segment) will experience worse abnormal returns at the announcement of large declines in the AAA tranche of the ABX index.

Consistent with our expectations, we find that banks which were more active lenders in the residential real estate sector experienced significantly negative abnormal returns on these event days. The

surprising declines in the AAA tranche of the ABX index likely signaled significant revisions of expectations regarding mortgage and MBSs losses, and banks that were heavily exposed were anticipated to experience larger losses. The conclusions are similar whether we calculate abnormal returns using standard market model methodology or using Scholes-Williams betas.

By contrast, banks less heavily exposed to the residential real estate sector actually experienced positive abnormal returns. The difference in mean abnormal returns between the two groups is significant at the 1% level using either estimation method. The difference in median abnormal returns is significant at the 1% level using the market model and at the 10% level using Scholes-Williams betas.

These results suggest two conclusions. Banks with greater (prior) residential real estate lending were considered more exposed to the decline in such markets. Despite securitization, high residential lending activity banks were not completely insulated. Too, banks that were exposed would likely have to curtail lending. We test this implication below.

4.2 Changes in Bank Lending Behavior

The current “credit crunch” highlights the severity of the collapse of housing markets and its associated spillover over effects. This is consistent with prior research on the “lending channel”. For example, Rajan (1994) and Gan (2007) previously document links between credit policy and real estate performance. There are important differences in our work. Rajan’s empirical work is limited to New England banks and he studies the previous real estate crisis. By contrast, we offer analysis of the national aggregate credit policy and we compare the previous housing crisis to the current one. Gan’s (2007) results are specific to Japan and analyze one time period. Again, our results suggest that tightening credit standards, in particular quantity responses by bankers, are more severe during the recent crisis.

Our study of aggregate bank credit policy focuses on responses of senior loan officers at U.S. banks to the Federal Reserve survey. We explain five credit policy indicators and how they vary during different economic regimes. The indicators are:

CI_tighten: The percent of domestic bank senior loan officers surveyed that respond indicating they tightened standards for (medium and large) C&I loans during the quarter.

CommRE_tighten: The percent of domestic bank senior loan officers surveyed that respond indicating they tightened standards for commercial real estate loans during the quarter.

RE_tighten: The percent of domestic bank senior loan officers surveyed that respond indicating they tightened standards for residential real estate loans during the quarter.

Consumer_loans_loosen: The percent of domestic bank senior loan officers surveyed that respond indicating they *loosened* standards for consumer loans during the quarter.

C&I Loans Spread: The rate of interest charged on all C&I loans minus the federal funds rate.

We present regressions of each of these indicators on macroeconomic control variables and dummy variables for the “state” of the housing markets. The control variables are real GDP growth and the level of interest rates (the 90 day risk-free rate). The dummy variables for the state of housing markets are Boom and Bust., identified using the approach detailed above in the business cycle analysis. Specifically, booms are the eight quarters leading up to (and including) the peak in house prices which is followed by a pronounced decline. This definition corresponds to the following calendar windows for booms: [1988:1 – 1989:4] and [2004:3 – 2006:2].²⁰ Busts are the eight quarters following these booms: [1990:1 – 1991:4] and [2006:3 – 2008:2]. We separate booms and busts within each housing episode because banks tend adjust their lending in opposite directions in booms versus busts.

Table 5 presents results from our regressions. They are consistent with propagation of real estate crises through bank lending behavior. In response to both crises, four of the five credit policy indicators show significant evidence of tightening standards, three along the supply dimension and one in terms of pricing. Banks tighten commercial and residential real estate lending and consumer (installment) lending standards, and they raise interest rates on C&I loans (in response to the prior real estate crisis).

Economically, the coefficients are meaningful. Studying real estate lending behavior, the positive coefficients (.240 and .236) on Bust2 indicate that on average 24% of senior loan officers indicated they tightened commercial and residential real estate lending standards (respectively) during the recent crisis. The negative coefficient on Bust2 in the consumer lending regression also indicates significant tightening,

²⁰ While the preceding discussion is illustrative of how we characterize “booms”, it turns out that we cannot run our tests with separate dummy variables for the two different “booms”. This is because data from the senior loan officer’s survey is available starting in 1990:2. We therefore only include one dummy variable for Boom.

because the dependent variable is couched in terms of loosening standards. Of these three documented effects, only residential real estate lending standards exhibit significant tightening during Bust1. By in large, the quantity effects documented above appear more severe during the recent crisis.²¹

The regression explaining spreads on C&I loans indicates that the earlier housing crisis (Bust1) associated with significant increases in business borrowing interest rate spreads. There is no evidence of this for Bust2. Banks' business lending activities were unaffected in terms of quantity, but pricing terms were significantly more affected during the earlier crisis. Overall though, we view pricing differences as a second order effect. It is not clear whether firms that encounter positive projects will in fact get funding. The contagion effects of the crisis may lead to a situation where banks simply ration even good borrowers fearing that their ability to pay is compromised.

We also offer an alternative approach to identifying booms and busts that begins with a full sample period perspective. We first identify all quarters in our full sample from 1987 through second quarter 2008 that are accompanied by rising house prices, and we label them as "up" periods. Correspondingly, quarters accompanied by falling house prices are "down" periods. Within the sample of "up" real estate markets, the top quartile of housing price return quarters are considered a boom. Correspondingly, busts are the worst quartile of "down" real estate return quarters. This alternative definition of booms and busts allows us to focus particularly on whether the distribution of negative real estate returns is concentrated in the more recent crisis period.

To compare distributions of house price returns, we use the concept of first degree stochastic dominance (FSD). One distribution first-degree stochastically dominates another distribution if the following condition holds: the cumulative distribution of the comparison variable (in our case house price returns) for one sample lies strictly to the right of the cumulative distribution of the variable for the other

²¹ Even though tests of differences in coefficients on Bust1 versus Bust2 indicate significance only in the regression on consumer installment loan provision, the lack of significance in both forms of real estate lending appear partly attributable to noisy estimates. In particular, the coefficient on Bust2 is nearly three times larger than the coefficient on Bust1 in the commercial real estate lending regression. The coefficient on Bust2 is 50% larger than that on Bust1 in the residential real estate lending regression.

sample. We find that this is the case. Declines in house prices during the early 1990s FSD dominate (i.e. are less pronounced than) declines in house prices in the current housing crisis.

Based on the above innovations we re-estimate the regressions in Table 5. The results are reported in Table 6. Not surprisingly, both housing price busts are now associated with credit tightening along all five credit availability indicators. This is because the Busts are now identified as the worst 25% of calendar quarters that exhibited house price declines. Previously, our definitions of Busts allowed for the inclusion of some quarters that may have experienced smaller declines or even house price increases. More interestingly we think, is the stronger evidence of worse propagation during the more recent crisis. Tests of differences in the coefficients on the previous and current house price busts carry p-values less than 10% for both residential real estate lending behavior and consumer installment loan provisions. Taken together, it appears that the effect of the recent housing crisis on bank lending behavior is significantly stronger than the previous one.

5. Evidence of Spillover from the Housing Markets Collapse

Asset price busts are typically not confined to one asset class or market. Indeed it's been argued that the collapse of the housing market was a major external factor contributing to the recent extreme turbulence in other asset markets. In this section, we study links between the housing market, the stock market, and bank stocks' returns. We seek empirical evidence of links between these groups of assets' returns and also ask whether the current crisis in housing influences other asset prices differently than in the past.

5.1 Data

Housing returns are calculated monthly using the Case-Shiller National housing price index for 10 cities. Again, the index built on 20 cities is not available until January 2000, rendering a comparison of the two housing boom-bust cycles impossible. Stock returns are calculated monthly using the S&P500 index. Our series of bank stocks' returns is return to a value-weighted portfolio of all bank holding companies' stocks with data on CRSP.

5.2 The VAR

We run a Bayesian VAR with diffuse priors. This involves drawing from a multivariate normal to compute the matrix of coefficients, and from a Wishart to obtain the inverse of the variance covariance matrix of the error term. In order to execute the strategy, first we run line-by-line regressions of the VAR system in equation (2) below. We collect the residuals from each regression and compute the outer product of residuals. These form the parameters of our posterior distributions, and we draw the coefficient and the variance-covariance matrices from their respective posterior distributions. First, we draw the inverse of the variance covariance matrix. Then, conditional on the variance-covariance matrix we draw the matrix of coefficients. We repeat these steps 10,000 times to draw from the marginal posterior distribution of the matrix of coefficients and the variance-covariance matrix. Our inferences in Table 7 are based on these draws from the posterior distribution.

Our model is:

$$\begin{bmatrix} H_t \\ S_t \\ B_t \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} H_{t-1} \\ S_{t-1} \\ B_{t-1} \end{bmatrix} + \begin{bmatrix} e_t \\ e_t \\ e_t \end{bmatrix} \quad (2)$$

where H indicates the housing return series, S indicates the stock return series and B indicates the return series to a portfolio of bank holding company stocks. The VAR is estimated with one lag.

5.3 Results

Our results suggest important differences in the relation between housing, stocks and banks across the two episodes. In episode one, we see strong persistence in housing returns. The coefficient a_{11} is positive (0.9) and significant. This may be due to the nature of the Case-Shiller Index calculation, which uses a three-month moving average. Also, banks appear to lead housing during episode one. The coefficient a_{13} is 0.41 with a t-statistic of 1.82 (significant at the 10% level). This suggests that when banks do well (poorly), the housing market follows next quarter. Notably, the opposite does not seem to hold. The coefficient linking current bank returns with prior housing returns (a_{31}) is apparently negative during episode one, though not significant (t-statistic = -0.14).

By contrast, in episode two housing does lead banks. The coefficient a_{31} equals 0.088 and is significant (t-statistic = 2.12). Moreover, the housing-led decline in banks' fortunes appears to link with the aggregate stock market. The coefficient (a_{23}) linking past bank returns with current stock returns is significantly positive, with a t-statistic of 2.38. Thus, there are real differences in the links between housing, banks and stocks across the two episodes.

Impulse response function graphs suggest the same. In episode one, with housing as the shock we see little effect on banks and stocks in general. In episode two, the responses are non-zero. See Figure 1 for details.

6. Summary and Conclusions

The current financial crisis that began with the deterioration in housing and mortgage markets has cascaded into all corners of the global financial and economic systems. This study examines the underpinnings of the episode and compares it with the previous housing-led recession in the U.S. of the early 1990s. In particular, we focus on three types of differences across the two episodes: default proclivity – particularly the sensitivity to common triggers; bank lending behavior; and relationships between housing and financial markets.

We find that all three perspectives are important. Borrower proclivity to default on mortgages is dramatically different in the current episode. Banks' curtailment of (consumer) lending is stronger in the current episode. And housing and financial markets show different linkages in the current episode. Combined, the three perspectives all suggest worse financial conditions over a longer spell than the previous housing-led downturn.

At some level, research on the current financial crisis must address possible courses of future action. Regulators have already demonstrated willingness to consider alternatives in resolving the crises. Our evidence suggests that attempts to encourage lending to consumers is a positive short-run goal. Also, efforts to recapitalize the banking system appear prudent. In the long-run, our research points to concerns with the nature of mortgages written during the run-up preceding the current crisis. In particular, any

lending strategy that hands borrowers a put option that can quickly become quite valuable is a concern. Future home-ownership mandates should be cognizant of the incentives they generate.

References

- Adalid, R. and C. Detken (2007), "Liquidity Shocks and Asset Price Boom/Bust Cycles, *European Central Bank Working Paper* No. 732.
- Allen, F. and D. Gale (1998), "Optimal Financial Crises", *Journal of Finance*, 53: 1245-1283.
- Allen, F. and D. Gale (1999), "Bubbles, Crises and Policy", *Oxford Review of Economic Policy*, 15, 9-18.
- Baig, A. and I. Goldfajn (1999), "Financial Market Contagion in the Asian Crisis", *International Monetary Fund* 40: 167-195.
- Bae, K. G. Karolyi, and R. Stulz (2003), "A New Approach to Measuring Financial Contagion" *Review of Financial Studies*, 16: 717-763.
- Bernanke, B.S. (1983), "Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression, *American Economic Review* 73: 257-76.
- Bernanke, B.S. and M. Gertler (1990), "Financial Fragility and Economic Performance, *Quarterly Journal of Economics* 105:87-114.
- _____ (1995), "Inside the Black Box: The Credit and Aggregate Demand", *American Economic* 82:901-21.
- Bordo, M. and O. Jeanne (2002), "Boom-Busts in Asset Prices, Economic Instability and Monetary Policy", *NBER Working Paper* 8966, National Bureau of Economic Research, Cambridge.
- Chichilnisky, G. and H. Wu (2006), "General Equilibrium with Endogenous Uncertainty and Default, *Journal of Mathematical Economics* 42 .
- Congdon, T. (2005), "Money and Asset Prices in Boom and Bust," *The Institute of Economic Affairs*, London.
- Demyanyk, Y. and O. Van Hemert (2009), "Understanding the Subprime Mortgage Crisis," forthcoming in the *Review of Financial Studies*.
- Doms, M., F. Furlong, and J. Krainer (2007) "Subprime Mortgage Delinquency Rates" *Federal Reserve Bank of San Francisco, Working Paper*.
- Dunn, K. and C. Spatt (1988), "Private Information and Incentive Implications for Mortgage Contract Terms and Pricing," *Journal of Real Estate Finance and Economics*, 1:47-60.
- Frank, N., B. Gonzalez-Hermosillo and H. Hesse (2008), "Global Transmission of Liquidity Shocks: Evidence from the 2007 Subprime Crisis," *IMF working paper*.
- Frantantoni, M. and S. Schub (2003), "Monetary Policy, Housing, and Heterogeneous Regional Markets, *Journal of Money, Credit, and Banking* 35:557-589.
- Gan, J. (2007), "The Real Effects of Asset Market Bubbles: Loan-and Firm-Level Evidence of Lending Channel, *Review of Financial Studies*, 20; 1941-1969.

- Gerardi, K., A. Lehnert, S. Sherlund and P. Willen (2008), “Making Sense of the Subprime Crisis,” forthcoming in *Brookings Papers on Economic Activity*.
- Gerardi, K., A. Shapiro, and P. Willen (2007), “Subprime Outcomes: Risky Mortgages, Homeownership Experiences, and Foreclosures,” *Federal Reserve Bank of Boston Working Paper 07-15*.
- Ghent, A. (2008) “Sticky Mortgage and Real Effects of Monetary Policy”, *Baruch College Working Paper*.
- Green, R.K. (1997), “Follow the Leader: How Changes in Residential and Non-residential Investment Predict Changes in GDP”, *Real Estate Economics* 25, 253-270.
- Greenlaw, D., J. Hatzius, A.K. Kashyap, and H. S. Shin (2008), “Leveraged Losses: Lesson from the Mortgage Market Meltdown” *University of Chicago School of Business Working Paper*.
- Hamilton, J.D. (2007), “Daily Monetary Policy Shocks and the Delayed Response of New Home Sales,” *University of California, San Diego Working Paper*.
- Hatzius, J. (2008), “Beyond Leveraged Losses: The Balance Sheet Effects of the Home Price Downturn,” *Brookings Papers on Economic Activity*, Fall 2008.
- Helbling, T. and M. Terrones (2003) “Real and Financial Effects of Bursting Price Bubbles”, *IMF World Economic Outlook*, Chapter II.
- Herring, R. and S. Wachter (2003), “Bubbles in Real Estate Markets,” *Asset Price Bubbles: The Implications for Monetary, Regulatory and International Policies*, Chapter 14: 217 MIT Press.
- Mian, A. and A. Sufi (2008), “The Consequences of Mortgage Credit Expansion: Evidence from the 2007 Mortgage Default Crisis,” *University of Chicago Graduate School of Business, Working Paper*.
- Pavlov, A. and S. Wachter (2008), Subprime Lending and House Price Volatility, *Wharton School Working Paper*.
- Rajan, R. (1994), “Why Bank Credit Policies Fluctuate: A Theory and Some Evidence”, *Quarterly Journal of Economics* 109, 399-441.
- Riley, J. (2001), “Silver Signals: Twenty-five Years of Screening and Signaling,” *Journal of Economic Literature* XXXIX, 221-231.
- Sa-Aadu, J., J. Shilling and A. Tiwari (2008) “On the Portfolio Properties of Real Estate in Good Times and Bad Times”, *Tippie College of Business, University of Iowa Working Paper*.
- Sa-Aadu, J. and C.F. Sirmans (1995), “Differentiated Contracts, Heterogeneous Borrowers and the Mortgage Choice Decision”, *Journal of Money, Credit and Banking*, 498-510.
- Schneider, M. and A. Tornelli (2004), “Balance Sheet Effects, Bailout Guarantees and Financial Crises,” *The Review of Economic Studies* 1-31.
- Shiller, Robert J. (2007), “Historic Turning Points”, *Cowles Foundation for Research in Economics Discussion Paper No 1610*, Yale University.

_____ (2005), "Irrational Exuberance, 2nd Edition, Princeton University Press.

Stanton, R. and N. Wallace (1998), "Mortgage Choice: What's the Point? *Real Estate Economics*, 26: 173-206.

Stiglitz, J., and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information, *American Economic Review* 71: 393-410.

Wojnilower, A. (1980), "The Role of Credit Crunches in Recent Financial History," *Brookings Papers on Economic Activity*.

Hatzius (2008)
Gerardi, Lehnert, Sherlund, and Willen (2008)
Frank, Gonzalez-Hermosillo, and Hesse (2008)
Daglish (2008)
Demyanyk, and Vanttemert (2007)
Wojnilower (1980)
Allen and Gale (1998 and 1999)
Herring & Wachter (2003)
Pavlov & Wachter (2008)

Table 1: The Behavior of House Prices in the Current and Previous Housing Episodes

House price index value (panel B) is the Case-Shiller Index value. Real House Price Index Value (panel A) is Case-Shiller Index Value deflated by the CPI deflator (index = 100 in 1982 – 1984). Returns are holding period returns over the given window. σ_{return} is the time series standard deviation of monthly returns over the given window. The risk-free rate is the average 30 day Treasury rate over the given window (data taken from Ken French’s web site). The Sharpe Ratio equals (House Price Return minus risk-free rate) all divided by σ_{return} .

Panel A: Real Terms

		Episode 1		Episode 2	
		Boom	Bust	Boom	Bust
Time window		1/88 – 12/89	1/90 – 12/91	7/04 – 6/06	7/06 – 6/08
Real House Price Index Value	Beg	60.74	65.20	95.00	112.08
	End	65.20	56.43	112.08	82.97
Real House Price Return		7.34%	-13.45%	17.98%	-25.97%
HPI σ_{return}		0.417%	0.587%	0.596%	0.948%

Panel B: Nominal Terms

		Episode 1		Episode 2	
		Boom	Bust	Boom	Bust
Time window		1/88 – 12/89	1/90 – 12/91	7/04 – 6/06	7/06 – 6/08
House Price Index Value	Beg	70.22	82.35	179.45	226.29
	End	82.35	77.99	226.29	180.38
House Price Return		17.27%	-5.29%	21.07%	-20.29%
HPI σ_{return}		0.437%	0.548%	0.504%	0.833%
Risk-free rate		7.206%	6.410%	2.954%	3.892%
Sharpe Ratio		23.030	-21.350	35.044	-29.030

Table 2
Returns on Housing, Banks and the Stock Market

Table presents univariate statistics for returns to various instruments: Bank return is the monthly value-weighted return to the sample of stocks for bank holding companies. Housing return is the monthly return to the Case-Shiller House Price Index. S&P500 return is the return to the S&P500 Index.

Full Sample [January 1987 – December 2008]

	Mean	Median	Standard deviation
Bank return	0.00058	0.00091	0.00396
Housing return	0.00403	0.00466	0.00815
S&P500 return	0.00687	0.01067	0.04174

Boom 1 [January 1988 – December 1989]

	Mean	Median	Standard deviation
Bank return	0.00082	0.00037	0.00204
Housing return	0.00667	0.00523	0.00437
S&P500 return	0.01553	0.01603	0.03272

Bust 1 [January 1990 – December 1991]

	Mean	Median	Standard deviation
Bank return	0.00021	0.00117	0.00376
Housing return	-0.00225	-0.00176	0.00548
S&P500 return	0.00810	0.01019	0.04965

Boom 2 [July 2004 – June 2006]

	Mean	Median	Standard deviation
Bank return	0.00065	0.00045	0.00211
Housing return	0.00972	0.01034	0.00504
S&P500 return	0.00472	0.00462	0.02190

Bust 2 [July 2006 – December 2008]

	Mean	Median	Standard deviation
Bank return	-0.00082	0.00008	0.00452
Housing return	-0.00946	-0.00638	0.00799
S&P500 return	0.00090	0.01143	0.03238

Table 3: Default Sensitivity to Interest Rates and Housing Price Returns

Table presents results from time series regressions. Dependent variable is the seasonally adjusted percent of U.S. mortgage loans that entered foreclosure during the quarter. Interest rate is average adjustable mortgage rate in that quarter (source: PMMS). Home price return is the return from previous quarter to current quarter in home price, using the Case/Shiller (National) housing price index (normalized to 100 in January 2000). Dummy “Recent” equals one for data from [2004:3 – 2008:2]. Dummy “Old” equals one for data from [1988:1 – 1991:4]. Unemployment rate is national seasonally adjusted unemployment rate in the quarter. Sample period is [1987:2-2007:4] (Home price data is available starting in the first quarter of 1987, so housing returns begin in 1987:2. LTV data is available through 2007:4. Foreclosure data is available for ARMs and FRMs starting in 1992. Foreclosure data is available for Prime and Sub-prime breakouts starting in 1998). T-statistics are in parentheses. ^{a,b,c} indicates significance at the 10%, 5%, 1% levels.

	Prime & Subprime Together			Prime Loans Only			Subprime Loans Only		
	All Loans	ARM Loans	FRM Loans	All Loans	ARM Loans	FRM Loans	All Loans	ARM Loans	FRM Loans
Constant	0.64 ^c (8.33)	0.50 (1.54)	0.38 ^c (6.82)	-0.01 (-0.06)	-0.17 (-0.43)	0.11 (1.27)	-3.79 ^a (-1.72)	-2.10 (-0.96)	-2.62 (-1.05)
Interest Rate	-0.08 (-1.50)	-0.22 (-1.04)	-0.05 (-1.31)	-0.27 ^c (-6.17)	-1.27 ^c (-5.88)	-0.17 ^c (-4.94)	-0.04 (-0.05)	-2.86 ^b (-2.41)	1.74 ^a (1.71)
Housing return	16.1 ^a (1.85)	125 ^b (1.99)	9.34 ^a (1.89)	21.81 ^c (4.41)	141 ^c (3.73)	9.74 ^b (2.57)	233 ^b (2.32)	716 ^c (3.46)	122 (1.08)
Interest Rate * Recent	0.03 ^c (7.82)	0.14 ^c (10.67)	0.01 ^c (4.90)	0.003 (1.47)	0.002 (0.20)	0.001 (0.63)	0.01 (0.25)	0.12 ^c (2.77)	-0.14 ^c (-2.74)
Housing return * Recent	-4.78 ^c (-7.99)	-16.9 ^c (-9.34)	-1.02 ^c (-3.09)	-0.32 (-0.85)	-2.01 (-1.49)	0.27 (0.92)	-4.66 (-0.61)	-24.3 ^c (-3.27)	3.60 (0.42)
Interest Rate * Previous	0.01 ^b (2.14)	-----	-----	-----	-----	-----	-----	-----	-----
Housing return * Previous	-2.01 ^b (-2.55)	-----	-----	-----	-----	-----	-----	-----	-----
Interest Rate * LTV	0.07 (0.94)	0.24 (0.90)	0.04 (0.77)	0.36 ^c (5.99)	1.71 ^c (5.86)	0.21 ^c (4.54)	0.85 (0.70)	4.17 ^c (2.61)	-1.50 (-1.09)
Housing return * LTV	-20.2 ^a (-1.77)	-157 ^b (-1.97)	-11.9 ^a (-1.84)	-29.7 ^c (-4.53)	-184 ^c (-3.84)	-13.4 ^c (-2.66)	-315 ^b (-2.37)	-919 ^c (-3.48)	-168 (-1.12)
Unemployment	-0.02 ^c (-2.64)	0.02 (0.76)	-0.02 ^c (-2.94)	0.04 ^c (3.12)	0.05 (1.14)	0.02 ^a (1.76)	0.53 ^a (1.95)	0.42 (1.66)	0.30 (0.98)
Window	[1987:2- 2008:2]	[1992:1- 2008:2]	[1992:1- 2008:2]	[1998:1- 2008:2]	[1998:1- 2008:2]	[1998:1- 2008:2]	[1998:1- 2008:2]	[1998:1- 2008:2]	[1998:1- 2008:2]
N	83	64	64	40	40	40	40	40	40
Column Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Table 4: Wealth Effects of Housing Markets Collapse on Financial Institutions

Table presents results from single-day event studies. Events are days when the AAA tranche of the ABX index was -1% or lower, chosen from the third quarter of 2007. Market model abnormal returns are based on an estimation window of [t-250, t-51], where t is the event day. SW beta indicates we used the Scholes-Williams beta estimation methodology, rather than the standard beta estimation method in our market model. Residential mortgage lending activity is measured as [residential mortgage loans / total loans]. Banks with residential mortgage lending activity in the top 25% of all reporting banks' ratios, at the end of 2006, are classified High, all others are Low. Tests of differences in means are t-tests. Tests of differences in medians are Wilcoxon χ^2 .

Panel A: Full Sample

	Abnormal Returns (market model)	Abnormal Returns (SW beta)	Raw Returns
Percent Return	0.09	-0.001	-1.038
t-statistic	2.13	-0.02	-24.40

Panel B: Sample split by Residential Mortgage Lending Activity

	Residential Mortgage Lending Activity		Difference Tests	
	High	Low	Mean t-statistic	Median p-value
Percent Abnormal Return (Market model)	-0.153 ^a (-1.74)	0.148 ^c (3.07)	t = 2.83 ^c	p = 0.01 ^c
Percent Abnormal Return (SW beta)	-0.266 ^c (-3.06)	0.062 (1.29)	t = 3.00 ^c	p = 0.06 ^a
Percent Raw Return	-1.273 ^c (-14.02)	-0.983 ^c (-20.48)	t = 3.30 ^c	p = 0.03 ^b

Table 5: Propagation of Housing Market Collapse through Bank Lending Behavior (Boom and Busts defined using two-year windows around S&P Case-Shiller house price index peaks)

Table reports results from regressions of various measures of bank lending behavior on controls and house price returns. Bank lending behavior variables: **CI_tighten** is the percentage of domestic bank senior loan officers surveyed that respond indicating they tightened standards for C&I loans (large and medium sized) during the quarter. **CommRE_tighten** is defined analogously for commercial real estate loans. **RE_tighten** is defined analogously for residential real estate loans. **Consumer_loans_loosen** is the percentage of domestic bank senior loan officers surveyed that respond indicating they loosened standards for consumer installment loans made during the quarter. **C&I Loans Spread** is measured as the rate of interest charged on all C&I loans minus the federal funds rate. Control variables: Real GDP growth is the growth rate in real GDP from the previous quarter to this one (annualized). Interest rate is the average one year treasury rate during the quarter (averaged from the three monthly rates during the quarter, pulled from Ken French's web site). Key variables: HPI_return is the return calculated using the current and previous quarter's values of the Case-Shiller National Composite house price index. Quarterly values of the HPI are averages of the three monthly values in the quarter. Boom is a dummy variable equal to one in the following two windows: [1988:1 – 1989:4] and [2004:3 – 2006:2]. Otherwise Boom = 0. Bust is a dummy variable equal to one in the following two windows: [1990:1 – 1991:4] and [2006:3 – 2008:2]. Bust1 is a dummy variable equal to one for the first of the two Bust windows. Bust2 is a dummy variable equal to one for the second of the two Bust windows. Bust1 – Bust2 (p-val) is the p-value from a test of whether the coefficients on Bust1 and Bust2 differ from each other. ^{a,b,c} indicates significance at the 10%, 5% and 1% levels respectively.

	CI_tighten	CommRE_tighten	RE_tighten	Consumer_loans_loosen	C&I Loans Spread
Intercept	0.2563 ^c (3.28)	0.3084 ^c (4.38)	0.0760 ^a (1.86)	0.0490 (1.18)	0.0245 ^c (37.52)
Real GDP Growth	-8.2155 ^c (-3.39)	-7.7294 ^c (-3.56)	-1.4299 (-1.14)	3.0220 ^b (2.35)	-0.0306 (-1.45)
Interest Rate	0.0173 (1.02)	0.0089 (0.59)	-0.0085 (-0.97)	-0.0116 (-1.28)	-0.0009 ^c (-7.71)
Boom	-0.2302 ^c (-3.29)	-0.2043 ^c (-3.28)	-0.0338 (-0.94)	0.0314 (0.84)	0.0033 ^c (6.80)
Bust1	-0.0024 (-0.02)	0.0831 (0.79)	0.1637 ^c (2.67)	0.0369 (0.61)	0.0025 ^c (2.71)
Bust2	-0.0294 (-0.40)	0.2401 ^c (3.65)	0.2358 ^c (6.17)	-0.0881 ^b (-2.24)	0.0007 (0.98)
Bust1-Bust2 (p-val)	0.8122	0.1359	0.2366	0.0416	0.0629
Adj. R ²	0.3245	0.5053	0.4844	0.1807	0.5674
N	73	72	72	73	84

Table 6: Propagation of House Market Collapse through Bank Lending Behavior (Booms and Busts defined as top and bottom quartiles of “up” and “down” markets)

Table reports results from regressions of various measures of bank lending behavior on controls and house price returns. Bank lending behavior variables: **CI_tighten** is the percentage of domestic bank senior loan officers surveyed that respond indicating they tightened standards for C&I loans (large and medium sized) during the quarter. **CommRE_tighten** is defined analogously for commercial real estate loans. **RE_tighten** is defined analogously for residential real estate loans. **Consumer_loans_loosen** is the percentage of domestic bank senior loan officers surveyed that respond indicating they loosened standards for consumer installment loans made during the quarter. **C&I Loans Spread** is measured as the rate of interest charged on all C&I loans minus the federal funds rate. Control variables: Real GDP growth is the growth rate in real GDP from the previous quarter to this one (annualized). Interest rate is the average one year treasury rate during the quarter (averaged from the three monthly rates during the quarter, pulled from Ken French’s web site). Key variables: HPI_return is the return calculated using the current and previous quarter’s values of the Case-Shiller National Composite house price index. Quarterly values of the HPI are averages of the three monthly values in the quarter. Boom is a dummy variable equal to one in the top quartile of calendar quarters that experienced rising residential home prices (nationally – Case-Shiller Index), otherwise Boom = 0. Bust is a dummy variable equal to one in the bottom quartile of calendar quarters that experienced a decline in residential home prices (nationally – Case-Shiller Index). Bust1 is a dummy variable equal to one if Bust=1 and the calendar year/quarter is from the earlier decline (1990 and 1991). Bust2 is a dummy variable equal to one if Bust=1 and the calendar year/quarter is from the more recent decline (2006:3 – 2008:2). Bust1 – Bust2 (p-val) is the p-value from a test of whether the coefficients on Bust1 and Bust2 differ from each other. ^{a,b,c} indicates significance at the 10%, 5% and 1% levels respectively.

	CI_tighten	CommRE_tighten	RE_tighten	Consumer_loans_loosen	C&I Loans Spread
Intercept	0.1542 ^a (1.89)	0.2875 ^c (3.79)	0.0810 ^b (2.46)	0.0920 ^b (2.26)	0.0236 ^c (31.54)
Real GDP Growth	-8.4559 ^c (-4.70)	-8.4423 ^c (-5.02)	-2.7515 ^c (-3.76)	2.6002 ^c (2.90)	-0.0617 ^c (-3.24)
HPI Return	5.1990 ^c (3.26)	1.2596 (0.86)	-0.0877 (-0.14)	-2.2070 ^c (-2.79)	0.0406 ^b (2.57)
Interest Rate	0.0245 (1.63)	0.0151 (1.04)	0.0019 (0.30)	-0.0120 (-1.61)	-0.0005 ^c (-4.07)
Boom	-0.2286 ^c (-2.86)	-0.1194 (-1.62)	-0.0191 (-0.60)	0.0733 ^a (1.85)	0.0003 (0.42)
Bust1	0.3187 ^b (2.20)	0.2567 ^a (1.91)	0.2046 ^c (3.51)	-0.1578 ^b (-2.19)	0.0032 ^b (2.08)
Bust2	0.4422 ^c (3.47)	0.4607 ^c (3.94)	0.3865 ^c (7.60)	-0.3026 ^c (-4.78)	0.0030 ^b (2.02)
Bust1-Bust2 (p-val)	0.4610	0.1902	0.0085	0.0852	0.9155
Adj. R ²	0.3604	0.5016	0.7077	0.3194	0.4159
N	73	72	72	73	84

Table 7: The Relation Between the Housing Sector, Banking Sector and Aggregate Stock Index – Bayesian Vector Auto Regressions

Coefficients and standard errors (σ) are drawn from the marginal posterior distribution of the matrix of coefficients and variance-covariance matrix, from a Bayesian VAR with diffuse priors. H stands for monthly return on housing, calculated using the Case-Shiller National House Price Index. S is the monthly return on stocks, proxied by the S&P500 index return. B stands for the monthly return on a value-weighted portfolio of bank holding company stocks.

Stocks, Housing and Bank Holding Companies (value-weighted portfolio) in the VAR

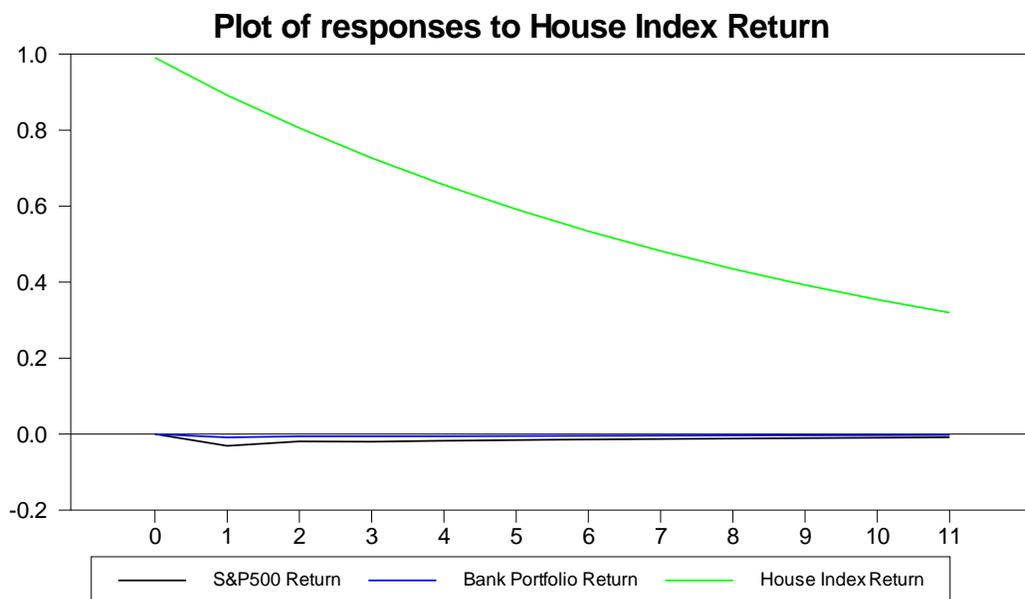
		Episode 1			Episode 2		
		March 1987 – December 1991			July 2003 – June 2008		
		H Ret. (t-1)	S Ret.(t-1)	B Ret (t-1)	H Ret. (t-1)	S Ret. (t-1)	B Ret (t-1)
Return on Housing (t) [Case – Shiller]	Coefficient (a)	0.900	-0.015	0.413	0.937	0.028	-0.138
	t-statistic	14.869	-0.908	1.817	24.529	1.395	-0.726
	p-val (Granger)	0.000	0.369	0.076	0.000	0.170	0.471
Return on Stocks (t) [S&P 500]	Coefficient (a)	-0.476	-0.388	5.351	0.065	-0.125	4.081
	t-statistic	-0.512	-1.514	1.531	0.189	-0.685	2.377
	p-val (Granger)	0.611	0.137	0.133	0.851	0.497	0.022
Return on Banks (t) [PF of BHCs]	Coefficient (a)	-0.009	-0.012	0.375	0.088	-0.005	0.088
	t-statistic	-0.142	-0.635	1.495	2.124	-0.214	0.424
	p-val (Granger)	0.888	0.529	0.142	0.039	0.832	0.674

$$\begin{bmatrix} H_t \\ S_t \\ B_t \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} H_{t-1} \\ S_{t-1} \\ B_{t-1} \end{bmatrix} + \begin{bmatrix} e_t \\ e_t \\ e_t \end{bmatrix}$$

Figure 1

Impulse Response Functions of the Effects of Housing Shocks on the System (Housing, Banks and Stocks)

Episode 1



Episode 2

Plot of responses to House Index Return

