INFORMED AND UNINFORMED INVESTMENT IN HOUSING:

THE DOWNSIDE OF DIVERSIFICATION

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Abstract

Concentrated lending declined dramatically between 1992 and 2006. We show that mortgage lenders that concentrate in a few markets behave like informed investors, while diversified lenders behave like uninformed investors. First, concentrated lenders accept and retain more mortgage applications than diversified lenders. Second, they have higher profits than diversified lenders, their profits vary less systematically, and their stock prices fell much less during the 2007-08 credit crisis. Third, when concentrated lenders retain more mortgages, future housing prices tend to appreciate, but retention rates of diversified lenders have no power to explain price changes. Both across markets and over time, the share of concentrated lending - that is, the share of informed lending - is negatively related to the recent housing price run-up. We conclude that inadequate information production helps explain the 2001-2008 real estate bubble and crash.

I. INTRODUCTION

Information production in real estate lending declined as banks gravitated away from a concentrated and toward a diversified lending strategy. Concentrated lenders – lenders focusing on one or a small number of local markets – have both better ability and stronger incentives to collect private information than diversified lenders. We focus on home mortgage lending, where informed lenders understand both current and future home prices in their primary markets. Since direct measures of private information are inherently unobservable, we test three implications of these investments. First, private information allows lenders to accept more mortgages because they can price risks better, but also reduces loan liquidity because potential buyers face adverse selection. Thus, we compare mortgage acceptance and retention rates for concentrated and diversified lenders. Second, private information should improve loan performance, so we compare profitability and loan losses of concentrated and diversified lenders. Third, we test directly whether investment decisions by concentrated lenders forecast future price changes better than similar decisions made by diversified lenders. By comparing lenders across these three dimensions, we offer strong evidence that concentrated lenders produce more information than diversified lenders. The share of mortgages originated by concentrated lenders fell from about 18% to about 4% between 1990 and 2006 (Figure 1). Hence, total information production about US housing values declined at exactly the time that housing prices inflated.

In our first set of tests, we compare investments by concentrated and diversified lenders in the non-jumbo v. jumbo segments of the market, and then test how mortgage retention rates and acceptance rates vary with lender diversification, controlling for other lender and borrower

characteristics. The Government-Sponsored Enterprises (Fannie Mae and Freddie Mac) subsidize lenders in the non-jumbo market by standing ready to purchase loans that conform to a set of underwriting criteria based on public information. Since jumbo mortgages are more costly to sell (due to the absence of GSE subsidies), lenders have more incentive to collect information in this segment of the market. Consistent with the notion that concentrated lenders invest in private information, we find that they are more active in the jumbo segment relative to diversified lenders. Moreover, concentrated lenders ration credit less than diversified lenders – they accept a higher proportion of mortgage applications; they also retain a higher proportion of those originations than diversified lenders, suggesting that private information reduces the liquidity of their loans.

Figures 2 & 3 provide graphical evidence that concentrated lenders both accept and retain more mortgages than diversified lenders, particularly so in the jumbo segment of the market. The difference in retention rates across the two lender types is large and persistent across both time and segments of the mortgage market. For example, diversified lenders sell about 65% of their mortgage originations, compared to just 40% for concentrated lenders. Much of the blame for the credit expansion has been placed on securitization. Figure 2 shows, perhaps somewhat as a surprise, that the mortgage retention rate exhibits *no time trend*. Instead, the composition of lenders has shifted over time away from concentration and toward diversification (Figure 1). Lenders used securitization as the means to implement the diversified-lending strategy, but the real change in mortgage credit supply was the dramatic move away from investment in information and toward diversification.

In our second set of tests, we compare performance of concentrated and diversified

lenders. Concentrated mortgage lenders' profits are both higher and less correlated with overall conditions in the real estate market than profits for diversified lenders. In addition, their loan losses are lower than losses for diversified lenders. To focus specifically on the real estate crash, we also compare cumulative stock-returns across banks during the seven-month period starting in August of 2007, when the poor conditions in the real estate market became clear to investors. Informed lenders ought to have been better insulated from the effects of the real estate crash; and, in fact, their stock prices performed much better than otherwise similar diversified lenders' stocks.

In our third test, we compare the ability of lender retention rates to forecast *future* real estate price changes.[1] Concentrated lenders tend to retain a smaller share of their loan portfolio in anticipation of price declines, suggesting that they sell when loan default risk is likely to increase. In contrast, the retention rate for diversified lenders is not correlated with future prices in either period.

Our results help explain the 'bubble' in housing credit markets. Information production is a necessary component to a stable asset-pricing equilibrium. In Grossman and Stiglitz (1981), there is a balance between informed and uninformed trading. Uninformed traders rationally view prices as a close approximation to fundamentals (present value of future expected cash flows). They trade for liquidity reasons, they hold well diversified portfolios, they are fairly compensated for the systematic risks that they bear, and they economize on information production costs. Informed traders, in contrast, invest in information and exploit deviations

[1] For evidence of market timing ability among hedge funds, see Chen and Liang (2007).

between prices and fundamentals, thereby earning above normal profits.[2] As a result , asset prices *have* to deviate somewhat from fundamentals to compensate costly investments in information; informed investments, in turn, are *necessary* for prices to be tied to fundamentals.[3]

Many now believe that asset prices sometimes move significantly above fundamentals for surprisingly long periods of time, and then crash suddenly (Kindleberger, 2000; Shiller, 1981; LeRoy and Porter, 1981; Shiller, 2000). These bubbles may arise because uninformed noise traders move prices. Delong, Shleifer, Summers and Waldman (1990) show that 'noise trading' creates risks to arbitrageurs. In their model, a high fraction of uninformed noise trading increases the average deviation of prices from fundamentals. Abreu and Brunnermeier (2002) show that bubbles can persist because selling too early (or selling short) – before the wave crests – can lead to large losses for informed traders.[5] What seems harder to understand is the timing with which bubbles pop. Gennotte and Leland (1990) show that uninformed traders can initiate a crash because they confuse price declines caused by random 'noise' trades with declines caused by informed trades.

[2] In equilibrium, informed traders earn a fair return on their investments in information, although to outsiders not privy to this information these traders appear to earn super-normal profits (e.g. positive 'alpha'). Traders with superior skill may earn positive alpha in equilibrium even after accounting for information costs.

[3] Deviations from fundamentals are larger when costs or risks to arbitrageurs are high (Pontiff, 1996), when there are limits to arbitrage from agency costs or from short sale constraints and other frictions (Shleifer and Vishny, 1997), or when investors are asymmetrically informed (Brunnermeier, 2008).

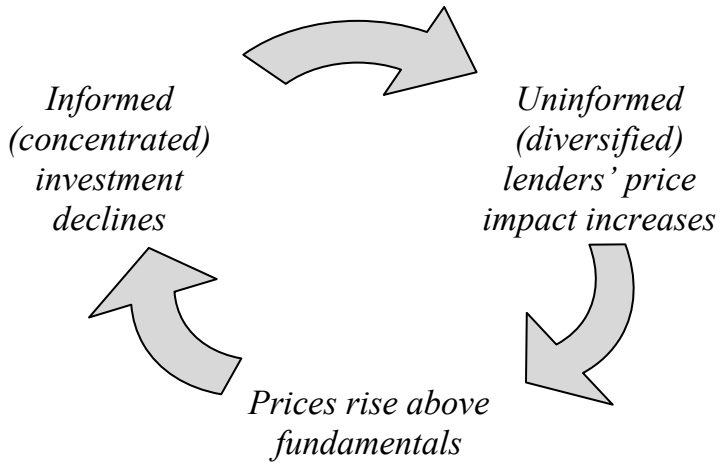
[5] As evidence, Brunnermeier and Nagel (2004), show that hedge fund managers profited by riding the internet bubble but were, on average, able to sell out at or near the peak of the market.

Real estate prices in the United States soared and then collapsed during the 2001 to 2008 period. Sufi and Mian (2008) and Demyanyk and Van Hemert (2008) provide evidence that the real estate 'bubble' originated from an excessive credit supply. We argue that the advent of diversified lending and the concurrent decline in informed lending allowed credit to expand beyond what was sustainable. In markets where lenders investing in information have sufficient market share, they will tend to constrict the supply of credit when prices become high relative to fundamentals, and vice versa when prices are low. Without such lenders, however, there is little to restrain credit supply; hence prices can move far above fundamentals. The absence of concentrated lending in local markets is strongly correlated with the magnitude of the price run-up. Consider Figure 4, where we scatter the average loan-market concentration of lenders (weighted by their share of originations) against housing price growth across 20 MSAs during the 1992 to 2006 period (Panel A), and during the 1992-2000 pre-bubble period (Panel B).[7] There is no correlation between prices and the importance of concentrated lenders across local markets in the first half of the data, but a significant negative overall. Panel C reports the same scatter for the second period alone. Our proxy for the share of uninformed lending explains *more than half* of the variance in the relative size of the 'bubble' across local markets.

Our results imply that the compositional shift toward diversified lending reduced information production. While we believe the decline in information helps explain the credit expansion, we do not estimate *how much* of the rise in housing prices can be tied to the decline of concentrated lending; we have no instrument to trace out the expansion in supply of

[7] These data are used to build the Case-Shiller housing price index.

uninformed lending. Instead, we motivate our tests by the cross-market correlation between the size of the bubble and the share of concentrated lenders (Figure 4), and the strong temporal link between the decline of concentrated lenders and the emergence of the bubble (Figure 1). Clearly the two trends reinforce each other:



The decline in informed investment is both a cause and a consequence of the 'bubble'. We are not suggesting that diversified lending is a bad thing. What we are suggesting is that *all* lending should not be done by diversified lenders, and that real estate finance in the United States got very close to this extreme in the recent past.

[9] Deregulation also unleashed competitive pressures on banks, leading to an expansion of credit supply, better lending, more firm creation and better economic performance (Jayaratne and Strahan, 1996; Black and Strahan, 2002; Cetorelli and Strahan, 2006).

II. THE GROWTH OF DIVERSIFIED LENDING

A. Regulation and Deregulation

Into the 1970s, most lending occurred through insured depository institutions, and these institutions faced a host of regulatory barriers to geographical expansion and diversification. State restrictions on expansion date back to colonial times, but explicit Federal legislation formalizing this authority to regulate in-state branching became law with adoption of the 1927 McFadden Act (Kroszner and Strahan 1999 and 2007). Although there was some deregulation of branching restrictions in the 1930s, about two-thirds of the states continued to enforce restrictions on in-state branching well into the 1970s. Only 12 states allowed unrestricted statewide branching in 1970, and another 16 states prohibited branching entirely. Between 1970 and 1994, 38 states eased their restrictions on branching. In addition to branching limitations, states also had the power to prohibit ownership of their banks by out-of-state holding companies. These barriers to diversification began to fall when Maine passed a 1978 law allowing entry by out-of-state BHCs if, in return, banks from Maine were allowed to enter those states. Other states followed suit, and state deregulation of interstate banking was nearly complete by 1992. The transition to full interstate banking was completed with passage of the Interstate Banking and Branching Efficiency Act of 1994 (IBBEA), which effectively permitted bank holding companies to enter other states without permission and to operate branches across state lines.

Removal of these statutory barriers to banking diversification led to quite dramatic consolidation of the industry (Berger, Demsetz and Strahan, 1999). Banks expanded outward, amoeba-like, first building regional, then super-regional and finally during the 1990s truly

nationwide franchises.[9] As a result, banks became better diversified (Demsetz and Strahan, 1997).

B. The Role of the GSEs

The move toward diversification, especially in mortgage lending, began even prior to deregulation due to the actions of the Government-Sponsored Enterprises (GSEs) - The Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac). Fannie Mae was created by the U.S. Congress in 1934 to promote access to mortgage credit for low and moderate-income household. During its first three decades, Fannie Mae was operated as a government agency that purchased mainly mortgages insured by the Federal Housing Authority (FHA). In 1968, Fannie Mae became a public corporation; its role in purchasing FHA mortgages (as well as mortgages insured by the Veteran's Administration) was taken over by a new government agency, the Government National Mortgage Association (GNMA). Freddie Mac was chartered by Congress in 1970 to provide stability and liquidity to the market for residential mortgages, focusing mainly on mortgages originated by savings institutions. Freddie Mac was privatized in 1986.

By the 1990s, both Fannie Mae and Freddie Mac were heavy buyers of mortgages from all types of lenders, with the aim of holding some of those loans and securitizing the rest. Together they have played the dominant role in fostering the development of the secondary market. As shown by Frame and White (2005), the GSEs combined market share has grown rapidly since the early 1980s. In 1990 about 25% of the $2.9 trillion in outstanding mortgages were either purchased and held or purchased and securitized by the two major GSEs. By 2003,

this market share had increased to 47%.[10] This market share fell after 2004 in the wake of the accounting scandals, and then increased significantly since 2006 in response to the credit crisis. GSE access to implicit government support allows them to borrow at rates below those available to private banks, and to offer credit guarantees on better terms than competitors without such implicit support.[11]

C. The Growth in Private Securitization

Starting in the early 1980s, private investment banks began to purchase and securitize jumbo loans, providing similar services for large mortgages that Fannie and Freddie provide for non-jumbos, although without the government subsidy. In the early deals, banks simply pooled mortgages and passed coupon and interest payments to investors. Over time, however, securitization increasingly offered clever ways to repackage cash flows with structures such as collateralized loan, mortgage and debt obligations (CDOs, CLOs, CMOs and, generically SIVs, or structured investment vehicles). These financing arrangements all start with a pool of loans whose credit quality can be evaluated using public information (e.g. current property values, FICO scores, loan-to-value ratios) by external rating agencies. Securitization involves selling the cash flows from the underlying pool to a separate legal entity known as a special purpose vehicle (SPV). The SPV purchases those cash flows from the proceeds of the sale of securities, such as

[10] GNMA provides a very important source of mortgage finance to low-income borrowers, holding or securitizing about 10% of all mortgages outstanding.

[11] Passmore, Sherlund and Burgess (2005) argue that most (but not all) of the benefits of GSE subsidies accrue to their shareholders rather than mortgage borrowers. To take advantage their low borrowing costs, during the 1990s the GSEs increasingly opted to hold, rather than securitize, many of the mortgages that they buy. Policymakers became concerned about the resulting expansion of interest rate risk at the GSEs (Greenspan, 2004), although the 2008 crisis resulted more from the credit guarantees offered by the agencies than from exposure to their retained mortgage portfolio.

bonds or commercial paper. The securities are sold to arm's-length investors like insurance companies and money market mutual funds, who rely on credit ratings to assess risk.[12] Rather than holding the asset on a balance sheet financing then with debt (e.g. deposits for banks or savings institutions), securitization transforms the asset itself from an illiquid one (pools of loans) into a liquid securities issued by the SPV (bonds and commercial paper). Securitization both lowers the total cost of financing a pool of loans (both by enhancing satisfying different clienteles and by enhancing liquidity), and offers a cheap mechanism to for lender diversification.

The growth of securitization has clear benefits for both lenders and borrowers. By enhancing the liquidity of mortgages and facilitating financial institution diversification, securitization expands their willingness to lend and, through competition, lowers borrowing costs. The downside of diversification, however, is that it weakens lenders' incentive to collect information by transforming the business model from originate and hold to originate and sell. The diversification of lending has grown due to several identifiable and plausibly exogenous shocks – examples include events like privatization of the GSEs and changes in state level regulations – but these events occurred prior to our sample period. The recent growth of securitization, especially securitization in the non-GSE segments (jumbos as well as non-conforming subprime and Alt-A non-jumbo mortgages), has permeated the market both gradually and endogenously over time, making it difficult to find a clean instrument for the

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[12] Cash flows are often restructured by prepayment or default so that the SPV can issue securities with different risk characteristics. This 'tranching' of cash flows allows the pool to satisfy different investor clienteles. For example, pension funds may purchase AAA rated super-senior tranches, while hedge funds may purchase lower rated, more junior tranches in return for higher yields. See Ashcraft and Schuermann (2008) for a detailed discussion of securitization of sub-prime mortgages.

expansion in the diversification strategy during our sample (1992-2006).[13] One strategy in a recent study exploits a quirk in market practice whereby mortgages to borrowers with a FICO credit score below 620 are difficult-to-impossible to securitize. Seru et al (2008) show a sharp discontinuity in defaults for mortgages around this cutoff, suggesting that lenders expecting to securitize a mortgage place much less weight on credit quality than on loans they expect to retain. Purnanandam (2008) exploits the 2007 liquidity pullback to show that banks intending to sell their originations faced larger losses than those intending to hold them when it became difficult to securitize mortgages.

III. EMPIRICAL METHODS, DATA & RESULTS

A. Data

We build our data sets from a comprehensive sample of mortgage applications and originations that have been collected by the Federal Reserve since 1992 under provisions of the Home Mortgage Disclosure Act (HMDA). The sample covers loan applications from 1992 to 2006. HMDA was passed into law by Congress in 1975 and expanded in 1988, with the purpose of informing the public (and the regulators) about whether or not financial institutions adequately serve local credit needs. In addition, regulators use the HMDA data to help identify discriminatory lending. These data are collected by the Federal Reserve under Regulation C, and all regulated financial institutions (e.g., commercial banks, savings institutions, credit unions, and mortgage companies) with assets above $30 million must report.

[13] Moreover, the growth in diversified lending facilitated by the regulatory shocks need not lead to instability. It is only when almost all lenders turn to the diversification strategy (originate-to-distribute) that one worries about prices

The HMDA data include information on the year of the application, the identity of the lender, the dollar amount of the loan, whether or not the loan was accepted, and whether or not the lender retained the loan or sold it to a third party. In addition, HMDA contains information on the location of the property, as well as some information on borrower credit risk such as income and loan size. However, HMDA contains no information on the property value or the borrower's credit score. We use the information on lender and property location to compute two measures of lender diversification. Both measure the extent to which a lender specializes within a single local market, defined at the Metropolitan Statistical Area (MSA) level. Our first measure equals the sum of squared shares of loans made by each lender in each of the MSAs in which it operates, where the shares are based on the number of accepted loan applications; the second measure is similar, although the shares are based on accepted loan volumes. Both measures vary from near 0 (for lenders operating across many MSAs) to 1 (for lenders operating in just one MSA).[14]

Using lender identity, we then collect bank-level data by merging the HMDA loan application data with the *Reports of Income and Condition* for commercial banks (the "Call Report"). We merge each application to the Call Report from the fourth quarter of the year prior to the mortgage application using the HMDA bank identification number with the Call Report identification number (RSSD ID) for banks reporting to the Federal Reserve (FR), with the Federal Deposit Insurance Corporation (FDIC) certificate ID (item RSSD9050 in the Call Report) for banks reporting to the FDIC, and with the Office of the Comptroller of the Currency

losing their link to fundamentals.

(OCC) ID (item RSSD9055 in the Call Report) for banks reporting to the OCC. The unmatched institutions from the HMDA data set are then matched manually using a bank's name and the zip code of its location. Our bank control variables include the following: size (log of assets), leverage (the capital-asset ratio), balance-sheet liquidity (investment and traded securities to assets), share of deposit finance (deposits / assets), an indicator for banks owned by holding companies, the costs of deposits (interest expenses on deposits to total deposits), letters of credit / assets, unused loan commitments / assets, and two loan-share variables (real estate loans / assets and commercial and industrial loans / assets).

Table 1 reports summary statistics for the bank characteristics and mortgage acceptance and retention behavior. We report the 25th, median and 75th percentiles of the distributions for all bank-years, and also for concentrated and diversified banks. For the latter statistics, we define concentrated lenders as those with at least 75% of all mortgages in one MSA.

The summary statistics show that the diversified lenders tend to be considerably larger than concentrated lenders. Their median total assets are $187 million, compared to just $42 million for the concentrated lenders. This size difference is important to consider carefully in our regressions because large and small banks differ across many dimensions. For example, large banks tend to hold less capital and lend more per dollar of assets. But, as we will see, differences between concentrated and diversified lenders are not based on size. Differences in the mortgage acceptance rates and retention rates appear small at the median, but there are much

[14] We have also estimated our regressions using a dummy variable measure for concentrated banks equal to one for those banks with 75% of their business in a single MSA (as in the Figures). All of the regression results are robust to using the indicator variable rather than the continuous measure of loan-market concentration.

larger differences in the lower part of the distribution. (Note that in our regressions we use the continuous variation in the diversification index.)

In our regressions of acceptance and retention rates, we also condition on borrower credit risk, including controls for the log of the applicant's income, the income-to-loan size ratio and the ratio of borrower income to the median income in the census tract of the property. There is no information on borrower assets, indebtedness, or the market value of the property in the HMDA data. Nevertheless, we can control for economic conditions with an indicator for properties located within Metropolitan Statistical Areas (MSAs) and with the median income in a property's Census Tract. We include indicators for minority and female applicants, as well as the share of the population that is minority in the property's Census Tract. Last, we include both time and state fixed effects.

The raw HMDA data contain more than 350 million applications. When we match the data to the Call Report, we drop mortgages originated by savings institutions, mortgage bankers, credit unions, and other non-bank lenders, leaving about 165 million applications to financial institutions reporting to the FDIC, FR, and OCC (mostly commercial banks). We also drop applications with missing characteristics such as loan size, property location, or the bank's approval decision on the loan. After applying these filters, we are left with about 152 million mortgage applications.

B. Concentrated Lenders Invest in Private Information

If the concentrated lenders invest more in private information, they should be able to condition their application acceptance decision on a broader set of information and hence accept

more applications. In addition, information-intensive loans should be less liquid, suggesting that concentrated lenders will retain a higher share of their originations. Conversely, diversified lenders ought to lend more intensively in the non-jumbo market segment where GSEs subsidize loans based on public information. To test these ideas, we compare the market presence of diversified and concentrated lenders in the jumbo and non-jumbo segments of the mortgage market, and then compare how acceptance a rates and retention rates vary by lender type across the two segments.

For the analysis of market presence, we report panel regression results with the following structure:

$$(Non\text{-}Jumbo - Jumbo\ Originations)_{i,t} / Assets_{i,t-1} = \alpha_1 Con_{i,t}$$

$$+ Borrower\ Controls_{i,t} + Bank\ \&\ Market\ Controls_{i,t} + \varepsilon^{NJ}_{i,t} \quad (1)$$

If concentrated lenders have a comparative advantage in private information lending, then they ought to lend more in the jumbo segment ($\alpha_1 < 0$). Data vary at the bank-year level, with the dependent variable equal to the total dollar value of accepted mortgages in the non-jumbo minus jumbo market for bank *i* in year *t*. We estimate two baseline specifications for (1), one for each of our two measures of mortgage concentration ($Con_{i,t}$). We also report each of these models during the first and second halves (1992 to 2000 and 2001 to 2006) of our sample. These robustness tests allow us to see whether the onset of the housing price run-up altered the behavior of the two different types of lenders.

We then evaluate the retention and acceptance rates using the following structure:

$$Acceptance\ Rate_{i,j,t} = \gamma_1 Con_{i,j,t} + \gamma_2 Jumbo_{i,,j,t} + \gamma_3 Con_{i,j,} Jumbo_{i,j,t}$$

$$+ Borrower\ Controls_{i,j,t} + Bank\ \&\ Market\ Controls_{i,t} + \varepsilon^{A}_{i,j,t} \quad (2a)$$

and

$$Retention\ Rate_{i,j,t} = \beta_1 Con_{i,j,t} + \beta_2 Jumbo_{i,j,t} + \beta_3 Con_{i,j,} Jumbo_{i,j,t}$$

$$+ Borrower\ Controls_{i,j,t} + Bank\ \&\ Market\ Controls_{i,t} + \varepsilon^{R}_{i,j,t}, \quad (2b)$$

where in (2a) the dependent variable ($Acceptance\ Rate_{i,j,t}$) equals the fraction of mortgage applications that were approved in market segment j to bank i in year t. In (2a) and (2b), we compute separately the acceptance rates for the non-jumbo and the jumbo segments, so there are two observations per bank-year.[15] In (2b), the dependent variable ($Retention\ Rate_{i,j,t}$) equals the share of accepted mortgages retained in segment j by bank i in year t. By computing retention and acceptance rates separately for the two segments, we can exploit the exogenous drop in mortgage liquidity around the jumbo-loan cutoff. As is quite obvious from Figure 4, non-jumbo mortgages are both more likely to be approved and less likely to be retained (more likely to be sold or securitized). Moreover, our earlier research suggests that mortgage *supply* declines discretely around the jumbo-loan cutoff (e.g. rates rise at the cut-off), and this drop in supply is greatest for banks with low levels of liquid assets and high costs of deposit finance (Loutskina and Strahan, 2008).

For equations (2a) and (2b), we start with two baseline specifications in which we include the measure of mortgage concentration, the jumbo market indicator, and the borrower, bank and market control variables without any interaction effects. In this simple set up, we can assess the

average difference between the concentrated and diversified lenders. If concentrated lenders invest in private information, they ought to have both higher acceptance and retention rates than diversified lenders, so $\gamma_1 > 0$ & $\beta_1 > 0$. We then add the jumbo indicator interacted with the measure of concentration to test how the GSE subsidy affects the two types of lenders. Because the GSEs enhance liquidity in the non-jumbo market, we expect higher acceptance and lower retention rates there, so $\gamma_2 < 0$ & $\beta_2 > 0$. But GSE willingness to purchase mortgages depends strictly on *public* signals. Thus, if concentrated lenders focus on *private* information to make loans, removing the GSE subsidy should have little effect on their lending decisions (at least relative to the diversified lenders); hence $\gamma_3 > 0$ & $\beta_3 < 0$.

For both sets of regressions, we include the following average characteristics of the loan applicant pool: the ratio of the loan size to applicant income; the log of applicant income; the share of properties located in MSAs; the percent minority in the population around the property; the median income in the area around the property; and shares of female and minority loan applicants. We construct these characteristics by averaging across all of the loans to a given bank in a given year. We also include all of the lender characteristics summarized in Table 1, and all of the regressions include both year and state fixed effects. Because there may be additional unobserved bank effects or some autocorrelation in the residual, we cluster the error in the model by bank in constructing standard errors.

Tables 2-4 report the results. We find first that concentrated lenders invest more than diversified lenders in the jumbo market segment, where GSEs do not subsidize mortgage liquidity. The effects are large economically as well as statistically, and the coefficient is almost

[15] There is a third market segment of loans subsidized by the Veterans Administration and the Federal Housing

the same across the two concentration measures.[16] If we compare the extremes – moving loan-market concentration from its minimum of zero to its maximum of one, the model suggests an increase in lending to the jumbo segment of about 4% of assets (Table 2). If concentration increases from the 25th to the 75th percentile (0.55 to 1), lending in the jumbo market rises by almost 2% of assets.[17] Either way the effect is very large. The split sample results (1992 to 2000 and 2001 to 2006) shows that these effects are stable over time (columns 3-6).

Before we continue, we should emphasize that the coefficients in Table 2 are not driven by the size of the lender. First, large banks are more likely to lend in the jumbo market because they are more capable of funding big loans. Moreover, our measure of concentration is *negatively* correlated with bank size ($\rho = -0.49$). Thus, if anything the effect of concentration is likely to be biased toward zero by inadequate controls for size. In fact, if we drop the size control the effect of concentration falls to -0.01 ($t = 1.57$). To rule out a size-related bias statistically, we have included size (log of assets), size squared and size cubed; the effect of concentration changes little in these robustness tests (not reported).[18]

Loan retention rates and acceptance rates are also both significantly higher for concentrated lenders (Tables 3 and 4). The direct effect of concentration on loan acceptance suggests that a move from the 25th to 75th percentile comes with an increase of 1.6 percentage points in the acceptance rate (Table 3, column 1). The effect of concentration on the retention

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Authority which we drop from these regressions.

[16] All of our subsequent results are very similar comparing the value-weighted v. equally-weighted concentration indices, so we report the remainder of the models using just the equally-weighted index.

[17] This difference comes from the 2006 distribution. The variance is lower in the early years because most lenders were concentrated then.

[18] Although we will not belabor this point below, the same holds for the all of the subsequent tests in the paper.

rate is even larger, about 5.3 percentage points (Table 4, column 1). Comparing the non-jumbo and jumbo segments, both models also suggest more liquidity (lower retention rates) and higher acceptance rates in the non-jumbo segment. However, this effect is much larger for diversified lenders, particularly the effect on retention rates. For fully diversified lenders (HHI = 0), the acceptance rate is about 1.6 percentage points higher in the non-jumbo segment; by contrast, the acceptance rate is not statistically significantly different across the two segments for lenders specializing on one market (HHI = 1). For retention rates, diversified lenders (HHI=0) experience a 17 percentage point higher retention rate for jumbos, while concentrated lenders only experience an increase of 8 percentage points (HHI=1). The jumbo/non-jumbo distinction matters much less for specialized lenders who condition on private information because the GSE subsidy affects only mortgages that are viable conditional on just public signals.

So, concentrated lenders focus on mortgages where private information is more important. With investments in information, liquidity is reduced because potential loan buyers face adverse selection. Lower liquidity (and thus less diversification) is the cost faced by concentrated lenders. Information also reduces the value of liquidity to the originator, however, because they can make better credit allocation decisions, which is the key benefit to these lenders. Given this tradeoff, we should see better performance of concentrated lenders relative to diversified lenders. Just as investors in securities markets are paid for investments in costly information (alpha>0), we expect concentrated lenders to be paid for their investments. We turn to this in the next section.

C. Concentrated Lenders Outperform Diversified Lenders

We have shown that concentrated banks behave in a more 'traditional' manner than diversified by holding more of their mortgages. Perhaps these banks are less sophisticated than the diversified lenders; maybe they have just missed out on the advent of a new financial technology. If so, they ought to perform relatively poorly. In contrast, if concentrated lenders invest in private information as we posit, then they ought to perform better as compensation for their lack of diversification. So, we now test how loan concentration affects performance.

We again estimate panel regressions, although we measure the data by bank-quarter rather than bank-year (as in equation (1) above). We consider three accounting measures, the return on equity (*ROE* = quarterly net income / equity), the return on assets (*ROA* = quarterly net income / assets) and non-performing loans (*NPL* = [loans 90+ days past due plus non-accruals] / total loans). The two profit variables include all aspects of performance, both on and off the balance sheet. Net income accounts for all interest and fees generated from lending activities, as well as loan loss provisions on those loans. Non-performing loans is more focused on loan performance, but misses key aspects of the mortgage lending business like fees generated to service loan sold to third parties. Fees are particularly relevant for heavy mortgage originators that sell or securitize most of their mortgages but service those loans (e.g. lenders like Washington Mutual, one of the biggest diversified lenders in the United States). While servicing fees do not have direct credit exposure, they fall with defaults and thus deprive the bank of the present value of future service flows.

As before, our key variables of interest are the two measures of lending concentration. If concentrated lenders invest in information, they ought to earn higher profits as compensation for

that investment. In addition, we test whether concentrated lenders are less sensitive to overall conditions in the real estate market by interacting concentration with the growth rate in the aggregate Case-Shiller (CS) Index of housing prices, as follows:

$$ROE_{i,t} = \gamma^{ROE}{}_1 Con_{i,t} + \gamma^{ROE}{}_2 Con_{i,t} \, x \, CS\ Index\ Growth_{i,t} + Bank\ Controls_{i,t} + \varepsilon^{ROE}{}_{i,t} \quad (3a)$$

$$ROA_{i,t} = \gamma^{ROA}{}_1 Con_{i,t} + \gamma^{ROA}{}_2 Con_{i,t} \, x \, CS\ Index\ Growth_{i,t} + Bank\ Controls_{i,t} + \varepsilon^{ROA}{}_{i,t} \quad (3b)$$

$$NPL_{i,t} = \gamma^{NPL}{}_1 Con_{i,t} + \gamma^{NPL}{}_2 Con_{i,t} \, x \, CS\ Index\ Growth_{i,t} + Bank\ Controls_{i,t} + \varepsilon^{NPL}{}_{i,t} \quad (3c)$$

These regressions have the same basic structure as equation (1) above, but we estimate the model at the bank-quarter rather than bank-year level. With the higher frequency, we exploit more of the variation from the monthly CS index. Note that we include a full set of time and state fixed effects; the time effects absorb the direct impact of the CS index on performance. The interaction term tests whether concentrated lenders' relative profit rate is more or less correlated with overall market conditions than diversified lenders' profits. Since we argue that concentrated lenders invest in local information, we expect their performance to be less systematic than diversified lenders (just as hedge funds tend to have low betas because they specialize in specific market segments). We include the same set of bank-level controls as in equation (1), we cluster at the bank level for standard errors (which addresses potential serial correlation in accounting data), and we report the models over the full sample (1992-2006) as well as over the same two sub-samples (1992-2000 and 2001-2006).

We report these regressions for all banks, and in robustness tests we also use a sub-sample of banks with heavy exposure to mortgage lending. This sub-sample defines 'heavy' using mortgage originations / assets (from the HMDA data) rather than mortgages held on

balance sheet. This assures us that we keep all heavy mortgage lenders, even those that sell off most of their originations. In this sample, we include only those bank-quarters where mortgage originations / assets in the top half of the distribution.

Table 5 reports these results. To streamline the table, we only report the coefficients for the concentration indices and the interaction term with the CS index. The average effects of concentration on *ROA*, *ROE* and *NPL* are statistically and economically important across all of the models. For the full sample, for example, the coefficient suggests moving from fully diversified (HHI = 0) to fully concentrated (HHI = 1) would raise ROA by about 0.3 percentage points and ROE by about 3 percentage points, both on an annualized basis. These effects are very large relative to the average bank ROA of about 1% per year (or the average ROE of about 10%). If we more conservatively consider a move from the 25th to the 75th percentile, the change in ROA falls to 0.135 percentage points (1.35 percentage points for ROE). The split sample results (Panels B & C) show that the higher profitability of the concentrated lenders is robust across time, with slightly larger effects for profits in the second half of the sample. The models with interaction effects show that accounting profits and losses are also less correlated with overall conditions in the real estate market for concentrated lenders than for diversified lenders. This makes sense because diversified lenders take applications across many markets and they also sell off many of their originations and use the proceeds to buy mortgage-backed securities, giving them very broad exposure to the overall market.

Panel D of Table 5 separates out the heavy mortgages originators. These results are similar qualitatively to the overall results, although the direct effect of our measure of concentrations on profits is about 1/3 larger than the overall effects. In this sample, the

concentrated lenders' (top 25th percentile) ROE exceeds that of the diversified lenders' (bottom 25th percentile) by about 1.7 percentage points. While one might expect a greater impact on our results, it seems likely that banks that specialize in mortgage lending may pursue a similar strategy across their other business lines.

As a final performance test, we estimate a regression of cumulative stock returns from August of 2007 to the end of March 2008 across banks, against the same set of bank control variables. These are the months during which widespread recognition of the end of the housing bubble affected market expectations.[19] On average, bank stocks fell by 15% over this period, much more than the overall market (the S&P 500 fell by about 8.5%). Since stock prices are forward looking, they provide a powerful test of how bank characteristics correlate with their performance response to the end of the housing bubble. While we can only include about 300 banking companies in these regressions (most banks do not have publicly traded stock), given the long lags in accounting data we think focusing on stocks offers a more powerful way to assess the real estate crash, at least based on market expectations. Our key variable of interest is our mortgage concentration index, which we argue should limit a bank's exposure to the crash.

Table 6 reports the results. As expected, banks with high exposure to real estate loans had lower returns over this period, as did banks with high levels of unused loan commitments. The latter effect was seen in the fall of 2007 when some large lenders such as HSBC and Citigroup had to re-finance off-balance sheet vehicles (SIVs) that could not roll over their

[19] Brunnermeier (2008) presents a complete chronicle of the 2007-08 credit and liquidity crises, culminating with the failure of Bear Stearns in March of 2008.

[21] We have tested whether the identity of loan buyers (as opposed to who is selling) affects price predictability but find no evidence that it does. For example, the share of loan originations that are sold to the GSEs adds no explanatory power, nor does its inclusion alter the effect on the overall retention rate by concentrated lenders.

commercial paper in the wake of the credit crunch. Most important for us, banks with information – concentrated mortgage lenders – suffered much less in response to the credit shock (at least in expectation) than other banks. According to our regressions, moving the loan concentration from the 25th to the 75th percentile is associated with an increase in the stock returns of about 6%, which is nearly half of the average drop in prices.

D. Concentrated Lenders Can Forecast Future Price Changes

In our last set of models we test for direct evidence of private information in concentrated lending. If these lenders understand where prices are heading, they ought to retain more mortgage originations before price increases, and sell more before prices decreases. In contrast, uninformed lenders should have no ability to forecast future prices, so diversified lender retention decisions should not predict prices. So, we run a market-timing test based on bank retention rates. Acceptance rates of informed lenders may also anticipate future price changes, although interpreting any correlation would be confounded because both credit supply and demand conditions could alter lender acceptance decisions. Hence, we include acceptance rates to absorb these confounding effects, but focus our attention on the correlation of retention rates and future price changes.

To test this notion, we use the Case-Shiller index of housing price changes across 20 MSA markets to measure house price changes, and estimate the following regressions:

$$CS\ Index\ Growth_{i,t+1} = \alpha_t + \delta_A{}^C Acceptance^C{}_{i,t} + \delta_R{}^C Retention^C{}_{i,t} \quad (4)$$
$$+ \delta_A{}^D Acceptance^D{}_{i,t} + \delta_R{}^D Retention^D{}_{i,t} + Market\ Controls_{i,t} + \eta_{i,t},$$

where the house-price growth rate equals the percentage change in the Case-Shiller index for MSA *i* in during year *t+1*. Since we have moved from bank-year to MSA-year as the unit of analysis, we control for the overall acceptance and retention rate for all concentrated lenders in MSA *i* and year *t*, and the same for all diversified lenders in the local market. For this test, a lender is concentrated if 75% of its mortgage acceptances are in one MSA.

Beyond the lender behavioral variables, we include variables describing the pool of borrowers in the local market, including the number of loan applications, the share of minority and female applications, the median income, and the average ratio of applicant income to area income.[21] We also take out the aggregate trends with time fixed effects.[22]

We estimate (4) for the whole sample, and then separate the sample in 2000 to test whether price predictability changed during the 'bubble' years. Table 7 reports these results, with models that include just the retention rate and acceptance rate of concentrated lenders, and then models with the same variables for the diversified lenders. We find a consistent positive correlation between concentrated lender retention rates and future price appreciation. When concentrated lenders hold more of their mortgage originations, future local house price tend to rise. In contrast, there is no correlation between the retention rate of the diversified lenders and future price changes.

In the last two columns of Table 7, we split the sample and find that all of the predictive power in concentrated banks' retention rate comes from the first half of the sample. This may be due to the diminishing role of the informed lenders in the market after 2001. As we saw in the

[22] We have also estimated the model with MSA fixed effects. In this model the coefficient on concentrated lenders remains statistically significant during the first half of the sample, but falls in magnitude. This approach is

introduction, the magnitude of the real estate run-up in these years was much greater in markets that began the period with a very low level of concentrated lending. If prices become unhinged from fundamentals, as they were after 2001, this may eliminate the value of information to concentrated lenders. Perhaps some concentrated lenders 'rode' the price wave, as suggested by Abreu and Brunnermeier (2002) and Brunnermeier and Nagel (2004).

IV. Conclusion

We have shown that concentrated mortgage lenders act like informed investors. They condition their lending decisions on private information, which raises acceptance rates but lowers loan liquidity and makes diversification harder to attain. As compensation, these lenders earn higher returns on their investments. The market share of these informed lenders fell dramatically over the past 15 years, to nearly zero by 2006. We argue that their presence became too small; real estate finance became dominated to an unsustainable degree by investors without information. Absence of incentives to invest in information is the downside of diversification. Just as 'noise' traders can destabilize prices in securities markets, the decline of informed lenders in mortgage markets set the stage for the real estate bubble and crash between 2001 and 2008.

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somewhat questionable, however, because the fixed effect is removed by demeaning the variables using all of the data, both past and future. Hence it is not appropriate as a forecasting regression.

References

Abreu D. and M. K. Brunnermeier, 2002, "Synchronization risk and delayed arbitrage," *Journal of Financial Economics* 66(2-3), 341-60.

Ashcraft, A. B. and T. Schuermann, 2008, "Understanding the securitization of sub-prime mortgage credit," mimeo, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1071189&rec=1&srcabs=1093137.

Berger, A. N., R. S. Demsetz, and P. E. Strahan, 1999, "The consolidation of the financial services industry: Cause, consequences and implications for the future," *Journal of Banking and Finance* 23, 135-94.

Black, S. E. and P. E. Strahan, 2002, "Entrepreneurship and bank credit availability," *Journal of Finance* 57(6), 2807-33.

Brunnermeier, M. K., 2008, "Deciphering the 2007-08 liquidity and credit crisis," forthcoming at the *Journal of Economic Perspectives*.

Brunnermeier M. K. and S. Nagel, 2004, "Hedge funds and the technology bubble," *Journal of Finance* 59(5), 2013-40.

Cetorelli, N., and P. E. Strahan, 2006, "Finance as a barrier to entry: Bank competition and industry structure in U.S. local markets," *Journal of Finance* 61(1), 437-61.

Chen Y. and B. Liang, 2007, "Do market timing hedge funds time the market?" *Journal of Financial and Quantitative Analysis* 42(4), 827-56.

DeLong, J. B., A. Shleifer, L. H. Summers, and R. J. Waldmann, 1990, "Noise trader risk in financial markets," *Journal of Political Economy* 98, 703-738.

Demyanyk, Y. and O. Van Hemert, 2008, "Understanding the subprime mortgage crisis," mimeo, http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=1020396.

Demsetz, R. S., and P. E. Strahan, 1997, "Diversification, size, and risk at bank holding companies," *Journal of Money, Credit, and Banking* 29, 300-313.

Frame, W. S. and L. J. White, 2005, "Fussing and fuming about Fannie and Freddie: How much smoke, how much fire?" *Journal of Economic Perspectives*, Spring 2005.

Genotte G. and H. E. Leland, 1990, "Market liquidity, hedging and crashes," *American Economic Review* 80(5), 999-1021.

Greenspan, A., 2004, Testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, February 24, 2004.

Grossman S. J. and J. E. Stiglitz, 1981, "On the impossibility of informationally efficient markets," *American Economic Review* 70(3), 393-408

Jayaratne, J., and P. E. Strahan, 1996, "The finance-growth nexus: Evidence from bank branch deregulation," *Quarterly Journal of Economics* 101, 639-70.

Keys, B. J., Mukerjee, T. K., Seru, A. and V. Vig, 2008, "Did securitization lead to lax screening? Evidence from sub-prime loans," mimeo, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1093137.

Kindleberger, C. P., 2000, *Manias, Panics and Crashes: A History of Financial Crises*, MacMillan, London, 5th edition.

Kroszner, R. S. and P. E. Strahan, 1999, "What drives deregulation? Economics and politics of the relaxation of bank branching restrictions," *Quarterly Journal of Economics* 114(4), 1437-67.

Kroszner, R. S. and P. E. Strahan, 2007, "Regulation and deregulation of the U.S. banking industry: Causes, consequences and implications for the future," forthcoming in *Economic Regulation and its Reform: What Have We Learned?* Edited by Nancy Rose, NBER.

Leroy S. F. and R. D. Porter, 1981, "The present value relation: Tests based on implied variance bounds," *Econometrica* 69(4), 831-59.

Loutskina, E., 2005, "Does securitization affect bank lending? Evidence from bank responses to funding shocks," mimeo, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=677001.

Loutskina, E., and P. E. Strahan, 2008, "Securitization and the declining impact of bank financial condition on loan supply: Evidence from mortgage originations," forthcoming, *Journal of Finance*.

Mian A. and A. Sufi, 2008, "The consequences of mortgage credit expansion: Evidence from the 2007 mortgage crisis," mimeo, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1072304.

Passmore, W., S. M. Sherlund, and G. Burgess, 2005, "The effect of housing Government-Sponsored Enterprises on mortgage rates," *Real Estate Economics* 33(3), 427-63.

Pontiff, J., 1996, Costly arbitrage: Evidence from closed-end funds, *Quarterly Journal of Economics*, 111 (4), 1135-51.

Purnanandam, A., 2008, "Originate-to-Distribute Model and the Sub-Prime Mortgage Crisis," http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1167786.

Shiller, R. J., 1981, "Do stock prices move too much to be justified by subsequent dividend changes?" *American Economic Review* 71(3), 421-36.

Shiller R. J., 2001, *Irrational Exuberance*, Princeton University Press.

Shleifer, A., and R. Vishny, 1997, "The limits of arbitrage", *Journal of Finance* 52:35-55.

Figure 1: Trends in House Price and Market Share of Concentrated Lenders

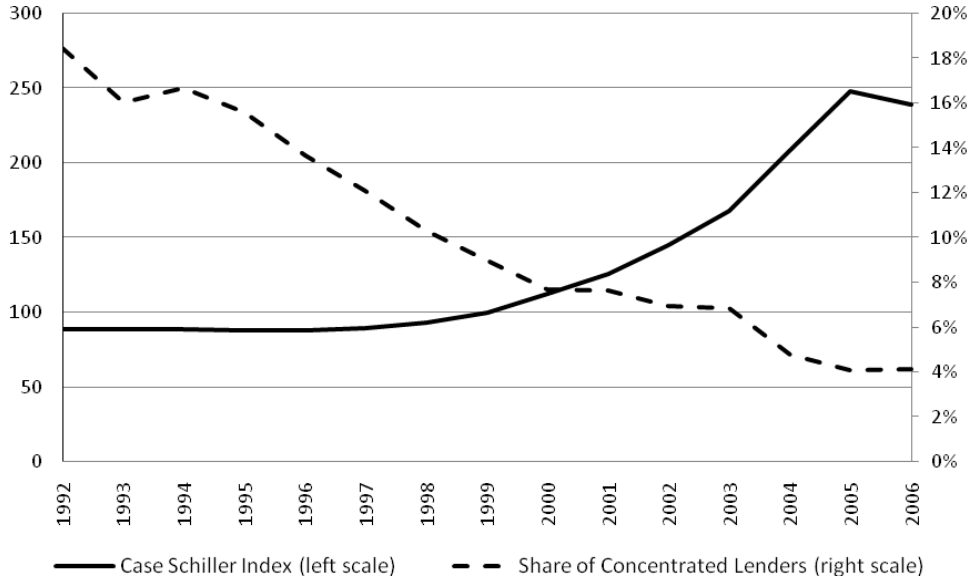

Figure 2: Mortgage Retention Rates over Time

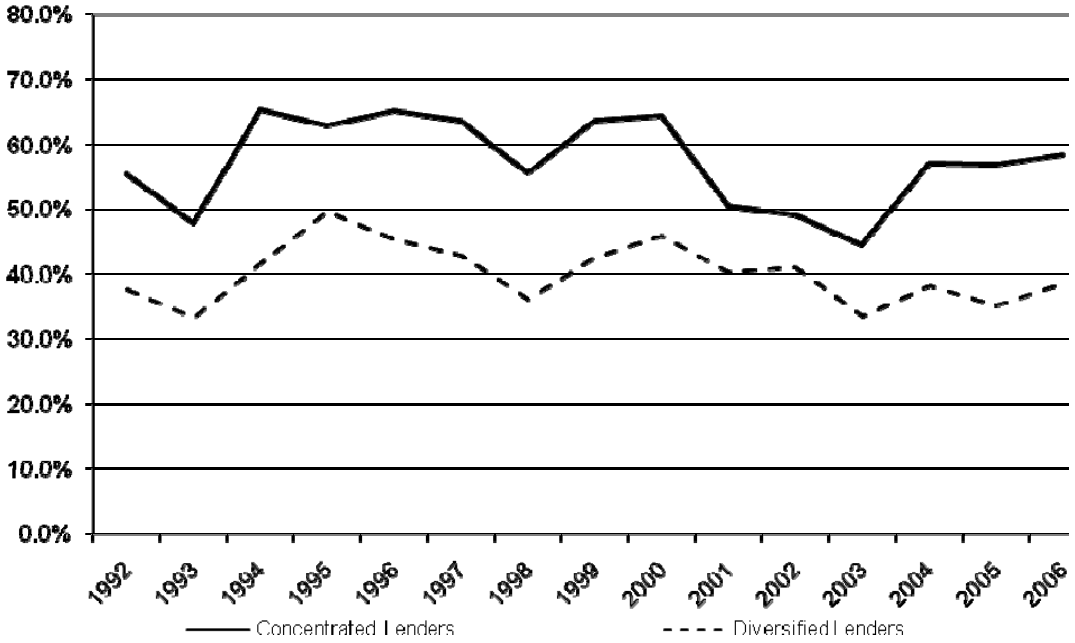

Figure 3A: Probability of Acceptance by Mortgage Size

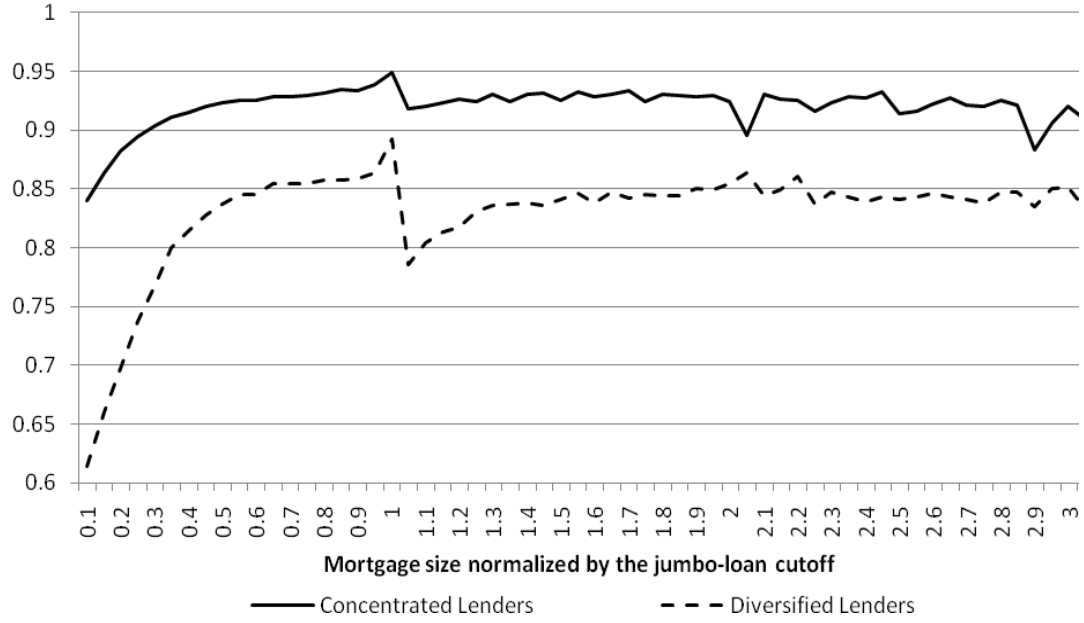

Figure 3b: Share of Mortgages Sold, by Size

Figure 4A: House Price Increases and Lender Concentration

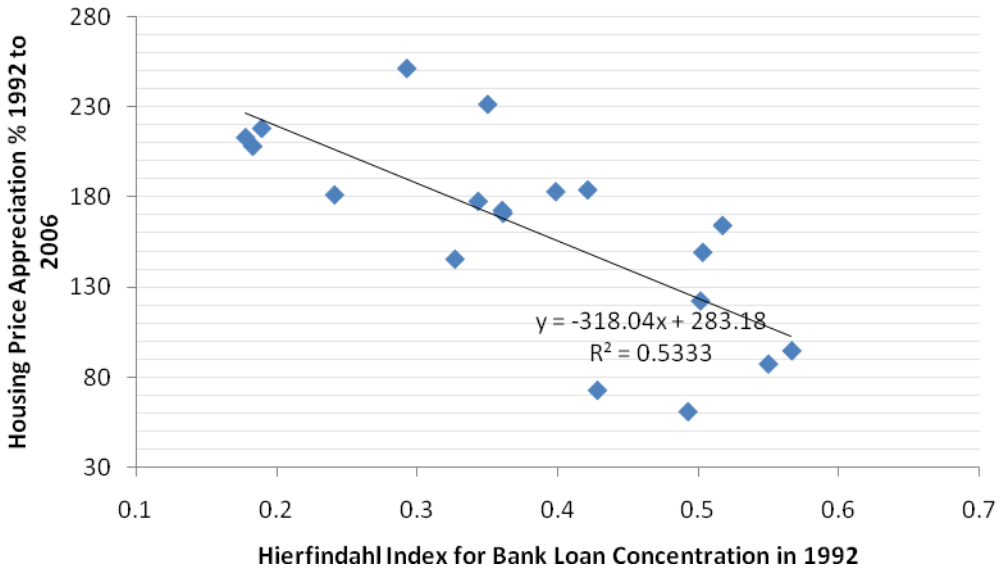

Figure 4B: House Price Increases and Lender Concentration

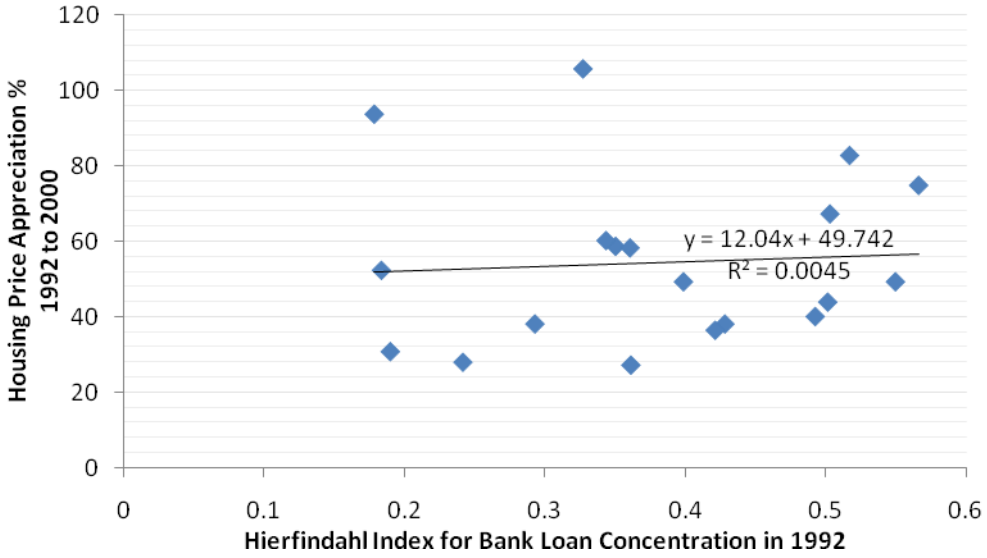

Figure 4C: House Price Increases and Lender Concentration

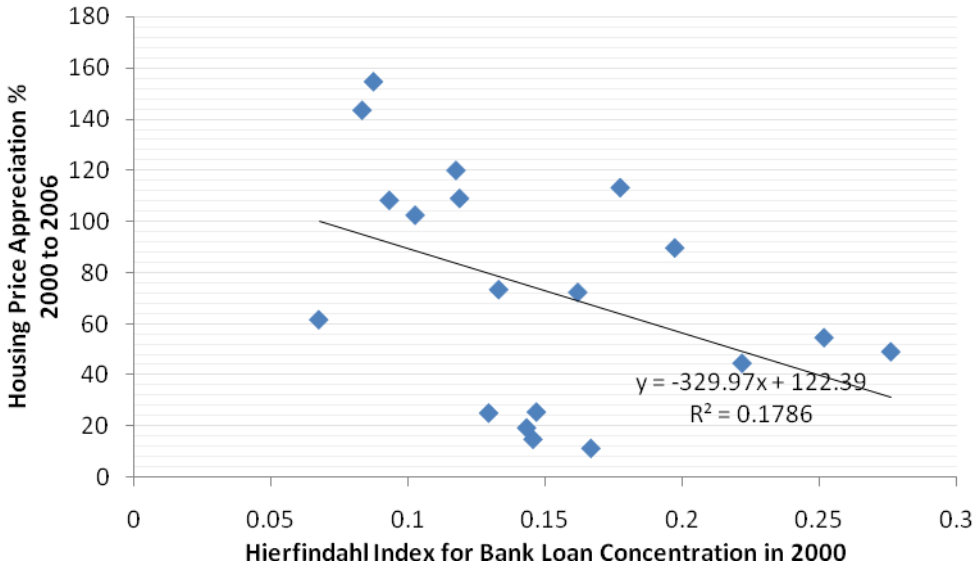

Table 1: Summary Statistics for Bank Characteristics

This table reports information on the distribution of characteristics for banks that we matched to the mortgage application data. Liquid assets equals cash plus marketable securities. The cost of deposits equals interest expense on deposits to total deposits.

	Panel A: All Banks			*Panel B: Concentrated Banks*			*Panel C: Diversified Banks*		
	25th Percentile	**Median**	**75th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**25th Percentile**	**Median**	**75th Percentile**
Total Assets (millions of $s)	23.5	47.1	105.0	21.7	42.2	86.4	78.7	187.1	520.0
Financial Struture & Liquidity (%)									
Liquid Assets / Assets	19.1	28.8	40.1	19.9	29.7	41.0	13.7	21.8	31.6
Cost of Deposits	2.2	3.2	4.0	2.3	3.3	4.1	1.6	2.6	3.4
Capital / Assets	7.8	9.2	11.3	7.8	9.2	11.4	7.7	8.8	10.4
Loan Shares (% of assets)									
Total Loans	50.1	61.2	70.5	49.2	60.3	69.7	58.3	67.9	75.8
Commercial & Industrial Loans	7.3	18.6	33.1	8.9	19.8	34.6	0.1	6.8	19.4
Home Mortgages	15.6	26.4	39.5	15.5	26.3	39.1	16.8	27.8	43.4
Commercial Mortgages	6.9	14.4	24.4	6.4	13.6	23.3	13.6	22.2	31.7
Consumer Loans	5.4	10.6	18.4	6.0	11.2	18.9	2.1	5.6	12.4
Profit (%)									
Net Income / Assets	0.6	1.0	1.3	0.6	1.0	1.3	0.6	1.0	1.3
Herfindahl Index									
Equal weighted	0.722	0.986	1.000	0.944	1.000	1.000	0.292	0.522	0.630
Value weighted	0.714	0.991	1.000	0.950	1.000	1.000	0.292	0.521	0.645
Mortgage application									
Number of loan applications	40	122	390	37	102	272	54	251	1238
Number of loans issued	34	106	346	32	88	244	46	216	1042
Number of loans securitized	0	0	62	0	0	30	0	6	276
Probability of Acceptance (%)	83%	91%	96%	84%	91%	96%	82%	91%	96%
Share of loans retained (%)	63%	100%	100%	72%	100%	100%	46%	96%	100%

Table 2

Regression of Loan Volumes for Nonjumbo
Mortgages Relative to Jumbos on Loan Concentration

This table reports regressions of the volume of approved non-jumbo minus jumbos mortgages, divided by beginning-of-period assets. The unit of observation is the bank-year, from 1992 to 2006. The regressions include the following controls for the loan pool characteristics in each bank-year: the share of loans made to borrowers in MSAs; percent minority applicants in the bank's lending markets; mean loan-to-income ratio; log of mean applicant income; average median income in bank's lending markets; the share of minority applicants; and the share of female applicants. All regressions also include year and state fixed effects. T-statistics are in parentheses, based on errors clustered at the bank level. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: (Volume of Approved Nonjumbos - Volume of Jumbos)/Assets$_{t-1}$					
	Full Sample		Prior to 2001		Post 2001	
	(1)	(2)	(3)	(4)	(5)	(6)
Loan concentration (number)	-0.039	-	-0.042	-	-0.035	-
	(6.31)***	-	(6.72)***	-	(3.51)***	-
Loan concentration ($ volume)	-	-0.034	-	-0.039	-	-0.028
	-	(5.71)***	-	(6.38)***	-	(2.98)***
Securities / assets	-0.06	-0.062	-0.077	-0.079	-0.051	-0.054
	(5.04)***	(5.17)***	(6.07)***	(6.16)***	(2.94)***	(3.08)***
Interest on deposits / deposits	0.097	0.092	0.082	0.085	0.122	0.114
	(2.70)***	(2.66)***	(2.64)***	(2.67)***	(2.32)***	(2.29)***
Log of assets	-0.013	-0.013	-0.015	-0.015	-0.009	-0.009
	(11.18)***	(10.91)***	(12.68)***	(12.55)***	(4.72)***	(4.43)***
Indicator if owned by BHC	-0.01	-0.01	-0.003	-0.003	-0.023	-0.023
	(3.56)***	(3.56)***	(0.90)	(0.90)	(4.84)***	(4.84)***
Capital / assets	-0.082	-0.08	-0.063	-0.062	-0.117	-0.115
	(2.13)**	(2.10)**	(1.50)	(1.48)	(1.87)*	(1.85)*
Deposits / assets	-0.095	-0.095	-0.109	-0.11	-0.08	-0.081
	(5.70)***	(5.72)***	(5.74)***	(5.75)***	(3.29)***	(3.31)***
Net income / assets	-0.092	-0.106	-0.197	-0.206	-0.012	-0.037
	(0.68)	(0.79)	(1.41)	(1.47)	(0.05)	(0.15)
Real estate loans / assets	0.106	0.105	0.102	0.101	0.107	0.105
	(7.81)***	(7.73)***	(7.09)***	(7.04)***	(5.38)***	(5.31)***
C&I loans / assets	-0.143	-0.144	-0.142	-0.143	-0.152	-0.152
	(8.34)***	(8.37)***	(7.61)***	(7.65)***	(5.25)***	(5.26)***
Unused loan commitments / assets	0.047	0.047	0.035	0.035	0.058	0.058
	(2.95)***	(2.92)***	(2.80)***	(2.80)***	(2.32)**	(2.29)**
Letters of credit / assets	-0.177	-0.194	-0.247	-0.262	-0.214	-0.233
	(1.91)*	(2.10)**	-1.55	(1.65)*	(1.84)*	(2.01)**
Observations	39,628	39,628	24,592	24,592	15,036	15,036
R-squared	21%	21%	23%	23%	20%	20%

Table 3

Regression of Acceptance Rates for Mortgages on Loan Concentration

This table reports regressions of the acceptance rate for jumbo and non-jumbo loan applications by bank-year. There are two observations per bank-year, from 1992 to 2006. The regressions include the following controls for the loan pool characteristics in each bank-year: the share of loans made to borrowers in MSAs; percent minority applicants in the bank's lending markets; mean loan-to-income ratio; log of mean applicant income; average median income in bank's lending markets; the share of minority applicants; and the share of female applicants. All regressions also include year and state fixed effects. T-statistics are in parentheses, based on errors clustered at the bank level. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: Number of Approved Mortgages / Number of Applications					
	Full Sample		Prior to 2001		Post 2001	
	(1)	(2)	(3)	(4)	(5)	(6)
Loan concentration (number)	0.036	0.031	0.035	0.033	0.036	0.028
	(7.02)***	(5.93)***	(5.58)***	(5.00)***	(5.45)***	(4.15)***
Jumbo * Loan concentration	-	0.013	-	0.005	-	0.022
	-	(2.58)***	-	(2.82)***	-	(3.47)***
Jumbo-loan indicator	-0.006	-0.016	-0.009	-0.014	-0.007	-0.023
	(3.16)***	(3.60)***	(3.11)***	(2.12)**	(2.76)***	(4.22)***
Securities / assets	0.024	0.024	0.059	0.059	-0.026	-0.026
	(2.43)**	(2.43)**	(4.64)***	(4.64)***	(1.95)*	(1.95)*
Interest on deposits / deposits	0.139	0.144	0.164	0.167	-0.068	-0.064
	(0.99)	(1.03)	(1.21)	(1.24)	(0.24)	(0.22)
Log of assets	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.73)	(0.76)	(0.58)	(0.60)	(0.52)	(0.54)
Indicator if owned by BHC	-0.001	-0.001	0.001	0.001	-0.007	-0.007
	(0.47)	(0.47)	(0.58)	(0.58)	(2.38)**	(2.38)**
Capital / assets	0.079	0.079	0.107	0.107	-0.006	-0.005
	(2.94)***	(2.95)***	(3.13)***	(3.13)***	(0.17)	(0.14)
Deposits / assets	0.355	0.357	0.292	0.293	0.317	0.32
	(3.03)***	(3.04)***	(2.13)**	(2.14)**	-1.62	-1.64
Net income / assets	-0.011	-0.012	-0.026	-0.026	-0.011	-0.011
	(0.68)	(0.69)	(1.56)	(1.57)	(0.53)	(0.54)
Real estate loans / assets	0.066	0.065	0.089	0.089	0.043	0.041
	(5.92)***	(5.86)***	(6.49)***	(6.47)***	(2.90)***	(2.82)***
C&I loans / assets	0.059	0.058	0.089	0.089	0.035	0.035
	(4.01)***	(3.99)***	(4.89)***	(4.89)***	(1.89)*	(1.86)*
Unused loan commitments / assets	-0.003	-0.003	-0.003	-0.003	-0.04	-0.04
	(4.09)***	(4.09)***	(7.12)***	(7.13)***	(1.80)*	(1.81)*
Letters of credit / assets	0.095	0.093	0.074	0.071	0.179	0.179
	(1.05)	(1.04)	(0.52)	(0.50)	(1.47)	(1.48)
Observations	86,628	86,628	53,254	53,254	33,374	33,374
R-squared	13%	13%	14%	14%	11%	11%

Table 4

Regression of Retention Rate for Mortgages on Loan Concentration

This table reports regressions of the retention rate for jumbo and non-jumbo loan applications by bank-year. There are two observations per bank-year, from 1992 to 2006. The regressions include the following controls for the loan pool characteristics in each bank-year: the share of loans made to borrowers in MSAs; percent minority applicants in the bank's lending markets; mean loan-to-income ratio; log of mean applicant income; average median income in bank's lending markets; the share of minority applicants; and the share of female applicants. All regressions also include year and state fixed effects. T-statistics are in parentheses, based on errors clustered at the bank level. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: Volume of Approved Mortgages Retained on Balance Sheet / Volume of Approved Mortgages					
	Full Sample		Prior to 2001		Post 2001	
	(1)	(2)	(3)	(4)	(5)	(6)
Loan concentration (number)	0.113	0.149	0.09	0.125	0.132	0.168
	(7.98)***	(9.98)***	(5.53)***	(7.28)***	(6.77)***	(8.34)***
Jumbo * Loan concentration	-	-0.095	-	-0.092	-	-0.096
	-	(8.85)***	-	(7.64)***	-	(6.40)***
Jumbo-loan indicator	0.095	0.171	0.092	0.17	0.095	0.168
	(21.15)***	(17.44)***	(15.58)***	(14.30)***	(17.05)***	(13.16)***
Securities / assets	0.222	0.222	0.217	0.218	0.239	0.239
	(7.83)***	(7.84)***	(6.37)***	(6.39)***	(6.30)***	(6.31)***
Interest on deposits / deposits	0.937	0.900	0.978	0.932	0.377	0.365
	(3.01)***	(2.90)***	(3.24)***	(3.09)***	-0.59	-0.58
Log of assets	-0.001	-0.001	0.009	0.009	-0.023	-0.023
	(0.33)	(0.24)	(2.99)***	(3.09)***	(5.03)***	(5.00)***
Indicator if owned by BHC	-0.025	-0.025	-0.034	-0.034	-0.009	-0.009
	(4.08)***	(4.09)***	(5.02)***	(5.03)***	(0.95)	(0.95)
Capital / assets	0.603	0.6	0.713	0.712	0.454	0.449
	(7.53)***	(7.50)***	(7.71)***	(7.71)***	(3.66)***	(3.63)***
Deposits / assets	0.024	0.01	-0.033	-0.049	0.242	0.233
	(0.08)	(0.03)	(0.11)	(0.16)	(0.49)	(0.47)
Net income / assets	0.18	0.181	0.186	0.188	0.167	0.168
	(4.57)***	(4.61)***	(3.93)***	(3.97)***	(3.43)***	(3.45)***
Real estate loans / assets	0.096	0.100	0.087	0.091	0.106	0.111
	(3.10)***	(3.24)***	(2.37)**	(2.49)**	(2.62)***	(2.75)***
C&I loans / assets	0.027	0.029	0.014	0.016	0.074	0.077
	(0.63)	(0.68)	(0.28)	(0.31)	(1.37)	(1.43)
Unused loan commitments / assets	0.000	0.000	0.001	0.001	-0.070	-0.069
	(0.09)	(0.12)	(1.07)	(1.14)	(2.88)***	(2.83)***
Letters of credit / assets	-0.606	-0.592	-2.047	-1.989	1.102	1.099
	(2.26)**	(2.21)**	(5.02)***	(4.89)***	(4.06)***	(4.05)***
Observations	85,149	85,149	52,243	52,243	32,906	32,906
R-squared	12%	12%	11%	12%	16%	16%

Table 5

Regression of Accounting Profit Rate on Loan Concentration and other Bank Characteristics

This table reports regressions of bank quarterly ROA (income / assets), ROE (income / book value of equity) and NPL / Loans (loan 90 or more days past due plus loan no longer accruing interest / total loans) by bank-quarter, from 1992 to 2006. The regressions include the following controls for bank characteristics: log of assets, securities / assets, interest expenses / deposits, deposits / assets, real estate loans / assets, C&I loans / assets, unused commitment / assets, and letters of credit / assets. All regressions also include year and state fixed effects. T-statistics are in parentheses, based on errors clustered at the bank level. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	ROA		ROE		NPL / Loans	
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Full Sample			
Loan concentration (number)	0.0007	0.0010	0.0076	0.0099	-0.0013	-0.0031
	(10.22)***	(12.81)***	(9.68)***	(12.18)***	(3.50)***	(7.08)***
Loan concentration (number)	-	-0.0033	-	-0.0335	-	0.0264
* Growth in Case-Shiller Index	-	(7.05)***	-	(6.50)***	-	(9.68)***
Observations	267,890	267,890	267,890	267,890	271,140	271,140
R-squared	28%	28%	32%	32%	7%	7%
			Panel B: Prior to 2001			
Loan concentration (number)	0.0008	0.0010	0.0074	0.0098	-0.0025	-0.0049
	(8.95)***	(10.45)***	(7.84)***	(9.09)***	(5.01)***	(7.63)***
Loan concentration (number)	-	-0.0058	-	-0.0586	-	0.0585
* Growth in Case-Shiller Index	-	(5.44)***	-	(4.79)***	-	(9.31)***
Observations	155,492	155,492	155,092	155,092	157,092	157,092
R-squared	29%	29%	32%	32%	8%	9%
			Panel C: Post 2001			
Loan concentration (number)	0.0008	0.0009	0.0083	0.0104	-0.0004	-0.0008
	(8.45)***	(9.07)***	(8.12)***	(9.43)***	(0.90)	(1.66)*
Loan concentration (number)	-	-0.0015	-	-0.0223	-	0.0047
* Growth in Case-Shiller Index	-	(3.38)***	-	(4.53)***	-	(1.89)*
Observations	112,398	112,398	112,798	112,798	114,048	114,048
R-squared	28%	28%	31%	31%	5%	5%
			Panel D: Heavy Mortgage Lenders (originations / assets > median)			
Loan concentration (number)	0.0010	0.0010	0.0094	0.0104	-0.0013	-0.0023
	(8.92)***	(10.19)***	(8.29)***	(9.61)***	(2.48)**	(4.36)***
Loan concentration (number)	-	-0.0018	-	-0.0202	-	0.0221
* Growth in Case-Shiller Index	-	(2.54)**	-	(2.64)***	-	(6.53)***
Observations	126,443	126,443	126,598	126,598	128,302	128,302
R-squared	26%	26%	30%	30%	5%	5%

Table 6

Regression of Stock Return from August 2007 to March 2008 on Bank Characteristics

This table reports cross-sectional regressions of cumulative return for publicly traded banks' stocks between August 2007 and March 2008. T-statistics are in parentheses, based on robust standard errorsl. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable: Cumulative Stock Return			
	(1)	(2)	(3)	(4)
Loan concentration (number)	0.165	-	0.127	-
	(3.03)**	-	(2.04)*	-
Loan concentration ($ volume)	-	0.162	-	0.109
	-	(2.94)**	-	(1.79)*
Securities / assets	0.781	0.767	-0.085	-0.076
	(5.55)**	(5.47)**	(0.36)	(0.32)
Interest on deposits / deposits	-	-	-0.188	-0.191
	-	-	(3.23)**	(3.27)**
Log of assets	-	-	-0.013	-0.016
	-	-	(0.83)	(0.97)
Capital / assets	-	-	-1.119	-1.093
	-	-	(1.39)	(1.34)
Deposits / assets	-	-	-0.236	-0.233
	-	-	(1.06)	(1.05)
Net income / assets	-	-	-6.294	-6.179
	-	-	(1.15)	(1.11)
Real estate loans / assets	-	-	-0.676	-0.663
	-	-	(3.01)**	(2.95)**
C&I loans / assets	-	-	-0.258	-0.254
	-	-	(0.90)	(0.88)
Unused loan commitments / assets	-	-	-0.526	-0.523
	-	-	(2.09)*	(2.07)*
Letters of credit / assets	-	-	-0.013	-0.016
	-	-	(0.83)	(0.97)
Observations	313	313	313	313
R-squared	13%	13%	24%	24%

Table 7

Regression of MSA-level housing price growth on lender acceptance and retention rates

This table reports regressions of the annual percentage change in 20 MSA-level Case-Shiller housing price growth indices on retention and acceptance rates for all lenders in each MSA-year that are concentrated and diversified. Concentrated lenders are those with at least 75% of their loans in one MSA. The models also include average loan-pool characteristics: the log of the number of loans in the MSA; the log of average borrower income; the share of borrowers who are minority; the share female; the fraction of minority in the MSA area; the median income in the MSA and the mean loan-income ratio. We also include annual fixed effects. Standard errors are clustered by MSA.

	(1)	(2)	(3)
		Panel A: Full Sample	
Acceptance rate by concentrated lenders	0.08	-	0.018
	(1.86)*	-	-0.34
Share retained by concentrated lenders	0.029	-	0.029
	(1.99)**	-	(2.00)**
Acceptance rate by diversified lenders	-	0.436	0.425
	-	(4.67)***	(4.18)***
Share retained by diversified lenders	-	-0.013	-0.001
	-	(0.34)	(0.02)
Observations	346	347	346
R-squared	52%	56%	56%
		Panel B: Prior to 2001	
Acceptance rate by concentrated lenders	0.065	-	0.029
	(1.78)	-	(1.63)
Share retained by concentrated lenders	0.045	-	0.049
	(3.81)***	-	(3.63)***
Acceptance rate by diversified lenders	-	0.224	0.210
	-	(3.50)***	(3.05)**
Share retained by diversified lenders	-	-0.018	-0.036
	-	(0.67)	(1.35)
Observations	200	200	200
R-squared	42%	44%	47%
		Panel C: Post 2001	
Acceptance rate by concentrated lenders	0.028	-	-0.041
	(0.26)	-	(0.42)
Share retained by concentrated lenders	-0.004	-	0.004
	(0.20)	-	(0.18)
Acceptance rate by diversified lenders	-	0.917	0.949
	-	(4.28)***	(5.55)***
Share retained by diversified lenders	-	-0.003	-0.014
	-	(0.03)	(0.10)
Observations	146	147	146
R-squared	60%	64%	64%