INFORMED AND UNINFORMED INVESTMENT IN HOUSING:

THE DOWNSIDE OF DIVERSIFICATION

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Abstract

We show that mortgage lenders that concentrate in a few markets invest in more information than diversified lenders. First, concentrated lenders focus on the jumbo-loan market, where returns to information production are highest. Second, they ration credit less and retain more mortgages than diversified lenders. Third, 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. 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 therefore conclude that inadequate information production played a key role in the 2001-2008 real estate bubble and crash.

I. INTRODUCTION

Both deregulation and the emergence of loan securitization have led to a dramatic increase in diversification as banks have expanded their operations across many markets. From 1992 to 2007 the share of mortgages originated by concentrated lenders, those taking most of their applications in just one local market, fell from about 18% to about 4%. This decline coincided with soaring real estate prices in the United States (Figure 1).

Traditional theories of banking suggest that the move toward diversification would lower delegated monitoring costs from external capital markets to bankers, and thus should have improved lending decisions and outcomes (Diamond, 1984). Such theories may not apply to mortgage lending, however, because much of the diversification has been fueled by securitization whereby originating lenders pass risks onto third parties. Theories based on agency costs within the firm suggest that focused lenders – such as lenders concentrating on one or a small number of local markets – may have both better ability and stronger incentives to collect information that is costly to transmit to others (Stein, 2002). Such 'soft' information is private to the decision-maker, in our context the lender deciding whether or not to approve a mortgage. In this paper we compare the lending practices of diversified lenders with those of concentrated mortgage lenders. Our results suggest that concentrated mortgage lenders invested more in private information than diversified lenders, leading to lower loan losses and higher profits, particularly during the recent real estate crash.

We evaluate several comparisons between concentrated and diversified lenders based on the implications of (unobservable) private-information investment. Private information allows lenders to accept more mortgages because risks can be priced, while reducing liquidity because

potential buyers face adverse selection. Thus, we compare mortgage acceptance and retention rates for concentrated and diversified lenders. Private information should have more value in the jumbo (non-GSE) mortgage segment where loans are more heterogeneous and less liquid. Private information also should improve loan performance, particularly when housing prices began to fall in late 2006, so we evaluate profitability and loan performance. By comparing concentrated v. diversified lenders across these dimensions, we offer strong evidence that concentrated lenders produce more private information.

In our first test, we compare investments made by concentrated and diversified lenders in the non-jumbo vs. jumbo segment of the market. The Government-Sponsored Enterprises (the 'GSEs', Fannie Mae and Freddie Mac) subsidize lending in the non-jumbo market by standing ready to purchase loans that conform to a set of underwriting criteria based on public information, thus eliminating the need for banks to collect private information. Jumbo mortgages, in contrast, are more costly to sell in part due to the absence of GSE subsidies and in part due to their heterogeneity. Lenders thus have more incentive to collect private information in the jumbo segment. Consistent with the notion that concentrated lenders invest in private information, we find that they are more active in jumbos relative to diversified lenders, controlling for other lender and borrower characteristics.

We then test how acceptance rates and retention rates vary with lender concentration. We find that concentrated lenders ration credit less than diversified lenders – they accept a higher proportion of mortgage applications controlling for borrower characteristics, especially in the jumbo market. The higher acceptance rates suggest that concentrated lenders can measure and price risks better (i.e. they ration credit less), thus allowing them to profitably approve more

loans than diversified lenders.[1] Concentrated lenders also retain a higher proportion of their originations than diversified lenders, consistent with private information reducing the liquidity of their loans. The difference in acceptance and retention rates are large and persistent across both time and across market segments. Concentrated lenders, for example, are unconditionally almost 50% more likely to retain their mortgage originations than diversified lenders, and their acceptance rates are about 5% higher (Figure 2).

We then ask whether concentrated lenders behave like diversified lenders when they enter *new* local markets. We estimate a within-bank regression that shows that concentrated lenders focus more on the non-jumbo segment in their peripheral markets, and they also are less likely to accept mortgages and more likely to sell them. So, while concentrated lenders behave as if they produce more information than diversified lenders, when these lenders extend their business into outlying markets their behavior is consistent with a notion that their credit decisions rely less on private information and more on public signals. This makes sense because concentrated lenders likely have less expertise about the local business environment in their outlying markets, and because by conditioning their decisions on public information they are better able to sell or securitize those loans.

One objection might be that higher acceptance and retention rates imply that concentrated banks have lower credit standards than diversified lenders. To rule out this interpretation, we compare performance across lender types.[2] Concentrated mortgage lenders' profits are both higher and less correlated with overall conditions in the real estate market than profits for

[1] Unfortunately we do not have pricing data, which would allow us to develop further tests for credit rationing differences across banks.
[2] The within-bank test is not available because we only observe performance statistics at the bank-year level (not at the market level).

diversified lenders. In addition, their loan losses are lower than those of diversified lenders, *despite accepting a higher fraction of mortgage applications conditional on observables*. This is strong evidence of better screening by the concentrated banks.

Finally, to focus specifically on the real estate crash, we 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.

Our results imply that the compositional shift toward diversified lending reduced information production in U.S. mortgage lending. Grossman and Stiglitz (1981) show that information production is a necessary component to a stable asset-pricing equilibrium. With declining market presence of informed lenders, prices may have become freer to wander away from fundamentals. Many now believe that asset prices can move significantly above fundamentals for surprisingly long periods of time (Kindleberger, 2000; Shiller, 1981; LeRoy and Porter, 1981; Shiller, 2000). Sorting out the causal links between the presence of informed investors and 'bubbles' is tricky, however, because over-valuation can induce exit by informed investors, and the timing with which bubbles end is unpredictable (Delong, Shleifer, Summers and Waldman (1990), Abreu and Brunnermeier (2002), Gennotte and Leland (1990)).

Several recent studies tie the run-up and collapse in U.S. housing prices to excessive credit supply (Dell'arricia et al (2008), Demyanyk and Van Hemert (2008) and Sufi and Mian (2008)). Our finding suggests that the dominance of diversified lending may have allowed credit to expand beyond a sustainable level. 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 may be little to restrain credit supply, particularly because diversified lenders condition their credit decisions heavily on the loan-to-value ratios; hence prices can move far above fundamentals. Consider Figure 3, where we scatter the average concentration of lenders (weighted by their share of originations) against future housing appreciation across 20 MSAs.[3] There is no correlation between price changes and the importance of concentrated lenders in the first half of the data (1992 to 2000), but a significant negative correlation overall. Panel C shows that the 2001 to 2007 period drives this negative correlation. Our proxy for the share of uninformed lending – the importance of diversified lenders in a market - explains *more than half* of the variance in the relative size of the 'bubble' across local markets during the time when real estate prices were rising sharply.

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

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

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 (Rice and Strahan, 2008).

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.[4] 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

[4] 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).

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%.[5] 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

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

to private banks, and to offer credit guarantees on better terms than competitors without such implicit support.[6]

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 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.[7] Rather

[6] 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.

[7] 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

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 expansion in the diversification strategy during our sample (1992-2007).[8] 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

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junior tranches in return for higher yields. See Ashcraft and Schuermann (2008) for a detailed discussion of securitization of sub-prime mortgages.

[8] 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 losing their link to fundamentals.

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 2007. 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.

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).[9]

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 (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

[9] 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.

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 mean and standard deviations 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 average assets equals $2.5 billion, compared to just $170 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. The raw data show that concentrated banks both accept and retain a higher fraction of their mortgages, consistent with private information production.[10] These differences hold up in the regression analysis reported below.

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

[10] The averages in Table 1 are across banks and thus are not weighted by lending amounts. This explains why the difference in both acceptance rates and retention rates are much larger in Figure 2, where data are dollar weighted based on loan-level data.

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 first 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 across the non-jumbo and jumbo segments, we report panel regressions with the following structure:

$$(Non\text{-}Jumbo - Jumbo\ Volume)_{i,t} / Assets_{i,t-1} = \alpha_1 Con_{i,t} + Borrower,\ Bank\ \&\ Market\ Controls_{i,t} + \delta_t + \varepsilon^{NJ}_{i,t} \quad (1)$$

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 2007) 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:

$$Acceptance\ Rate_{i,j,t} = \gamma_1 Con_{i,t} + \gamma_2 Jumbo_{i,j,t} + \gamma_3 Con_{i,t} Jumbo_{i,j,t} + Borrower\ Controls_{i,j,t} + Bank\ \&\ Market\ Controls_{i,t} + \delta_t + \varepsilon^{A}_{i,j,t} \quad (2a)$$

and

$$Retention\ Rate_{i,j,t} = \beta_1 Con_{i,t} + \beta_2 Jumbo_{i,j,t} + \beta_3 Con_{i,t} Jumbo_{i,j,t} + Borrower\ Controls_{i,j,t} + Bank\ \&\ Market\ Controls_{i,t} + \delta_t + \varepsilon^{R}_{i,j,t}, \quad (2b)$$

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.[11] 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 2, 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 do not enhance liquidity in the jumbo market, we expect lower acceptance and higher 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

[11] There is a third market segment of loans subsidized by the Veterans Administration and the Federal Housing Authority which we drop from these regressions.

least relative to the diversified lenders); hence the interaction effects will offset the direct effect of the jumbo indicator ($\gamma_3 > 0$ & $\beta_3 < 0$).

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 the same across the two concentration measures.[12] If we increase loan-market concentration by two standard deviations (one $\sigma = 0.23$), the model suggests an increase in lending to the jumbo segment of about 6.8% of assets (Table 2). The split sample results (1992 to 2000 and 2001 to 2007) shows that these effects are even stronger in the second half of the sample (columns 3-6).

Before we continue, we should emphasize that the coefficients in Table 2 are not driven by the lender size. Large banks are more likely to lend in the jumbo market because they are

[12] 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.

more capable of funding big loans. In fact, 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. 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 (i) controlled for an up to third degree polynomial of size (log of assets); (ii) controlled for lending activity via the log of total mortgage originations during the prior year; and (iii) implemented our tests with top and bottom size deciles banks eliminated from the sample. The effect of concentration changes insignificantly in these robustness tests (not reported).[13] Finally, we have normalized the difference between non-jumbo and jumbo originations by total mortgage originations in the preceding year as an alternative to normalizing by total assets. These results are similar in magnitude (relative to sampling variation of the two dependent variables) and statistical significance.

Tables 3 and 4 show that loan retention and acceptance rates are both higher for concentrated lenders than for diversified lenders. The direct effect of concentration on loan acceptance suggests that a two-sigma increase comes with a rise of 1.7 percentage points in the acceptance rate (Table 3, column 1). The effect of concentration on the retention 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 than in the jumbo segment; by contrast, the acceptance rate is not significantly different across the two segments for lenders

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

specializing on one market (HHI = 1). For retention rates, diversified lenders (HHI=0) experience a 16.4 percentage point higher retention rate for jumbos over non-jumbos; but for concentrated lenders the retention rate is only 7.4 percentage points higher in the jumbo segment than in the non-jumbo segment. The jumbo/non-jumbo distinction matters much less for specialized lenders who condition their decisions on private information because the GSE subsidy affects only mortgages that are viable conditional on just public signals.

C. Within-bank Tests

Concentrated lenders are, on average, producing more private information than diversified lenders. These results could be generated by the extremes, comparing highly concentrated and highly diversified banks, while lenders in the middle may adopt a mixed private-information processing strategy. To test this notion, we focus on concentrated banks that extend their operations beyond the primary local market. We evaluate whether concentrated lenders behave differently in their primary markets relative to areas where they do less business (peripheral markets). Specifically, we test whether concentrated lenders behave more like diversified lenders when they extend their lending into new markets where production of private information might be more expensive than in their primary market.

In conducting this within-bank test, we consider only concentrated lenders with the HHI above 0.75, and collect information about bank lending decisions for every geographic area where they issue loans (MSA level). Thus we measure the variables at the Bank-MSA-Year level, and control not only for year and MSA fixed effects but for the bank-level fixed effects as well. Hence this test removes potential biases from unobservable bank characteristics. While we

exclude all lenders that are fully specialized (lend in one market in all years), we do include fully concentrated bank-years if such banks later extend their operations in other geographic areas. These observations act as a benchmark in evaluating the changes in behavior when expanding to new markets.

To summarize analytically, we re-formulate regression equation (1) as follows:

$$\begin{aligned} &(Non\text{-}Jumbo - Jumbo\ Volume)_{i,k,t} \,/\, Total\ Volume_{i,k,t-1} = \\ &= \alpha_1 Primary\ Market\ Indicator_{i,k,t} + Bank\ Controls_{i,t-1} + Borrower\ Controls_{i,k,t} \\ &\quad + \alpha_i + \gamma_k + \delta_t + \varepsilon^{NJ}_{i,k,t} \end{aligned} \tag{2a}$$

where α_i is a bank fixed effect, γ_k is an MSA-level fixed effect and δ_t is a year fixed effect. Since we are looking within bank, the measure of concentration now depends on the share of non-jumbo v. jumbo business in a given MSA area and concentration measure is replaced by the 'primary market indicator'. This indicator variable equals one for the MSA in which the bank makes at least 50% of its mortgages in a given bank-year and zero otherwise.[14]

In contrast to equation (1) above, where we normalized the volume differential by lagged total assets, we now normalize by the previous year's total mortgage volume in the same MSA. This change eliminates a bias in α_1. The lower loan origination in peripheral markets, if normalized by bank assets, would be mechanically positively correlated with the size of the local market. Dividing by volume in a given MSA in the prior year eliminates this correlation.

For the within-bank analysis of the acceptance and retention rates, where we measure each of these by market segment, we re-formulate equations (2a) and (2b) as follows:

[14] In robustness tests we have also used the actual share of business across all markets in which a bank makes at least one mortgage and found similar results.

$$Acceptance\ Rate_{i,j,k,t} = \gamma_1\ Primary\ Market\ Indicator_{i,k,t} + \gamma_2 Jumbo_{i,j,k,t} + \gamma_3\ Primary\ Market\ Indicator_{i,k,t} Jumbo_{i,j,k,t} + Borrower\ Controls_{i,j,k,t} + Bank\ Controls_{i,t-1} + \alpha_i + \gamma_k + \delta_t + \varepsilon^A_{i,j,k,t} \quad (2c)$$

and

$$Retention\ Rate_{i,j,k,t} = \gamma_1\ Primary\ Market\ Indicator_{i,k,t} + \gamma_2 Jumbo_{i,j,k,t} + \gamma_3\ Primary\ Market\ Indicator_{i,k,t} Jumbo_{i,j,k,t} + Borrower\ Controls_{i,j,k,t} + Bank\ Controls_{i,t-1} + \alpha_i + \gamma_k + \delta_t + \varepsilon^R_{i,j,k,t} \quad (2d),$$

where *j* indexes the two market segments (non-jumbo and jumbo).

The within-bank results are conceptually consistent with the across-bank comparisons in terms of both sign and statistical significance. That is, concentrated banks behave more like information producers in their primary lending markets compared to their peripheral markets, just as concentrated lenders overall produce information relative to banks operating across many markets. For example, a concentrated bank originates 25% more jumbos than non-jumbos in its primary market than in its peripheral markets (Table 5, column 1). This coefficient is about twice as large as what we estimated across banks. For example, if we estimate the same dependent variable in the cross-bank regressions of Table 2 (normalizing by lagged mortgage originations rather than lagged assets), we estimate a coefficient on concentration of -0.234. This coefficient implies that a two-sigma increase in bank concentration comes with a decline in non-jumbo lending of 11%, which is less than half of the effect estimated within bank between its primary and secondary markets.

The effect on acceptance rates of moving between primary markets and secondary markets also exceeds the effect of moving across banks (from concentrated to diversified

lenders). Approval rates are 4.3 percentage points higher in the primary market area than in peripheral markets (Table 5, column 2). Across banks, if we move bank concentration up by one two standard deviations, the acceptance rate rises by just 1.7 percentage points. The effect of moving across markets for the retention rates is slightly smaller relative to the parallel comparison across banks. For example, the retention rate is 3.1 percentage points higher in the primary market relative to the secondary markets (Table 5, column 4). Moving the concentration index up by two standard deviations across banks increases the retention rate by 5.3 percentage points. The within-bank tests also suggest that moving across the jumbo-market cutoff is more important in the peripheral markets than in the primary market, meaning that the interaction between the primary-market and the jumbo indicators consistently enters with the opposite sign of the direct effect of jumbo. Again, this suggests that the jumbo/non-jumbo distinction matters less for mortgages that involve production of private information.

D. 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, formerly 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:

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

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

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

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 (1992-2007) as well as over the same two sub-samples (1992-2000 and 2001-2007).

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 sub-sample, we include only those bank-quarters where mortgage originations / assets in the top half of the distribution.

Table 6 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 6 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.[15] The sample of publicly traded banks for this tests is

[15] 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.

much smaller than before (n=313), but we still have substantial variation in our loan concentration measure (σ=0.27), ranging from nearly zero for banks like Bank of America and Wachovia to nearly one for banks like Bank of Hawaii and Suffolk Bank. 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 7 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 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 by two standard deviations came with an increase in the stock returns of about 6%, which is nearly half of the average drop in prices.

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 by a factor of five over the past 15 years, to nearly zero by 2007. This decline in concentrated lending thus led to a market-wide decline in information production, and may help explain the 'bubble' in housing markets that inflated between 2001 and 2006. As shown in Grossman and Stiglitz (1981), information production is a necessary component to a stable asset-pricing equilibrium. In their equilibrium 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 between prices and fundamentals, thereby earning above normal profits.[16] 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.[17] Concentrated banks act like informed traders, while diversified banks act like uninformed traders.

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;

[16] 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.

[17] 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).

LeRoy and Porter, 1981; Shiller, 2000). These bubbles may arise because uninformed (or 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.[18] 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.[19]

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, it has not been the objective of this paper to estimate *how much* of the rise in housing prices can be tied to the decline of concentrated lending. For one, finding a powerful and plausibly exogenous instrument to trace out the expansion in supply of uninformed lending might prove to be difficult. Instead, we argue that both the strong cross-market correlation between housing price growth and the initial share of concentrated lenders (Figure 3), as well as the time series relationship between the two are suggestive that the changing structure of lending played an important role in inflating the 'bubble'. The two trends, of course, reinforce each other: The decline in informed investment (concentrated lending) is both a cause and a consequence of the 'bubble'. Moreover, we are *not* suggesting that diversified lending is a bad

[18] 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.

[19] Morgan et al (2008) suggest that bankruptcy reform that made it harder to walk away from unsecured debt may have acted as the trigger that ended the housing price run up.

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. The pendulum has begun to swing back, as the share of concentrated lenders bottomed out in 2005 and increased for the first time between 2006 and 2007 (Figure 1).

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

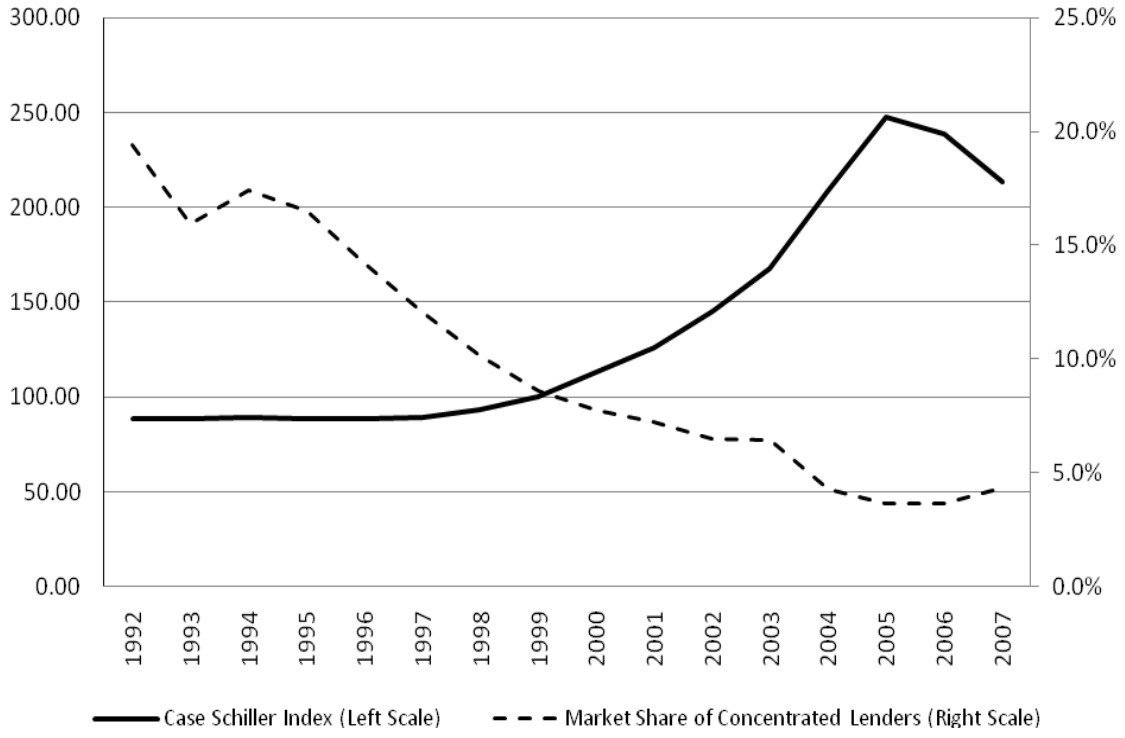

Figure 2A: Probability of Acceptance by Mortgage Size

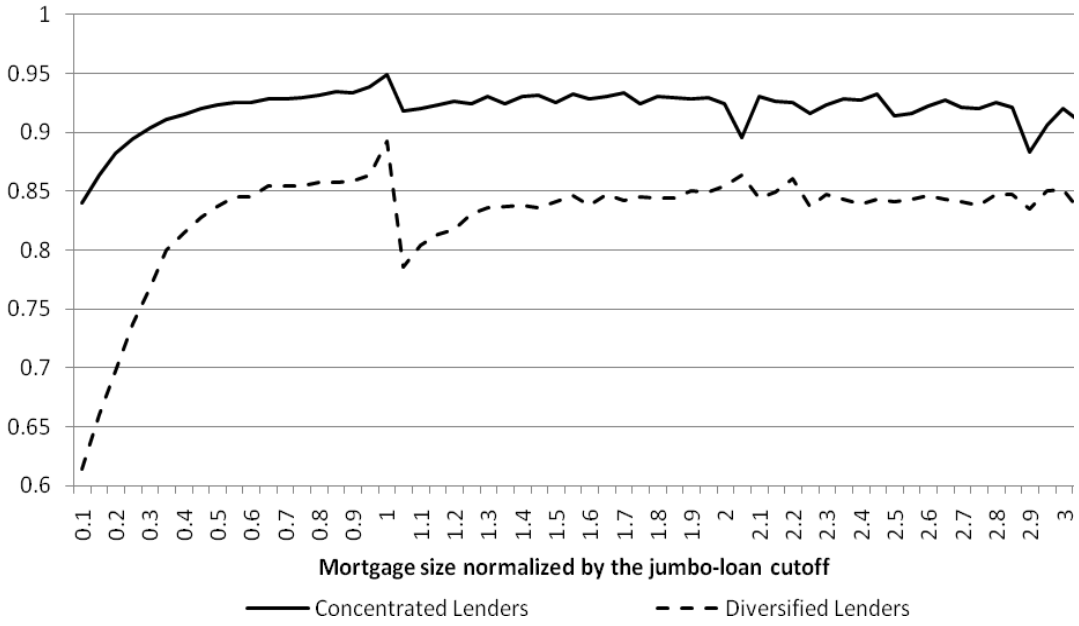

Figure 2b: Share of Mortgages Sold, by Size

Figure 3A: House Price Increases and Lender Concentration

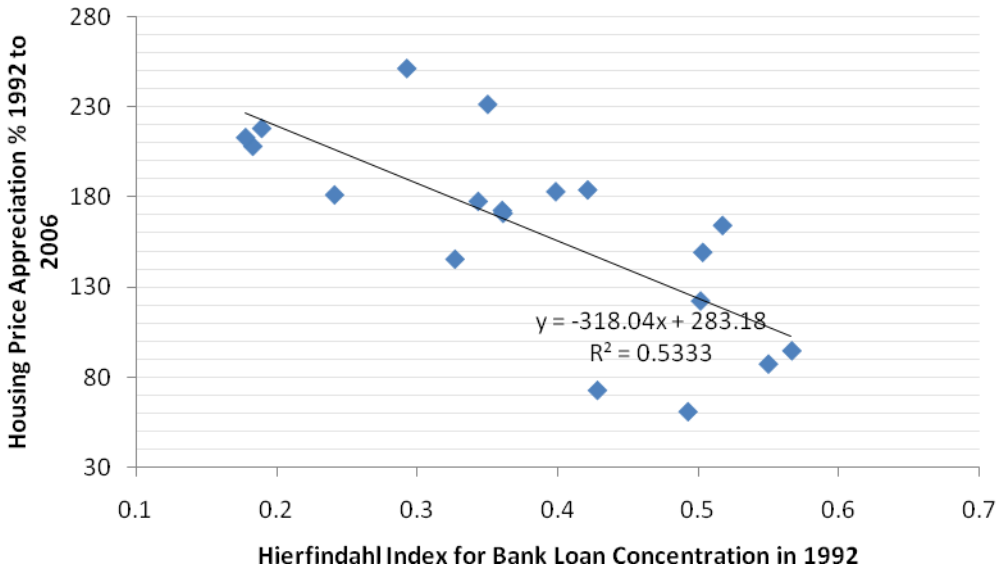

Figure 3B: House Price Increases and Lender Concentration

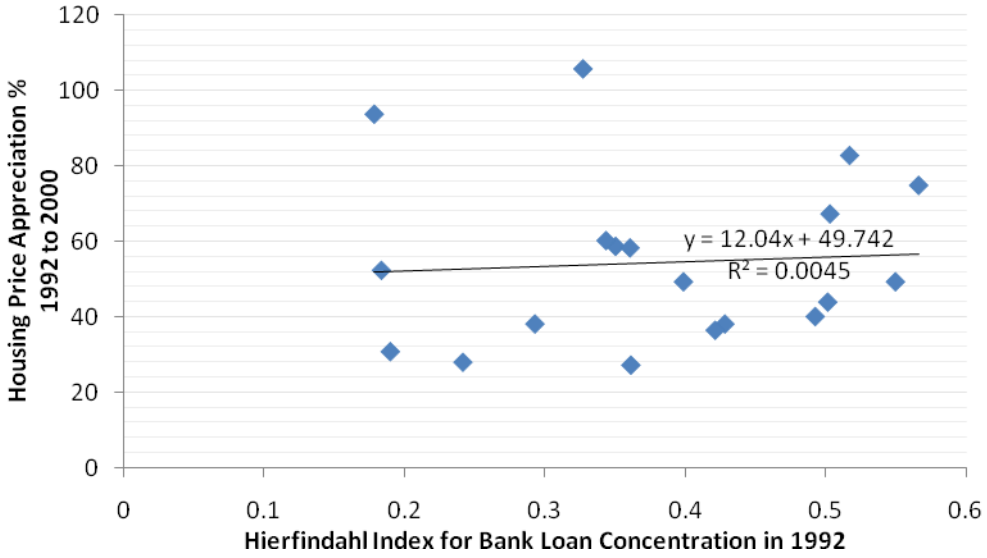

Figure 3C: House Price Increases and Lender Concentration

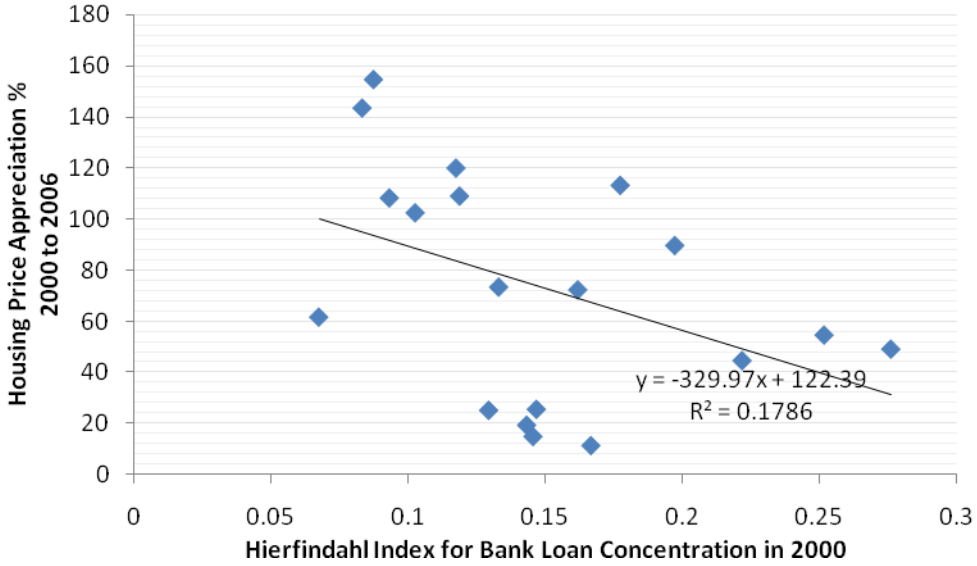

Table 1: Summary Statistics for Bank Characteristics

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***	
	Mean	**St. Dev.**	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**
Total Assets (millions of $s)	391.1	6661.4	170.0	3355.1	2474.1	18750.0
Financial Struture & Liquidity (%)						
Liquid Assets / Assets	30.5	15.6	31.2	15.6	23.9	13.7
Cost of Deposits	3.2	5.9	3.3	6.2	2.7	1.1
Capital / Assets	10.1	4.1	10.2	4.2	9.4	3.2
Loan Shares (% of assets)						
Total Loans	59.5	15.3	58.8	15.3	65.8	13.8
Commercial & Industrial Loans	22.2	18.7	23.2	18.9	13.1	14.2
Home Mortgages	36.6	30.0	36.6	29.6	36.8	30.4
Commercial Mortgages	17.1	13.2	16.4	12.9	23.5	14.3
Consumer Loans	13.6	11.7	14.0	11.7	9.7	11.0
Profit (%)						
Net Income / Assets	0.90	1.13	0.90	1.14	0.95	0.98
Herfindahl Index						
Equal weighted	0.841	0.227	0.959	0.065	0.495	0.176
Value weighted	0.834	0.231	0.948	0.092	0.498	0.189
Mortgage application						
Probability of Acceptance (%)	87.53	13.33	88.06	12.60	86.31	14.80
Share of loans retained (%)	79.20	31.81	81.76	30.48	73.26	33.97
Average Loan Amount ($000)	134	350	113	178	186	578
Average Applicant Income ($000)	95	127	88	99	112	174
Average Loan-to-Income Ratio	1.67	3.08	1.61	3.38	1.81	2.20
Averate Loan to Area Income	2.07	2.41	2.00	2.02	2.24	3.15
Percent Minority	16.40	15.80	15.49	15.89	18.57	15.36
Percent Female	17.31	10.80	16.70	10.99	18.77	10.18

Table 2
Regression of Loan Volumes for Nonjumbo

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)	-0.147***	-	-0.111***	-	-0.192***	-
	(4.811)	-	(2.792)	-	(4.488)	-
Loan concentration ($ volume)	-	-0.133***	-	-0.104***	-	-0.168***
	-	(4.623)	-	(2.763)	-	(4.140)
Securities / assets	-0.128***	-0.132***	-0.0903***	-0.0930***	-0.180***	-0.188***
	(5.127)	(5.241)	(4.313)	(4.403)	(4.376)	(4.481)
Interest on deposits / deposits	-0.621**	-0.610**	-0.368	-0.365	-1.008*	-0.982
	(2.320)	(2.282)	(1.548)	(1.541)	(1.672)	(1.627)
Log of assets	-0.0373***	-0.0362***	-0.0306***	-0.0302***	-0.0466***	-0.0444***
	(7.396)	(7.350)	(7.017)	(7.132)	(4.588)	(4.435)
Indicator if owned by BHC	-0.00489	-0.00506	0.00427	0.0043	-0.0232***	-0.0238***
	(1.007)	(1.043)	(0.966)	(0.972)	(2.655)	(2.713)
Capital / assets	-0.185***	-0.182***	-0.114	-0.112	-0.245**	-0.240**
	(2.944)	(2.887)	(1.192)	(1.170)	(2.372)	(2.308)
Deposits / assets	-0.286***	-0.288***	-0.198***	-0.200***	-0.384***	-0.387***
	(3.598)	(3.616)	(3.467)	(3.480)	(2.870)	(2.882)
Net income / assets	0.722	0.7	0.221	0.208	1.666	1.62
	(1.372)	(1.329)	(1.092)	(1.033)	(1.191)	(1.155)
Real estate loans / assets	0.123***	0.120***	0.151***	0.149***	0.0905*	0.0842
	(3.876)	(3.765)	(5.751)	(5.744)	(1.691)	(1.563)
C&I loans / assets	-0.182***	-0.184***	-0.126***	-0.128***	-0.278***	-0.279***
	(5.284)	(5.336)	(4.791)	(4.869)	(4.146)	(4.148)
Unused loan commitments / assets	-0.000985	-0.000941	-0.000321	-0.00028	0.00127	0.00119
	(0.578)	(0.553)	(0.256)	(0.221)	(0.309)	(0.292)
Letters of credit / assets	-0.242*	-0.286**	-0.164	-0.19	-0.308	-0.381*
	(1.773)	(2.072)	(0.818)	(0.971)	(1.512)	(1.809)
Observations	68,321	68,321	40,326	40,326	27,995	27,995
R-squared	8%	8%	7%	7%	9%	9%

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)	0.0380***	0.0325***	0.0381***	0.0370***	0.0365***	0.0271***
	(7.369)	(6.196)	(5.873)	(5.459)	(5.672)	(4.188)
Jumbo * Loan concentration		0.0142***		0.0026		0.0249***
		(3.016)		(0.401)		(4.272)
Jumbo-loan indicator	-0.00458**	-0.0158***	-0.00433	-0.00651	-0.00771***	-0.0264***
	(2.246)	(3.536)	(1.277)	(0.962)	(3.092)	(5.006)
Securities / assets	0.0232**	0.0232**	0.0637***	0.0637***	0.0227*	0.0226*
	(2.423)	(2.428)	(4.996)	(4.995)	(1.802)	(1.797)
Interest on deposits / deposits	0.155	0.161	0.134	0.135	0.0227	0.0262
	(1.085)	(1.123)	(0.935)	(0.945)	(0.091)	(0.105)
Log of assets	-0.000854	-0.000892	-0.000713	-0.000722	-0.00128	-0.00132
	(0.818)	(0.856)	(0.635)	(0.644)	(0.796)	(0.823)
Indicator if owned by BHC	-0.00086	-0.000863	0.00228	0.00228	-0.00724**	-0.00724**
	(0.392)	(0.393)	(0.879)	(0.880)	(2.396)	(2.397)
Capital / assets	0.0629**	0.0634**	0.0959***	0.0959***	-0.0228	-0.0214
	(2.372)	(2.390)	(2.758)	(2.760)	(0.661)	(0.623)
Deposits / assets	0.393***	0.396***	0.388***	0.389***	0.308*	0.311*
	(3.455)	(3.474)	(2.798)	(2.801)	(1.685)	(1.706)
Net income / assets	-0.00307	-0.00334	-0.0196	-0.0197	-0.00421	-0.00452
	(0.189)	(0.206)	(1.144)	(1.147)	(0.219)	(0.235)
Real estate loans / assets	0.0659***	0.0653***	0.0939***	0.0937***	0.0437***	0.0425***
	(6.042)	(5.977)	(6.740)	(6.719)	(3.169)	(3.079)
C&I loans / assets	0.0555***	0.0552***	0.0894***	0.0893***	0.0376**	0.0372**
	(3.965)	(3.947)	(4.865)	(4.864)	(2.124)	(2.103)
Unused loan commitments / assets	-0.00328***	-0.00329***	-0.00274***	-0.00274***	-0.0347*	-0.0350*
	(3.686)	(3.688)	(6.127)	(6.129)	(1.797)	(1.813)
Letters of credit / assets	0.0734	0.0721	0.0569	0.0553	0.16	0.162
	(0.849)	(0.835)	(0.372)	(0.361)	(1.469)	(1.491)
Observations	94,721	94,721	54,687	54,687	40,034	40,034
R-squared	13%	13%	14%	14%	12%	12%

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)	0.116***	0.151***	0.0862***	0.121***	0.137***	0.170***
	(8.550)	(10.490)	(5.440)	(7.198)	(7.548)	(9.003)
Jumbo * Loan concentration		-0.0902***		-0.0908***		-0.0877***
		(8.893)		(7.802)		(6.302)
Jumbo-loan indicator	0.0922***	0.164***	0.0959***	0.172***	0.0879***	0.153***
	(21.980)	(17.940)	(16.420)	(14.890)	(16.820)	(13.140)
Securities / assets	0.214***	0.214***	0.212***	0.213***	0.218***	0.218***
	(8.005)	(8.007)	(6.360)	(6.386)	(6.219)	(6.216)
Interest on deposits / deposits	0.691**	0.657**	0.865***	0.819***	-0.200	-0.209
	(2.249)	(2.143)	(2.858)	(2.716)	(0.350)	(0.366)
Log of assets	-0.00132	-0.00109	0.00920***	0.00949***	-0.0209***	-0.0208***
	(0.475)	(0.395)	(3.147)	(3.246)	(4.816)	(4.788)
Indicator if owned by BHC	-0.0257***	-0.0257***	-0.0351***	-0.0351***	-0.0128	-0.0128
	(4.295)	(4.295)	(5.171)	(5.186)	(1.466)	(1.463)
Capital / assets	0.535***	0.532***	0.696***	0.694***	0.359***	0.354***
	(6.975)	(6.945)	(7.572)	(7.567)	(3.194)	(3.157)
Deposits / assets	-0.0305	-0.0437	0.057	0.0415	-0.117	-0.126
	(0.102)	(0.146)	(0.195)	(0.142)	(0.214)	(0.230)
Net income / assets	0.170***	0.172***	0.180***	0.182***	0.153***	0.154***
	(4.418)	(4.458)	(3.884)	(3.924)	(3.143)	(3.158)
Real estate loans / assets	0.0908***	0.0950***	0.0833**	0.0876**	0.0936**	0.0981***
	(3.110)	(3.257)	(2.316)	(2.440)	(2.528)	(2.649)
C&I loans / assets	0.031	0.0329	0.0207	0.0222	0.0625	0.0642
	(0.772)	(0.819)	(0.409)	(0.441)	(1.220)	(1.253)
Unused loan commitments / assets	0.000	0.000	0.001	0.001	-0.0701***	-0.0692***
	(0.269)	(0.307)	(1.202)	(1.270)	(3.282)	(3.220)
Letters of credit / assets	-0.639**	-0.630**	-1.980***	-1.921***	0.890***	0.884***
	(2.486)	(2.458)	(4.911)	(4.770)	(3.429)	(3.409)
Observations	92,958	92,958	53,555	53,555	39,403	39,403
R-squared	12%	12%	11%	11%	16%	16%

Table 5
Within-Bank Results

This table reports within-bank regressions of the relative business in nonjumbos, the retention rate, and the loan approval rate. For each bank-year, we construct there three variables for each MSA in which the bank makes mortgages. The primary market indicator equals one for the market where the bank has its highest share of loans. In columns (2)-(5), each of these is computed separately for nonjumbos and jumbos. For these tests we include only banks with at least 75% of their loan applications in one market. 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 bank, year, and MSA 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.

	Volume of Approved Nonjumbos - Volume of Jumbos)$_t$/Total Volume$_{t-1}$	**Number of Approved Mortgages / Number of Applications**		**Volume of Approved Mortgages Retained on Balance Sheet / Volume of Approved Mortgages**	
	(1)	(2)	(3)	(4)	(5)
Primary Market Indicator	-0.252***	0.0426***	0.0506***	0.0314***	0.0398***
	(25.81)	(49.89)	(52.66)	(20.06)	(22.64)
Jumbo * Primary Market	-	-	0.0292***	-	-0.0314***
	-	-	(18.080)	-	(10.490)
Jumbo-loan indicator	-	0.00043	-0.0171***	0.0939***	0.113***
	-	(0.481)	(12.990)	(56.47)	(45.950)
Securities / assets	0.0233	-0.0167**	-0.0155**	0.0612***	0.0599***
	(0.284)	(2.208)	(2.057)	(4.40)	(4.313)
Interest on deposits / deposits	-1.024	-0.013	-0.014	0.368**	0.370**
	(1.132)	(0.161)	(0.179)	(2.49)	(2.499)
Log of assets	-0.0911***	-0.0024	-0.00247	-0.0156***	-0.0155***
	(4.964)	(1.492)	(1.538)	(5.28)	(5.242)
Indicator if owned by BHC	-0.0232	0.000744	0.000871	-0.0109***	-0.0110***
	(1.062)	(0.373)	(0.436)	(2.97)	(3.004)
Capital / assets	0.912***	0.0177	0.0171	0.245***	0.245***
	(3.029)	(0.783)	(0.757)	(5.91)	(5.920)
Deposits / assets	0.319***	0.481***	0.488***	0.0545	0.0462
	(2.924)	(6.505)	(6.610)	(0.40)	(0.339)
Net income / assets	0.984	0.00562	0.00412	0.120***	0.122***
	(1.009)	(0.565)	(0.415)	(6.58)	(6.666)
Real estate loans / assets	-0.846***	0.004	0.005	0.000391	0.000
	(9.294)	(0.477)	(0.541)	(0.03)	(0.016)
C&I loans / assets	-0.638***	0.0155	0.0165*	-0.115***	-0.116***
	(5.681)	(1.547)	(1.647)	(6.23)	(6.298)
Unused loan commitments / assets	0.016	0.00835**	0.00832**	-0.000626	-0.001
	(0.325)	(2.453)	(2.445)	(0.10)	(0.102)
Letters of credit / assets	1.250***	-0.398***	-0.402***	-0.372***	-0.366***
	(2.632)	(10.020)	(10.150)	(5.12)	(5.035)
Observations	76,678	179,659	179,659	177,784	177,784
Number of Fixed Effects	7,190	7,977	7,977	7,977	7,977
R-squared (within)	5%	4%	4%	5.4%	6%

Table 6

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)	0.000720***	0.000927***	0.00748***	0.00975***	-0.00277***	-0.00442***
	(9.148)	(11.810)	(8.658)	(11.420)	(7.349)	(10.210)
Loan concentration (number)		-0.00295***		-0.0323***		0.0233***
* Growth in Case-Shiller Index		(6.446)		(6.407)		(8.694)
Observations	247,620	247,620	247,620	247,620	250,170	250,170
R-squared	30%	30%	33%	33%	4%	4%
			Panel B: Heavy Mortgage Lenders (originations / assets > median)			
Loan concentration (number)	0.000737***	0.000949***	0.00748***	0.00988***	-0.00296***	-0.00568***
	(7.288)	(8.935)	(6.766)	(8.503)	(5.868)	(9.249)
Loan concentration (number)		-0.00290***		-0.0327***		0.0367***
* Growth in Case-Shiller Index		(3.926)		(3.927)		(8.448)
Observations	124,344	124,344	124,170	124,170	125,499	125,499
R-squared	33%	33%	36%	36%	4%	4%
			Panel C: Prior to 2001			
Loan concentration (number)	0.000761***	0.000989***	0.00773***	0.0102***	-0.00452***	-0.00727***
	(8.310)	(9.692)	(7.629)	(9.006)	(8.631)	(10.620)
Loan concentration (number)		-0.00499***		-0.0538***		0.0593***
* Growth in Case-Shiller Index		(4.619)		(4.410)		(9.232)
Observations	136,825	136,825	136,516	136,516	137,873	137,873
R-squared	32%	32%	34%	34%	6%	6%
			Panel D: Post 2001			
Loan concentration (number)	0.000724***	0.000865***	0.00749***	0.00950***	-0.00133***	-0.00151***
	(7.114)	(8.176)	(6.663)	(8.192)	(2.982)	(3.079)
Loan concentration (number)		-0.00155***		-0.0221***		0.0021
* Growth in Case-Shiller Index		(3.446)		(4.461)		(0.851)
Observations	110,795	110,795	111,104	111,104	112,297	112,297
R-squared	28%	29%	31%	32%	5%	5%

Table 7

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%