Risk-taking by banks:
What did we know and when did we know it?

by
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Abstract

The *composition* of risks assumed by U. S. commercial banks underwent a dramatic transformation over the years leading up to the financial crisis: between 2000 and 2006 idiosyncratic risk dropped by almost half while systematic risk doubled. These patterns, more pronounced in banks with heavy involvement in residential mortgage lending and securitization, were accompanied by higher earnings per share performance. The stock market's response to these changes was, however, not uniformly enthusiastic. Banks heavily engaged in residential mortgage lending started exhibiting lower earnings response coefficients and had lower stock returns even prior to the crisis. Their managers, on the other hand, earned significant amounts through compensation plans heavily geared to short-term earnings. Our analysis provides strong support for the view that, even though financial markets were able to identify banks engaging in excessively risky lending activity long before the onset of the financial crisis, managerial compensation schemes failed to respond effectively to dramatic changes in the risk taking environment engendered by increased levels of securitization.

Keywords : Banking Crisis, Subprime Mortgage, Financial Crisis, Earnings Response Coefficient, Managerial Compensation.

JEL classification codes: G21, G32, D82

1 Introduction

The analysis of the causes of the financial crisis in the U.S. during 2007-2009 has followed three distinct tracks. One track focuses on the important role played by the shadow banking system in the securitization of mortgage loans. It characterizes the dramatic collapse in lending and stock prices of financial intermediaries as a bank run in wholesale markets (see Gorton (2008), Gorton and Metrick (2009), Hsu and Moroz (2010) for examples), triggered perhaps by shocks to house prices. A second track examines the incentives provided by the securitization process to skimp on adequate due diligence in the origination process (see Keys *et al* (2008), Purnanandam (2010) for examples) and concludes that, indeed, screening standards were affected adversely by the prospect of securitization. A third track focuses on the role of banks in originating unduly risky loans and also examines the incentives of bank management to originate risky loans (see Fahlenbrach and Stulz (2011) and Acharya and Richardson (2009) for examples).

While all these lines of attack provide both valuable insights and establish the merits of *ex post* investigation, all essentially take the contemporaneous financial market as a passive bystander till the crisis erupted. In this paper, we focus instead on what markets knew about excessive risk-taking by commercial banks as it happened. We first study the operations of all publicly held commercial banks in the U.S., with a particular emphasis on their mortgage lending and securitization activity during the period 2000-2006. We look for and find signs that the financial markets were able to identify instances of excessive risk-taking well in advance of the market meltdown to come. We then examine why, in spite of market signals about excessive risk-taking, bank managers kept originating risky loans.

We document remarkable changes in the *composition* of risk-taking by banks from 2000 to 2006. While measured levels of idiosyncratic risk dropped by almost a half, the level of systematic risks (measured by CAPM β) associated with banking stocks more than doubled. These patterns were more pronounced in banks that engaged heavily in mortgage lending and securitization activities during this period. This relationship is especially strong for years 2003-2005, a period that coincides with tremendous growth in mortgage lending and securitization activities. It is important to note that the increase in systematic risk and its relationship with mortgage lending is not explained away by the increasing size of banks or by changes in their leverage levels. Overall, these findings suggest that while banks were able to shed off their firm-specific risks by adopting the private-label mortgage securitization technology, concomitantly they were assuming significantly higher economy-wide risk. Thus, securitization-driven lending allowed banks to partially insulate their performance from the local idiosyncratic shocks while, at the same time, making them more dependent on general macro-economic conditions. While we do not explore the precise channels through which these effects occur, our results are consistent with the view that the availability of funds to sustain the securitization market is pro-cyclical and with the general idea that securitization connects traditional banking activities more closely to the broader capital markets.

The assumption of increased systematic risk coincided, on average, with higher stock returns during this period. At an aggregate level, banks earned significantly higher positive returns during the later half of our sample period (2003-2006) compared to the earlier half (2000-2002). However, a cross-sectional analysis reveals that banks that engaged in higher mortgage lending activity in the years leading up to the crisis had disproportionately lower stock returns. Our results, therefore, suggest that shareholders did not expect future cash flows from very high levels of mortgage exposure to be high enough to adequately compensate them for the higher systematic risk exposure. When we focus on earnings per share, we find that this measure did, indeed, increase for banks heavily engaged in mortgage lending. Together these findings suggest that markets perceived these earnings as being excessively risky. To test this interpretation more directly, we compute the earnings surprises of these banks on their quarterly earnings announcement dates and analyze the market's stock price reaction to such surprises. There is a remarkable drop in the earnings response coefficient (stock price reaction to a unit surprise in earnings) for banks with higher involvement in mortgage lending during this period. In other words, earnings reported by high mortgage banks were perceived as less credible and a signal of excessive risk-taking by the banks. In addition, we show that banks with lower stock price responses to earnings surprises in the pre-crisis period had disproportionately higher mortgage default rates at the advent of the crisis in 2007. Thus, the financial market seems to have been aware of excessive risk-taking by banks engaged in high levels of mortgage activity.

Our results suggest, therefore, that the subprime mortgage crisis was not a complete surprise for market participants. While runs on the shadow banking system may very well have exacerbated the magnitude of the financial crisis to a degree unanticipated by the financial markets, investors appear to have been able to correctly understand the risk-taking behavior and implications for earnings quality of banks in the cross-section. But, in turn, this raises the following important question: why were banks taking on excessive risk despite compromising on stock performance? Blinder (2009), among others, has suggested that misaligned incentives of bank managers led them to take on excessive risks. To explore this line of reasoning, we look at the structure of compensation for bank CEOs. We show that bank CEOs' compensation depends heavily on the earnings per share measure. Thus, heavy mortgage-related activities that resulted in concomitant increase in earnings per share resulted in larger compensation packages for the CEOs. We also show that banks with higher sensitivity of CEO's compensation to short-term earnings experienced higher mortgage default rates in 2007.

We interpret these findings as consistent with an economic model where CEOs assume substantial systematic risk to boost their company's short term earnings in an environment of rising markets. While the effect of increased risk is likely to be felt in economic downturns, CEOs are awarded significant financial packages for posting large short term earnings. With the advent of private-label mortgage securitization, a bank's ability to generate short term earnings at the expense of higher systematic risk increased considerably during the 2000-2006 period. However, the nature of their compensation contract and, in particular, the sensitivity of their compensation to short term earnings, remained essentially unchanged from the pre-2000 period. Thus, CEO compensation structures did not adjust adequately to counteract managerial incentives to assume higher risks to produce higher short term earnings with the help of the new securitization technology.

We are not the first to examine the link between managerial incentives and risk-taking in the context of financial firms during the financial crisis. In an influential paper, Fahlenbrach and Stulz (2011) also examine this link and argue that stock holdings by rational CEOs would tend to counter any incentives to maximize short run compensation through the assumption of excessive risk through lending. In contrast, Cheng *et al.*(2009) find that annual CEO compensation in the financial sector is positively correlated with risk measures even though CEOs have high levels of insider ownership of stock. Our results are in broad agreement with those in Cheng *et al.*(2009) with the caveat that our sample is restricted to commercial banks while both Fahlenbrach and Stulz (20011) and Cheng *et al.*(2009) analyze samples that include investment banks. Together with these papers, our study provides important inputs to the ongoing academic and policy debate on managerial compensation and risk-taking in financial firms (see Bebchuk, 2009; Diamond and Rajan, 2009; Levine, 2010). We also contribute to the literature on managerial compensation by highlighting the need for optimal compensation structures to adapt to technological innovations that impact the risk taking environment.

Our analysis is also related to that in Coval *et al.*(2009) who claim that investors relying on ratings measures tend to ignore relevant measures of risk associated with financial instruments they invest in. Thus, they end up paying excessive prices for investing in what they mistakenly believe are less risky securities. Collin-Dufresne *et al.*(2010) present an alternative pricing scheme to show that tranches of mortgage-backed securities may not have been mis-priced and, instead, suggest that misaligned incentives for managers of investment firms may have been responsible for their assumption of excessive risks through the acquisition of tranches of mortgage backed securities. Our analysis shows that misaligned incentives may very well have played a substantial role in the origination and assumption of excessively risky loans in the primary markets in addition to the role they may have played in secondary markets. Finally, our study is also related to a growing literature in mortgage lending and bank risk-taking such as Loutskina and Strahan (2010), Demyanyk and Van Hemert (2011), and Acharya et al. (2009).

The rest of the paper proceeds as follows. Section 2 describes the data and provides descriptive statistics. Section 3 presents the results and Section 4 concludes.

2 Data and Descriptive Statistics

We gather data from multiple sources. Bank accounting statements are from their call report filings, quarterly earnings surprises from the I/B/E/S database, stock returns from CRSP and information on CEO compensation from the Executive Compensation Database of Compustat. The call report data of every commercial bank for each year from 2000 to 2006 are consolidated at the holding company level and bank holding companies are matched to their CRSP permanent number codes using a link file maintained by the Federal Reserve Bank of New York. Returns and risk measures at the holding company level are computed using the CRSP daily stock return database. To enter our sample, a bank holding company needs to be publicly traded and covered in both the CRSP and I/B/E/S databases. The sample is further restricted to firms covered by the Executive Compensation database when we look at CEO compensation. All variables are winsorized at the 1% level from both tails of the distribution to minimize the effect of outliers. For ease of exposition, we refer to bank holding companies as banks in the rest of the paper.

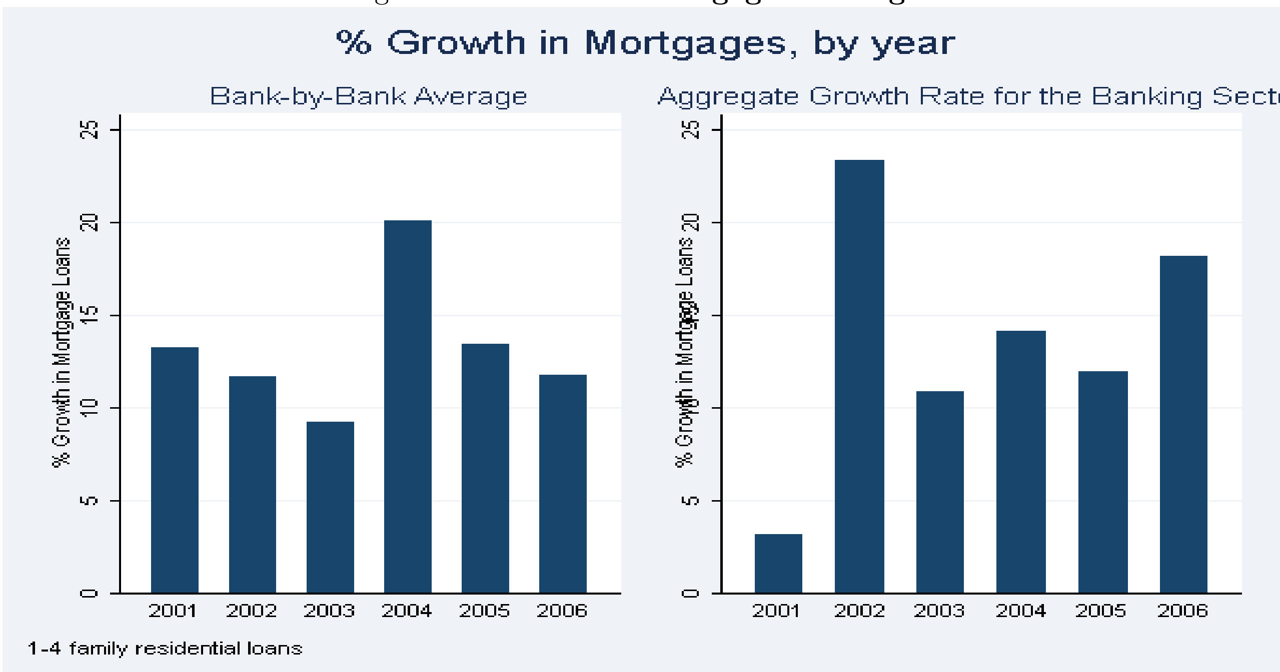
Our primary sample is an unbalanced panel of 1836 bank-year observations from 2000 to 2006, ranging from 233 to 278 banks annually. Starting the sample period in 2000 ensures that it begins prior to the major acceleration in lending growth in residential mortgage markets. It also ensures that the starting point captures the effects, if any, of the enactment of a series of important bank-related regulatory changes in the late 1990s.[1] Our sample stops just short of the onset of the financial crisis due to our focus on understanding the market's perception of bank performance and risk-taking prior to the crisis. In some of our tests we also estimate default rates on residential mortgage portfolios using data from 2007. We cover practically all large and medium-sized U. S. commercial banks: banks in our sample have average assets of $21.79 billion (call report data item: RCFD2170) and median assets of $2.09 billion. A bank's exposure to the mortgage market is measured by scaling its outstanding exposure to one-to-four family residential mortgages (call report data item: RCON1797+RCON5367+RCON5368) by its total assets.[2]

In our sample, the average bank's mortgage to total assets ratio is 17%. Individual bank exposure ranges from 0% to 48% with significant cross-sectional and time-series variation. Figure 1 plots the year-over-year growth rate in banks' exposures to the residential mortgage market. We first compute bank-by-bank average growth rates and find that the average bank consistently increased its total mortgage holdings by double digit percentage points during the sample period;

[1] For example, the repeal of the Glass-Stegall Act and the enactment of the Commodities and Futures Modernization Act of 2000.

[2] To clarify, we first sum mortgages held by all subsidiaries of a bank holding company and then scale this by their aggregated total assets.

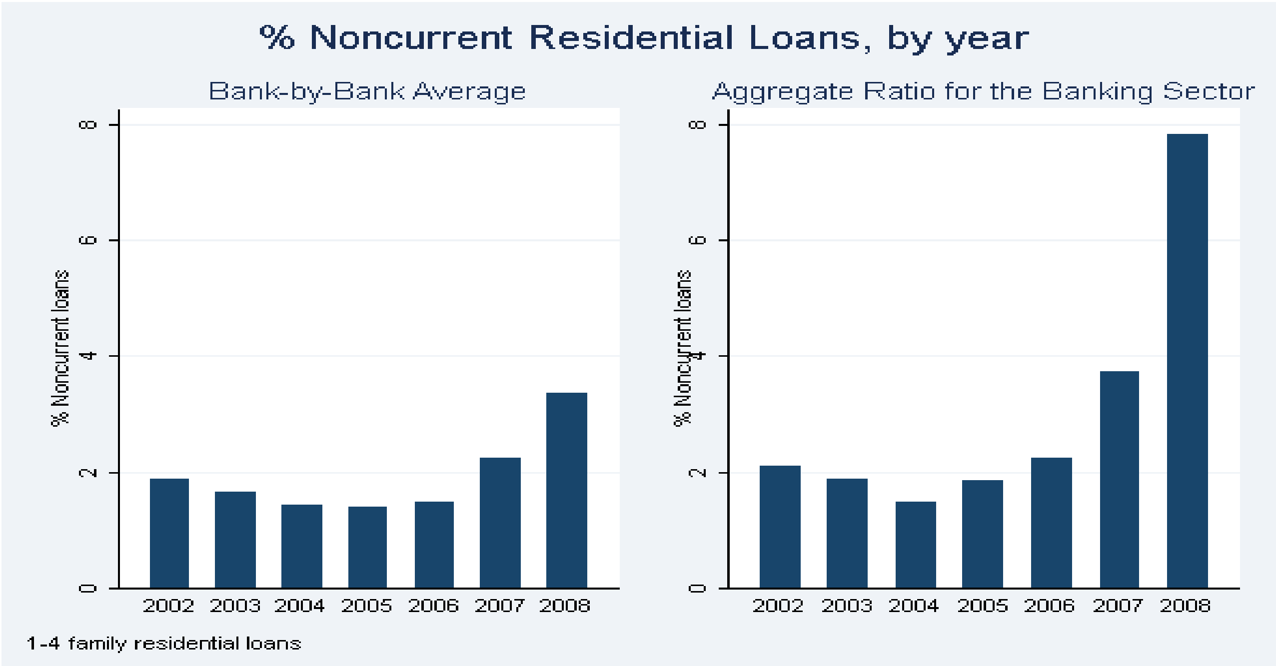
Figure 1: **Growth in Mortgage Lending**



in 2004, the average bank's mortgage lending portfolio grew by about 20%. To estimate the growth in mortgage loans exposure of the entire banking sector, we also compute the rate of growth of mortgage loans for the entire sample. In 2002, our sample of commercial banks grew their mortgage exposure by over 20%. This was followed by annual growth rates of 10-18%. Overall, we confirm the anecdotal evidence that banks considerably increased their exposure on this count in the pre-crisis period: large banks witnessed their highest growth in 2002 and relatively smaller banks experienced peak growth in 2004.

Figure 2 plots the default rates of these loans from 2002 to 2008. We measure the default rate by the percentage of non-current residential mortgages. In their call reports banks report all residential mortgages behind on their payment obligations, along with the duration of delinquency, for example, for 30 or 90 days. We classify all non-current and delinquent loans as being in default and construct our measure by adding call report items RCON5398, RCONC236, RCONC238, RCON5399, RCON5400, RCONC237, RCONC239, RCONC229, and RCONC230. We then scale this number by the outstanding mortgage loans to get default rates. The average bank's default rate

Figure 2: **Mortgage Default Rate**



increased from less than 2% in 2006 to about 4% in 2008. On an aggregate basis, the default rate of the entire sample jumped from about 2% in 2006 to almost 8% by the end of 2008. Thus, larger banks experienced significantly higher rates of default during the first two years of the financial crisis.

Table 1 provides summary statistics of other variables used in the study. The average bank had about 12% of its assets in commercial and industrial loans. On the liability side, 67% of their capital came from non-demandable deposits and 9% from demand deposits. During our sample period, banks were highly profitable: return on equity for the average bank was about 13%, and earnings per share was $1.82. High profitability was accompanied by high average stock returns of about 18% during the sample period. Overall, we find that the period leading up to the onset of the financial crisis represents a period of very high growth in mortgages, high earnings and positive stock returns for the average bank.

3 Results

3.1 Risk

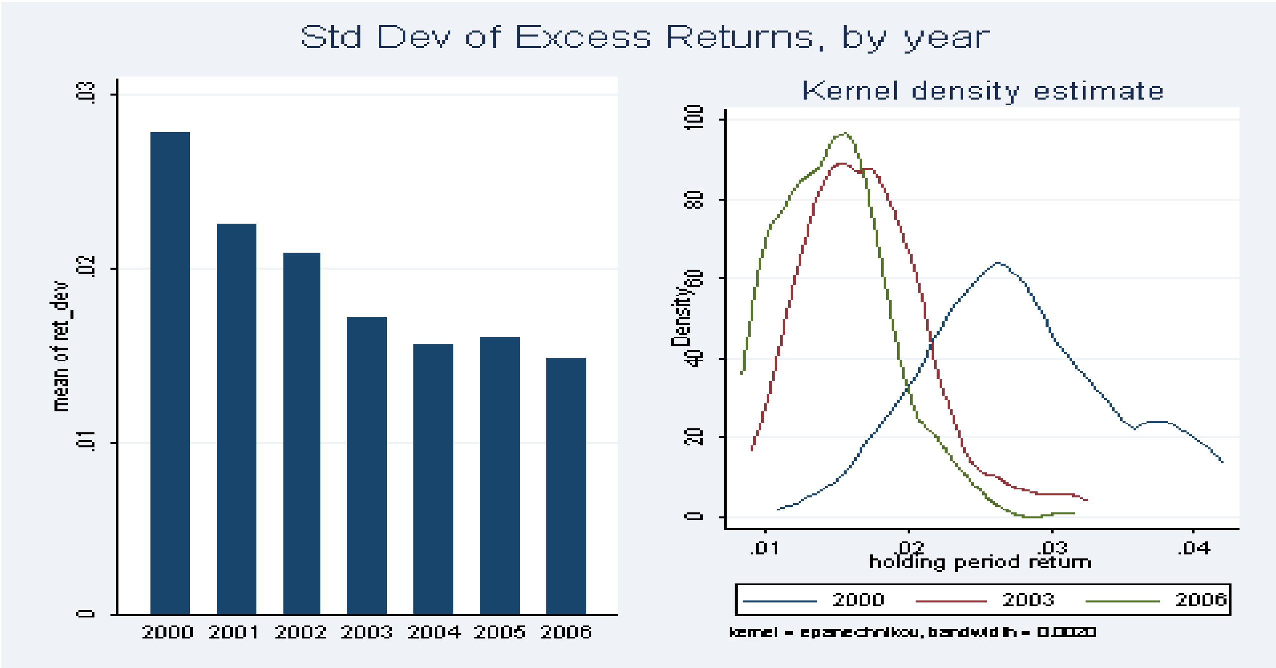
Was the rise in default rates of mortgage loans attributable to banks taking on greater levels of risk in the pre-crisis period? Did the nature of risk-taking by banks change during this period? If so, were the financial markets able to correctly infer such changes contemporaneously? These questions have significant implications for our understanding of the crisis and of the informational efficiency of financial markets. Answers to these questions would also inform recent policy debates about risk-taking by banks.

We begin our analysis by looking at the level of total risk in stock returns during the sample period. We calculate the standard deviation of daily stock returns for each bank for each year during 2000-2006 and plot the results in Figure 3. The figure depicts both the average values over time and the distribution of the standard deviation measure cross-sectionally for three of these years. Clearly, according to the market's perception, bank stocks' total riskiness declined secularly over this period. Moreover, the dispersion in the total risk measure also declined steadily over this period. There is no evidence to indicate that the stock market thought banks were increasing their total risk exposures.

In the wake of the significant rise in defaults on residential mortgage loans post-2007, it has been widely asserted that mortgage lenders took on excessive amounts of risk in the pre-crisis period. However, the evidence above suggests that, in the view of the financial markets, the banking sector's overall risk was declining secularly. While it is tempting to conclude that the markets were systematically fooled, the evidence is also consistent with the phenomenal rise of securitization-driven lending. Over our sample period, the Securities Industry and Financial Markets Association (SIFMA) reports that the issuance of mortgage-related securities in the U.S. increased from $684 billion in 2000 to a peak of $3,071 billion in 2003 before declining to $1,987 billion in 2006.[3] The typical securitization bundle was structured to diversify away local risk by combining mortgages originated in different parts of the country. A rise in securitization activity, then, should show up in

[3]See http://www.sifma.org/uploadedFiles/Research/Statistics/SIFMA_USBondMarketIssuance.pdf

Figure 3: **Total Risk**



a reduction of idiosyncratic risks in bank stocks, especially for less geographically diversified smaller banks exposed to higher levels of idiosyncratic risk.[4] To test this hypothesis, we regress daily excess stock returns (over the risk-free rate) on the excess return of the value-weighted market index and compute residuals for each bank. Figure 4 presents the calculated standard deviations of these residuals: the left panel shows the evolution of the yearly average over time and the right panel presents the cross-sectional distribution during selected years. Consistent with our hypothesis, there is a marked lowering of the level of idiosyncratic risk associated with bank stock returns over this period. Comparing with Figure 3, it is easy to see that the fall in total risk levels was essentially driven by the fall in the levels of idiosyncratic risk. Figure 4 also shows that the reduction in idiosyncratic risk was markedly concentrated in banks that started out the period with the highest levels of idiosyncratic risk. These patterns are consistent with the idea that the rising levels of securitization played a significant role in influencing the markets' inferences about risk-taking by banks over this period.

[4]See Allen and Carletti, 2006, for a discussion of the welfare implications of credit risk transfers.

While the effect of increased securitization on measured idiosyncratic risk is relatively straightforward to see, the implications for systematic risk are not as obvious. There are two non-mutually exclusive channels through which securitization-based lending can increase a bank's systematic risk. The first is a supply-side effect emanating from the increased availability of funds to support securitization. Given the procyclical nature of this funding availability, increased securitization may have a positive impact of systematic risk. The second channel is through possible changes in the bank's lending portfolio. Compared to the traditional originate-and-hold model of lending, securitized lending frees up bank capital and allows for greater levels of lending. Of course, increased lending with the same levels of diligence need not affect a bank's systematic risk exposure. A lower level of idiosyncratic risk exposure may, however, encourage bankers to take on higher systematic risk exposure if their principal focus is on total risk levels. Additionally, laxer lending standards would also increase the systematic risk of banks since loans with higher loan-to-value ratio or loans to lower income borrowers are more sensitive to general economic conditions. The provision of near-term performance guarantees for sold loans would only augment such exposure. While all these factors argue for increased correlation of individual bank performance with the general economy, they could all be, in principle, offset by a more conservative lending policy. So, the net impact of securitization activity on systematic risk is, in principle, ambiguous.

To study the dynamics of systematic risk of U.S. commercial banks we regress their excess returns on the excess return on the value-weighted market index to obtain CAPM betas.[5] We compute betas on an annual basis from 2000 to 2006. As an alternative model (unreported), we regress bank stock returns on the value weighted market return as well as the return on risk-free treasury bonds. We call the estimated coefficient on the market return variable the two-factor-based market-beta of the bank. Figure 5 presents the evolution of betas for the entire sample. The market-model beta of the average firm is about 0.40 in 2000 but increases more than 100% to about 1 by the end of the sample period. As a point of comparison, Flannery and James (1984) estimate an average market beta of about 0.55 for their sample of 67 commercial banks over 1976-1981 (see

[5]Our results are robust to corrections for non-synchronous trading bias. In this alternate specification, we compute betas by regressing daily stock returns on both contemporaneous and lagged values of market return. Because our results do not change, we do not present these estimation results.

Figure 4: **Idiosyncratic Risk**

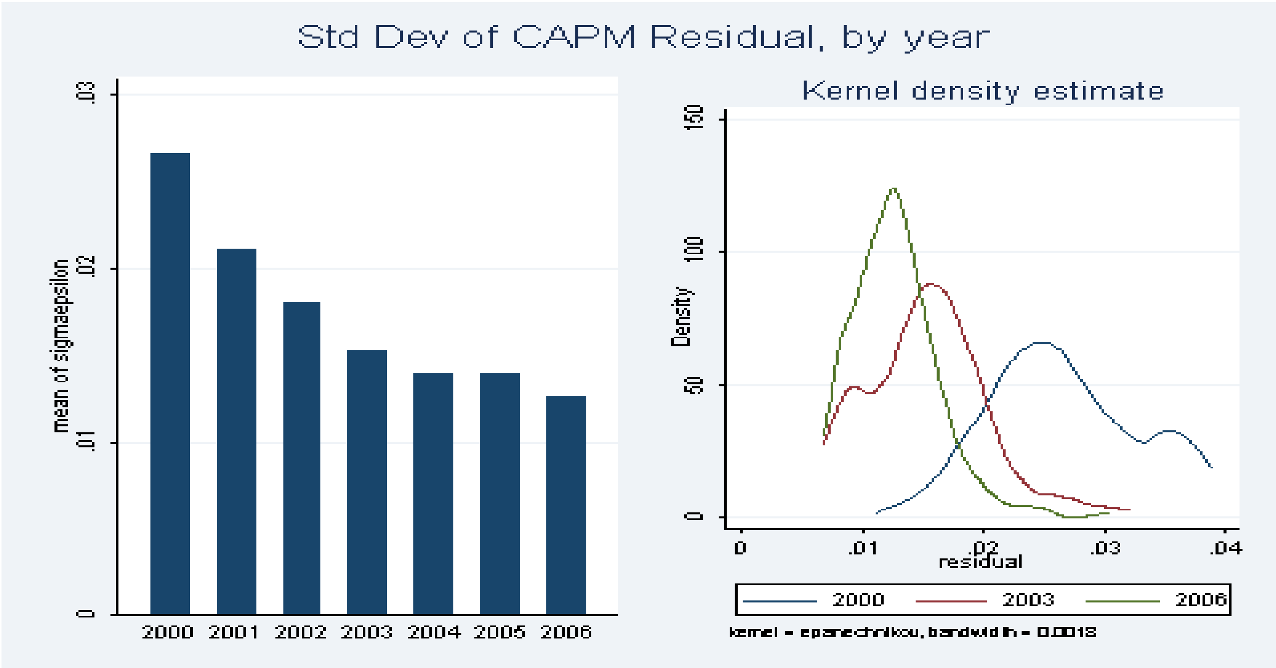
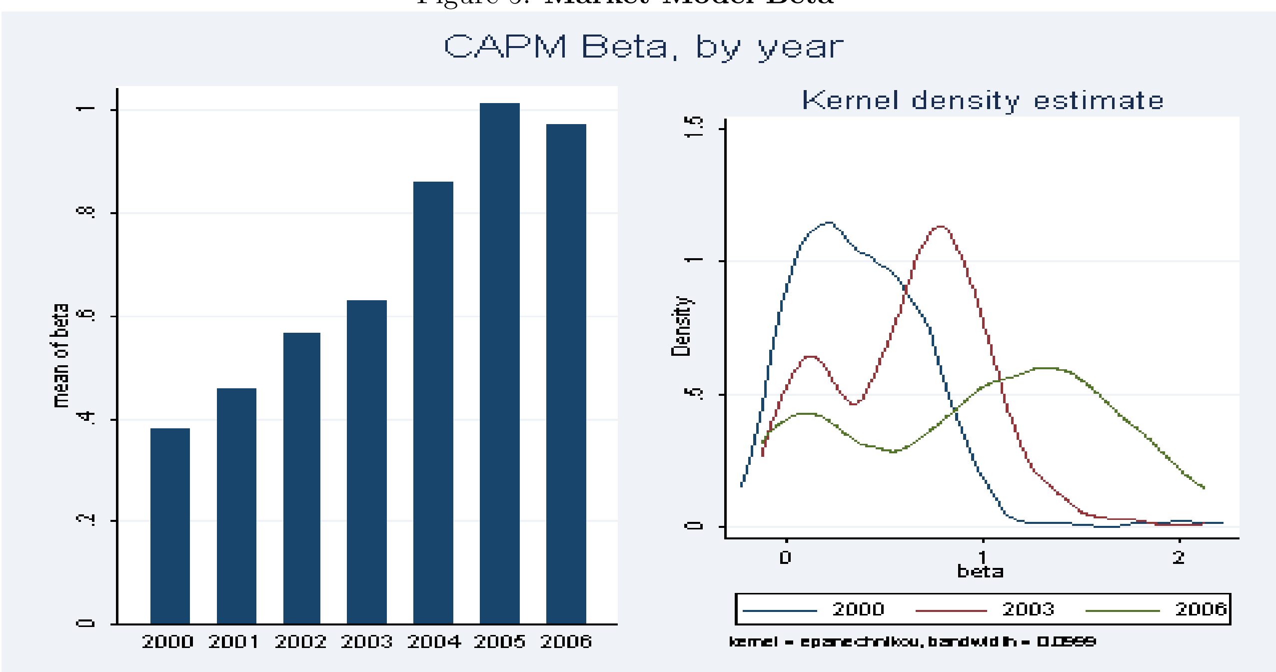


Figure 5: **Market Model Beta**



their Table III, page 1147). We also plot the entire distribution of the market-model beta for three years, namely, 2000, 2003 and 2006 in the figure. There is a remarkable rightward shift in the entire distribution of banks' systematic risk exposures. Similar results (unreported) hold for betas estimated using the two-factor model. These results establish that, in the market's assessment, banks' systematic risk exposures dramatically increased over the years leading up to the crisis. It's important to note that, over our sample period, the balance sheet leverage ratios of commercial banks did not increase significantly: the total equity to asset ratio of the average bank went from 8.46% in 2000 to 9.99% in 2006 in a fairly steady manner. While it is possible that off-balance sheet leverage ratios might have partly contributed to the dramatic increases in the market-betas of bank stocks, it is not attributable to the increased balance-sheet based financial risk exposure of the average bank. It is also important to note that the increased proportion of the banking sector in the entire economy during this time period could have contributed to the increase in the average levels of market beta. As a result, in subsequent analyses, we focus on the cross-sectional determinants of the increase.

Overall, our results show a remarkable change in the *composition* of bank risk-taking. In the market's opinion, banks were increasingly becoming safer on the idiosyncratic risk dimension whereas their systematic risk exposure was increasing almost secularly. In the rest of this paper, we explore the determinants of these changes and their implications for shareholder wealth and managerial compensation.

3.2 Mortgage exposure and risk-taking

To formally explore the connection between increased securitization activity and the changes in composition of risk exposures, we run several tests. In our first test, we estimate the following regression equation:

$$risk_{it} = \alpha_i + a_1 * after_t + a_2 * \frac{mort}{TA}_{it} + a_3 * \frac{mort}{TA}_{it} * after_t + \sum \gamma X_{it} + \epsilon_{it} \qquad (1)$$

The dependent variable is our measure of risk for bank i in year t: the annual market-beta is our measure of systematic risk and the natural logarithm of the standard deviation of the market-model residual is our measure of idiosyncratic risk.[6] The right hand side variable, $mort/TA$, is the fraction of mortgage lending in a bank's total asset portfolio. Prior to the third quarter of 2006, commercial banks were not required to detail their securitization activity in their regulatory filings. As a result, no reliable measure of bank-level mortgage securitization activity is available for the early part of our sample period. Given the widespread use of securitization by banks, however, it seems reasonable to assume that mortgage intensity of their assets is highly correlated with their securitization activity. Therefore, in most of our tests, we use this measure as our proxy for bank securitization activity. Later tests establish that our results are robust to the use of a direct proxy of securitization-driven lending that became available in later years.

α_i denotes bank fixed-effects and standard errors are clustered at the bank-level (see Bertrand, Duflo, and Mullainathan, 2004). $after_t$ is an indicator variable for the period 2003-2006 that allows us to compare risk levels of bank stocks in years closer to the crisis with those in earlier periods. In an alternate specification, we replace $after$ with the indicator variable $peak$ for years 2003-2005; the only difference in $peak$ and $after$ being the exclusion of year 2006. The alternate model allows us to focus specifically on the market's assessment of bank risk-taking during the peak of the residential loan origination activity before any visible signs of declines in real estate prices or rise in mortgage default rates. Also, Mian and Sufi (2010) show that 2002 to 2005 is the only period in almost two decades when incomes and mortgage credit growth were negatively correlated. Thus, our second model allows us to estimate the marginal effect of mortgage lending on risk measures during a unique period of mortgage lending activity characterized by significant lending growth despite negative earnings growth in poorer neighborhoods.

Our principal focus is on a_3, which measures the effect of mortgage lending intensity on measures of bank risk in the later half of the sample as compared to the earlier half. We capture the time effect of increase in risk through the $after$ variable and the level effect of mortgage lending on risk by $mort/TA$. Thus, a_3 can be interpreted as the incremental effect of mortgage exposure on systematic or idiosyncratic risk in later periods. We include control variables, X, to control for the size effect, other lending activities, and the liability structure of the bank. These variables include

[6] We use the natural logarithm of the standard deviation of market-model residuals to eliminate the effect of outliers on our estimation results.

commercial and industrial lending exposure (cil/TA) of the bank, non-demand deposits-to-total assets, and demand-deposit-to-total assets ratios. We break deposits into demandable and non-demandable groups because of the differences in their impact on a bank's financial fragility (see Diamond and Dybvig (1983)). We include the logarithm of total assets to control for any effect of bank size on risk measures. We also include its squared value, $logta^2$, to isolate the effect of very large banks as they are likely to have a higher ability to hedge their risks in the derivatives markets. In addition, as has been often argued, such large banks enjoy implicit too-big-to-fail government guarantees. As noted earlier, we repeat our tests with *peak* in place of $after$.

Results are provided in Table 2. Models 1 and 2 use systematic risk measure as the dependent variable. We find positive and significant coefficient on $mort/TA * peak$. The coefficient on $mort/TA * after$ is positive, but not significant at conventional levels. These results show that in years closer to the collapse, banks were loading up on significant amounts of systematic risk through their mortgage lending and securitization activities. This effect is especially pronounced for the 2003-2005 period, coinciding with the considerable growth in mortgage origination to inferior borrowers documented in Mian and Sufi (2010). By our estimate, a single standard deviation increase in mortgage exposure translated into an increase of about 12% in the market beta[7] during the peak period. While the increase in mortgage exposure is not able to explain away all the increase in beta around this period, its effect is significant. When we estimate the same model excluding mortgage ($mort/TA$) and its interaction with *peak*, the estimated coefficient on *peak* is 0.18. This is the unconditional increase in beta during *peak* years as compared to the rest. With the inclusion of the interaction variable, this coefficient drops to 0.08 and a significant portion of the increase in beta gets explained by the interaction term.

Models 3 and 4 use our idiosyncratic risk measure as the dependent variable. We find a negative and significant coefficient on the interaction of $mort/TA$ and *peak*. Similar result holds for the interaction of $mort/TA$ with $after$. Overall, we find that in years closer to the crisis, banks with higher mortgage intensity experienced a greater decline in their levels of idiosyncratic risk. Our results suggest that increased securitization activity allowed banks to lower their idiosyncratic risk

[7] As a percentage of the sample average of beta during 2000-2002.

levels. Taken along with the large increases in systematic risk documented earlier, our analysis shows that securitization activity significantly affected the *composition* of risk levels for commercial banks.

The use of the mortgage intensity measure $mort/TA$ in the analysis above combines the effects of mortgage lending and asset size in a specific way. To separate out the effect of bank size from its level of mortgage lending activity, we estimate the following fixed-effect regression model:

$$
\begin{aligned}
risk_{it} \quad = \quad & \alpha_i + a_1 * after_t + a_2 * logmort_{it} + a_3 * logta_{it} + \\
& a_4 * logmort_{it} * after_t + a_5 * logta_{it} * after_t + \sum \gamma X_{it} + \epsilon_{it} \qquad (2)
\end{aligned}
$$

As before, we estimate this model with both $after$ and $peak$ as the periods of interest but only report results with $after$ to save space. $logmort_{it}$ denotes the logarithm of the dollar value of one-to-four family residential mortgage loans held on the bank i's balance sheet on December 31 of year t.[8] We introduce the interaction of both $logta$ and $logmort$ with $after$ to separately estimate the effect of these variables on market beta and idiosyncratic risk during the period of interest. Results are provided in Table 3. We find a positive and significant coefficient on $logmort * after$ in Model 1, indicating a higher impact of mortgage exposure on a bank's systematic risk during the latter half of our sample period. Model 2 finds, correspondingly, a significant negative impact of the interaction variable on idiosyncratic risk. While this variant confirms our earlier results, statistical significance levels are higher. Thus, once we separate out the effect of bank size from mortgage exposure, our results become stronger. Other results show that the effect of firm size on market beta decreased during the later periods. Thus, in the run up to the financial crisis, bank size correlates with relatively lower systematic risk levels and it is primarily its mortgage exposure that increases its beta and decreases its idiosyncratic risk.[9]

[8]There are 23 bank-year observations with zero values of residential mortgage loans outstanding. These observations get dropped in the log-transformed regression model. Since these observations represents only about 1% of the sample, there is no qualitative change in our results by dropping these observations.

[9]As a further robustness check, we include the interaction of $after$ ($peak$) with all the other bank characteristics that enter the model (i.e., interactions of cil/ta, td/ta, dd/ta with the period dummies) and find that the magnitude and significance of our results (unreported) on the $logmort * after$ and ($logmort * peak$) variables remain similar. Thus, the effect that we document does not get explained away by changes in other bank characteristics such as commercial lending, total deposits, or demand deposits of the bank.

3.3 A direct proxy of mortgage securitization

As mentioned earlier, our use of mortgage intensity as a proxy for the level of mortgage securitization activity is on account of data limitations. Consequently, it is conceivable that our interpretation of the results is driven by errors in the measurement of actual securitization activity. To address this possible concern, we make use of a direct proxy of securitization activity: the extent of Originate-to-Distribute (OTD) lending undertaken by a bank. All banks with significant exposure to mortgage lending or securitization were required to report this item pursuant to a regulatory change in 2006 (see Purnanandam (2010) for further details). We use this data from the first quarter of 2007, keeping in mind the general caveats associated with the use of ex post data. We repeat the analysis reported above using this measure of securitization activity. Specifically, we use the natural logarithm of OTD lending (called *logotd*) as the key explanatory variable.[10] Given the single period nature of this data, the coefficient on the *logotd* variable is subsumed in the bank fixed-effects in this model. Results are provided in Table 4. We find that our results, with respect to both systematic and idiosyncratic risk, remain unchanged. The rank correlation between OTD lending in 2007Q1 and the most recent year-end mortgage exposure (that is, December 31, 2006) is 63.44%, giving us further confidence in our empirical results based on the balance sheet data reported earlier.

The evidence we present above strongly suggests that the stock market clearly understood the changing nature of the risk exposure of banks in the pre-crisis period. The significant fall in the levels of idiosyncratic risk and the concomitant rise in stock betas appear to be driven by residential mortgage exposure and securitization activity. The former effect is a natural outcome of current and future expected securitization activity. The sensitivity of market betas to mortgage intensity, however, may have several explanations that we cannot disentangle. It is certainly consistent with the view that banks loosened their lending standards and underwrote loans with higher sensitivity to economy-wide factors. It is also consistent with early pay default warranties provided by sellers of mortgage loans and the typical delay of one or two quarters between the origination and sale of mortgage loans. Finally, it may also be the case that, over this period, the sensitivity of real estate

[10] We add one dollar to the extent of OTD lending to ensure that banks with zero amount of OTD lending are included in the sample.

assets to general economic activity rose secularly as the value of real estate as a portion of the global portfolio of risky assets rose due to rising prices. Whatever the precise reasons behind the strong association of the mortgage intensity measure with rising betas, it is clear that the market knew that the systematic risk exposure of commercial banks significantly rose over our sample period. What remains to be examined is whether stock holders obtained the rights to higher levels of cash flows to compensate them for this increased risk exposure. This is the topic to which we turn next.

3.4 Earnings

In this section, we first examine whether increased mortgage exposures led to higher cash flows for shareholders to compensate for the heightened levels of systematic risk borne by them. Since earnings per share (EPS) is widely used by analysts to compare economic performance of firms and also in managerial compensation plans that seek to align managerial incentives with that of shareholders, we focus on this measure. After examining the sensitivity of contemporaneously reported EPS to mortgage exposure over our sample period, we take a look at the market's estimation of the riskiness of firms as revealed by the stock price reactions accompanying earnings announcements.

We measure EPS by dividing the consolidated net income of a bank holding company by the number of shares outstanding at year-end obtained from the CRSP database.[11] Our regression model estimates the effect of mortgage lending on EPS on a yearly basis. We consider years 2000 and 2001 as the initial period, and include a dummy variable for each of the subsequent years from 2002 to 2006. We include the interaction of $mort/TA$ with these yearly dummies as explanatory variables, with $mort/TA$ itself included as a control variable. The estimated coefficients on the interaction terms measure the incremental effect of mortgage exposure on the EPS of a bank for the corresponding year.[12] The model is presented below:

[11]Because we use the CRSP dataset to measure outstanding shares, our EPS measure is not on a fully diluted basis. For a smaller subset of banks covered by the COMPUSTAT executive compensation database, we can measure EPS on a fully diluted basis. Our results remain similar for this subset.

[12]The effect is incremental over the effect of mortgage on EPS during years 2000 and 2001. As an alternative, we only exclude year 2000 from the sample and estimate separate coefficients for each year starting from 2001. All our results remain qualitatively similar and quantitatively stronger for this alternative model. We prefer to keep both 2000 and 2001 as the excluded years because this smoothes the base case estimate by averaging them over more years.

$$eps_{it} = \alpha_i + \sum_{k=2002}^{k=2006} a_k * year_k + b_1 * \frac{mort}{TA}_{it} + \sum_{k=2002}^{k=2006} c_k * \frac{mort}{TA}_{it} * year_k + \sum \gamma X_{it} + \epsilon_{it} \quad (3)$$

eps_{it} measures bank $i's$ EPS in year t and α_i denotes the bank fixed-effect. $year_k$ is an indicator variable that equals one for year k, and is zero otherwise. The year fixed effects control for unobservable shifts in the earnings potential of the banking sector. X_{it} are control variables included to capture differences due to size, commercial lending, and leverage ratios of banks. Results are provided in Table 5. The effect of mortgage intensity on EPS is significantly higher in 2002 compared to the 2000-2001 base period. The marginal effect reaches its peak value in 2003 after which it declines secularly till 2006. In the peak year of 2003, a single standard deviation increase in mortgage intensity translated into a 15 cent increase in a bank's EPS. Compared to the unconditional sample median EPS of \$1.70, this is an economically large effect. As a robustness exercise, we also estimate alternative models that compare the later half of the sample period with the earlier half, as well as the peak period of mortgage lending (2003-2005) with the remaining period. These models are of the following form:

$$eps_{it} = \alpha_i + a_1 * after_t + a_2 * \frac{mort}{TA}_{it} + a_3 * \frac{mort}{TA}_{it} * after_t + \sum \gamma X_{it} + \epsilon_{it} \quad (4)$$

All the right hand side variables have the same meaning as in our equation describing the bank risk regressions of the previous section. Results are provided in Table 6. Our results indicate that higher mortgage exposure was accompanied by boosted earnings per share in the years leading up to the crisis. The effect of mortgage exposure on earnings was particularly high during the peak years of 2003-2005 (see Model 1). Our estimates show that one standard deviation increase in mortgage exposure resulted in an increase of about 7 cents in earnings per share during these years. In an unreported test, we estimate this model with *logmort*, *logta*, and their interactions with *peak* to separate the effect of mortgage lending from the bank's size. We find a positive and significant coefficient on the interaction of *logmort* and *peak*, suggesting that higher earnings were actually generated by mortgage-related activities during these years. The effect of mortgage exposure on

EPS is positive but weaker in Model 2 indicating that the positive effect of mortgage exposure on earnings started to decline appreciably in 2006.

These results show that the assumption of higher systematic risk levels through mortgage lending was, indeed, accompanied by higher earnings performance. The clear pattern of earnings reaching a peak in 2003 and gradually declining thereafter establishes that the contemporaneous rewards to the assumption of increased systematic risk started declining well before the jump in mortgage defaults. We know from ex-post evidence that a significant proportion of newly originated mortgages defaulted in later years. We also know that fee-based incomes jumped along with the growth of securitization and loan sales. Was the market able to decipher associated risk-taking implications of such earnings-generating technologies well before actual defaults? We examine this possibility next by analyzing the market's reaction to earnings surprises of these banks.

3.4.1 Earnings Response Coefficients

We use the Earnings Response Coefficient (ERC) as a tool to uncover market beliefs about risk-taking conveyed by earnings announcements. ERC is defined as the stock market's reaction to an unit increase in a firm's *unexpected* earnings. Focusing on unexpected earnings allows us to draw sharper conclusions about market beliefs about future performance by focusing on performance signals *on the margin*. If a positive surprise in earnings were deemed to be obtained by engaging in higher risk activities, we should expect that the impact of such surprises would be muted compared to positive surprises that conveyed no information about excessive risk-taking. On the other hand, in an environment of rising global earnings, an earnings disappointment may very well convey the news that a bank did not engage in excessive risk-taking in order to boost current earnings. As a result, negative surprises may not be particularly informative about excessive risk-taking. Given this, if the markets were able to recognize that banks heavily engaged in mortgage lending were increasingly taking on excessive amounts of risk through their lending, we should expect their ERCs to have declined. Moreover, such a decline should be concentrated in the sub-sample of non-negative earnings surprises.[13]

[13] During the sample period, 70% of earnings surprises were non-negative.

We follow Livnat and Mendenhall (2006, pp. 184-186) in measuring earnings surprise as the difference between actual and expected quarterly earnings scaled by the firm's stock price. This measure, the Standardized Unexpected Earnings (SUE), is used widely in the Accounting literature. We use consensus analyst forecasts obtained from the I/B/E/S database to measure expected earnings.[14] For every bank-year observation, we have up to four quarterly data points for the ERC estimation. To avoid outlier problems, we winsorize the SUE number at 1% from both tails. We measure the market's reaction by the cumulative abnormal return (CAR) over the (-1, 1) day window surrounding the earnings announcement. We then compute abnormal returns with respect to corresponding daily returns on a portfolio of firms with similar size and book-to-market ratio. Returns on these benchmark portfolios are obtained from Professor Kenneth French's data library.[15] We match quarterly SUEs and corresponding CARs to each bank's balance sheet data as of December 31 of the prior year to ensure that the balance sheet information we utilize is available to the market as of the earnings announcement date.[16] We estimate the following bank fixed-effect regression model:

$$\begin{aligned} CAR_{iqt} &= \alpha_i + b_1 * SUE_{iqt} + b_2 * after_t + b_3 * \frac{mort}{TA}_{it} + c_3 * \frac{mort}{TA}_{it} * after_t + c_4 * \frac{mort}{TA}_{it} * SUE_{iqt} \\ &+ c_5 * SUE_{iqt} * after_t + c_6 * SUE_{iqt} * after_t * \frac{mort}{TA}_{iqt} + \sum \gamma X_{it} + \epsilon_{iqt} \qquad (5) \end{aligned}$$

α_i denotes bank fixed-effects, included to isolate bank-specific heterogeneity in reporting standards and disclosure policies. CAR_{iqt} and SUE_{iqt} are the cumulative abnormal return and earnings surprises associated with bank i in quarter q of year t. $\frac{mort}{TA}$ and $after$ are as defined earlier. We separate the unconditional effect of SUE, $\frac{mort}{TA}$ and time trend ($after$) using the levels of these variables. We include all the double interactions of SUE, $\frac{mort}{TA}$ and $after$ variables in the regression model as well as their triple interaction. The double interaction of SUE with $after$ measures the change in ERC during the later half of our sample and serves as a control for effects such as the passage of and compliance with SOX during this time period. Similarly, the coefficient on

[14] The computational details behind ERC calculations can be found in Livnat and Mendenhall (2006).

[15] see http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[16] For example, all earnings surprises in 2005 are matched with balance sheet data as of Dec 31, 2004. Robustness tests using a procedure matching SUEs in 2005 to balance sheet data in 2005 also yield similar results.

$SUE * \frac{mort}{TA}$ measures the average ERC of high mortgage exposure banks during the entire sample period. Our primary interest is on the coefficient on the triple interaction term, which measures the ERC of higher mortgage exposure banks during the years close to the financial crisis. X_{it} is a set of control variables that captures the effect of the bank's size: we include both log of total assets and its squared value to control for any non-linear effect of bank size. Standard errors are clustered at the bank level to account for correlations in error terms across multiple observations from the same bank.

Table 7 presents the estimation results. Model 1 provides results without using bank fixed effects, while model 2 incorporates them. As results are similar across these model specifications, we focus on the results in Model 2. As expected, we find a strong positive coefficient on SUE: markets respond positively to firms reporting higher than expected earnings. We also find a positive and significant coefficient on both SUE and its interaction with $after$, suggesting that the unconditional impact of earnings surprises actually rose in the later half of our sample period. Perhaps this is due to the passage of more stringent disclosure regulations like SOX in the aftermath of the Enron debacle. A strong negative coefficient on the triple interaction term, $\frac{mort}{TA} * after * sue3$ shows, however, that ERCs declined significantly for firms with higher mortgage intensity over the later half of our sample period. In other words, enhanced earnings performance reported by banks engaged in higher mortgage lending was discounted more heavily by the markets during this period. This suggests that financial markets were becoming increasingly skeptical, on the margin, about risk levels of earnings generated by high mortgage banks.

Models 3 and 4 in Table 7 present separate estimations of our main specification conditional on the nature of the earnings surprise: Model 3 presents estimates with non-negative surprises and Model 4 is for negative surprises only. In line with our expectations, the triple interaction term is significant in Model 3. Thus, in the markets' opinion, higher than expected earnings of high mortgage banks came from the assumption of excessive risk by these banks. For negative earnings surprises, however, there is no such distinction between high and low mortgage banks.

To provide further support for our interpretations above, we conduct two additional tests. First, we estimate a year-by-year cross-sectional regression model with CAR as the dependent variable and SUE, $\frac{mort}{TA}$ and their interaction term on the right hand side. We also include the logarithm of size and its squared term as control variables. The coefficient on the interaction term now represents the effect of high mortgage lending on ERC in a given year.[17] To preserve space we do not present complete results of this model but, instead, plot the yearly estimated coefficients on the interaction term in the first plot of Figure 6. As is evident, the effect of mortgage lending on ERC became significantly negative after 2003, attaining a peak in 2005-2006. The estimated coefficients are negative and significant in each of the 2003, 2004, 2005 and 2006 yearly regressions.

Second, we estimate a fixed-effects regression model closer in spirit to Model 2 above:

$$
\begin{aligned}
CAR_{iqt} \quad = \quad & \alpha_i + b_1 * SUE_{iqt} + \sum_{k=2002}^{k=2006} b_{2,k} * year_k + b_3 * \frac{mort}{TA}_{it} + \sum_{k=2002}^{k=2006} c_{3,k} * \frac{mort}{TA}_{it} * year_k \\
& + c_4 * \frac{mort}{TA}_{it} * SUE_{iqt} + \sum_{k=2002}^{k=2006} c_{5,k} * SUE_{iqt} * year_k \\
& + \sum_{k=2002}^{k=2006} c_{6,k} * SUE_{iqt} * year_k * \frac{mort}{TA}_{it} + \sum \gamma X_{it} + \epsilon_{iqt} \qquad (6)
\end{aligned}
$$

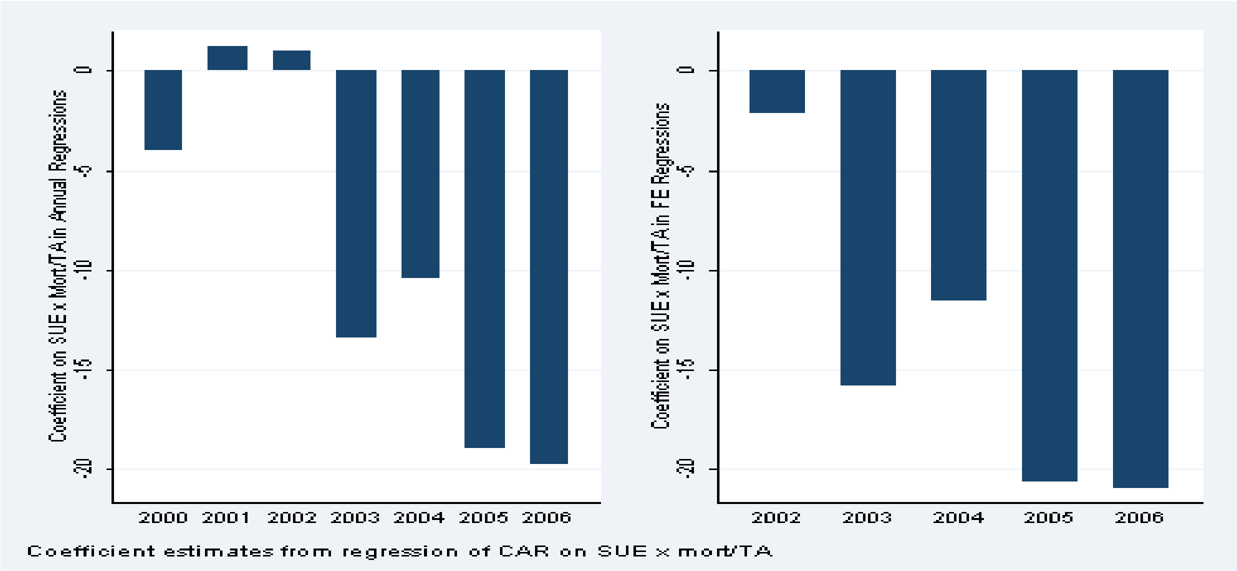
where $year_k$ is an indicator variable for observations in year k. Thus, the first two years of our sample (2000 and 2001) are taken as the base case and the incremental effect of mortgage lending on ERC for every subsequent year is found in the coefficients $c_{6,k}$.[18] To save space, we again just present our results in graphical form as the second plot of Figure 6. The yearly coefficient decreases significantly from 2003 and it is again evident that the sharpest decline occurs in 2005-2006.

Our analysis of the market's reactions to earnings announcement surprises establishes that the market's view of risk-taking changed dramatically on the margin for banks engaged heavily in mortgage lending. It is instructive to note that this change happened well before the downturn in the housing market and increased defaults on mortgages. This suggests that financial markets became aware of the increasingly risky nature of residential mortgage activity by banks in the years leading up to the crisis. In principle, such a reaction could also be consistent with a market-wide view of increased competition leading to lower levels of fee-based incomes and not a reflection of

[17] While instructive, this regression specification does not control for unobservable bank fixed-effects. Thus we prefer our earlier specification for reporting purposes.

[18] The model is similar to our earlier analysis but allows us to pin down the evolution of the mortgage-ERC relationship more precisely.

Figure 6: **Effect of Mortgage Lending on ERC: Yearly Estimates**



perceived levels of risk associated with anticipated mortgage defaults. To disentangle these two effects, we turn to an examination of the default performance of mortgage loans made by banks.

3.4.2 Earnings Responses and Future Defaults

To establish more clearly whether the market's skepticism about earnings of high mortgage banks was driven by its attitude toward increased risk-taking through mortgage lending activity, we estimate the average impact of earnings surprises on stock prices for each bank using pre-crisis data and then use our estimates to explain the cross-sectional variation in mortgage default rates post 2006. We first fit a model of the effect of SUE on CAR across our entire sample using data for years 2003-2006, that is, for the period over which we document a deterioration of this relationship.[19] The model yields residuals for each bank-quarter over this period. We average the residuals for each bank over this four-year period to construct a bank-level measure of the estimated probability of future impaired performance. Banks whose earnings announcements communicated a more pessimistic estimate of future performance would consistently have lower levels of such residuals. Correspondingly, banks communicating comparatively favorable news about future performance

[19] Our results are robust to small changes in the starting year of this estimation exercise.

should have higher average values. Therefore, this bank-level measure provides an estimate of the market's assessment of the risk of future performance deterioration. We call this measure ERR (earnings response residual) for convenience.

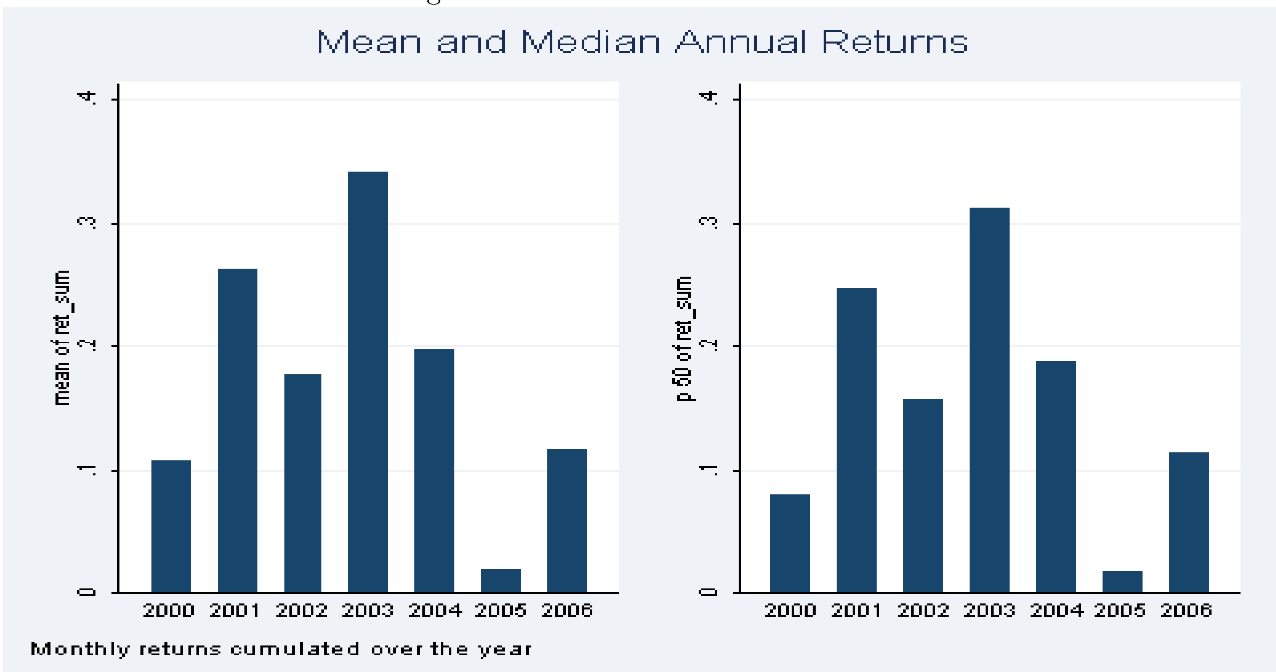
We measure a bank's mortgage default rate by the fraction of non-current one-to-four family residential mortgages in its portfolio based on the year-end data for 2007. Results are provided in Model 1 of Table 8. Model 1 uses the $ERR-Bank$ variable calculated using the raw residuals data and Model 2 uses decile rankings of the variable as a predictor of default rates in 2007. In either case, we find a strong negative coefficient associated with the $ERR-Bank$ measure, providing support for the contention that markets were able to distinguish between banks loading up on varying amounts of default risk.

The results so far suggest that commercial banks took on greater levels of systematic risk through investments in residential mortgages in the pre-crisis period but that the market was aware of this change in the *composition* of risk taking. With increasing systematic risk came higher EPS. But the market's reactions to earnings announcements show evidence of investor skepticism about the riskiness of these earnings, especially for banks engaged in higher levels of mortgage activity. Higher ex post default rates were associated significantly with those banks whose earnings announcements were viewed more skeptically by the market. It seems, therefore, that not all risk taking was viewed as positive by the market. To see whether the market thought that some banks were engaged in excessive, value destroying risk taking, we turn next to an analysis of stock returns over the period.

3.5 Stock Returns

On average, banks earned significantly positive returns during the sample period: the average stock return is 18% per year from 2000 to 2006 for banks in our sample. Figure 7 plots the yearly return of the average and the median bank in our sample. The average bank's return remained very high till 2004, after which we observe a decline. Our interest lies in understanding the effect of mortgage exposure on stock returns. As banks undertook higher systematic risk through their mortgage exposure, did the shareholders make commensurate gains in terms of stock returns? We fit a bank fixed-effect model similar to the one that we estimate for assessing the impact of mortgage exposure

Figure 7: **Annual Stock Returns**



on risk levels. The dependent variable is the bank's annual stock return computed as the cumulative monthly returns over the year. All the right-hand side variables are the same as described in the bank risk regressions presented earlier.

Table 9 presents the estimation results. We present models both with and without bank fixed-effects. Stock returns to banks with high mortgage exposure were relatively lower in the later half of the sample as indicated by the negative and significant coefficient on the interaction term: a standard deviation increase in mortgage exposure resulted in a decrease of about 2.2% annual return in the $after$ period as per the specification of Model 1 in Table 9. Similar results hold for the $peak$ period.

We also estimate a Fama-McBeth regression model on an annual basis relating mortgage exposure to annual stock returns. In this specification we include all the control variables that enter the pooled regression model as well. To save space we do not tabulate these results. The Fama-MacBeth regression results confirm that during the peak years, higher mortgage exposure correlates with lower returns to the shareholders. We find negative and significant coefficients (at the 1% level) on the $\frac{mort}{TA}$ variable for years 2003 and 2004. The coefficient is negative but insignificant in 2005 and 2006.

Overall, the evidence indicates that stockholders of banks with higher mortgage exposure did not earn correspondingly higher returns during these years, despite increased levels of systematic risk associated with such high exposure. Higher systematic risk esposure was, indeed, accompanied by higher EPS performance and higher stock returns compared to historical patterns. But the market did distinguish between banks with varying levels of mortgage exposure, both in terms of the credibility of their earnings performance and in terms of stock returns. The fact that stock returns in the later half of the sample actually declined for high mortgage banks strongly suggests that the market was aware of excessive levels of risk taking by banks engaged in higher levels of mortgage lending. This evidence is novel in the sense that while many observers have talked of excessive risk taking in the wake of unprecedented defaults, we find that the markets *contemporaneously* penalized banks engaged in large levels of mortgage exposure through lower stock returns, despite higher levels of systematic risk assumed. This is the first evidence we know of that shows the existence of contemporaneous inference in the market about excessive risk taking activity.

3.6 Compensation

It is clear, then, that the risk characteristics of banks changed dramatically over the pre-crisis period through their high levels of participation in the mortgage market. We have also presented facts that point to the lack of investor enthusiasm for their enhanced risk-taking activities in the period leading up to the crisis. If investors became wary of the banks' exposure to mortgage lending, what motivated banks to continue on such a path? As a possible answer to this conundrum, we focus on the compensation of bank CEOs to see whether the incentives they faced could be a possible explanation for such behavior. Our goal is to understand whether CEOs stood to gain by engaging in strategies that produce higher short-term earnings, perhaps even at the expense of sacrificing firm value. In particular, we analyze the effect of EPS on the bank CEOs' overall compensation. We fit the following model:

$$comp_{it} = \alpha_i + b_1 * eps_{it} + b_2 * return_{it} + \sum \gamma X_{it} + \epsilon_{it} \quad (7)$$

$comp_{it}$ is a measure of CEO compensation for bank i in year t. eps_{it} measures the earnings per share. We gather information on total compensation as well as the bonus component from the COMPUSTAT Executive Compensation database. We use a log transform of these variables to alleviate outlier problems. Because some bank-year observations have zero bonus payments, we add one dollar to the compensation measures before taking the log transform. Since the Executive Compensation database also provides us with EPS excluding extraordinary items, we use EPS data from this dataset for this sample of banks.[20] The model is estimated using 452 bank-year observations from 2000 to 2006. For easier economic interpretation, we subtract the sample means of EPS and annual returns from these variables and then divide the differences by their respective standard deviations. Thus, the estimated coefficients measure the increase in compensation for one standard deviation increase in either EPS or the return variable from their respective means.

Table 10 provides the results. In Models 1 and 2, we show that the total compensation of a bank's CEO increases significantly with the bank's EPS. In fact, controlling for the EPS, the contemporaneous stock return has no effect in explaining CEO compensation. In Models 3 and 4, we only use the bonus compensation and show that CEOs earn significant bonus compensation for achieving higher EPS for their banks. The effect of stock returns on bonus compensation is positive, but economically less important than that of the EPS. Compensation contracts seem to reward CEOs for short-term earnings even when stock returns are not high. Under such a compensation scheme, it is value increasing for a CEO to undertake investments that produce higher earnings in the short term. Our results suggest that firms engaged in activities with higher systematic risk produced higher short term earnings of poorer quality. While shareholders didn't earn returns commensurate with the higher levels of systematic risk undertaken by the banks, CEOs benefitted from producing higher levels of EPS. It is possible that the advent of private label securitization and other financial engineering products allowed banks to undertake such earnings-

[20] Note that even though this measure of EPS is more reliable, we cannot use it for all banks since they are not covered by this Compustat database.

boosting investments in the post-2000 period, whereas their compensation contracts did not account for this change. Our results suggest that such a failure in firm governance may have contributed to the risk-seeking behavior of banks during the later half of our sample period.

To explore this angle further, we analyze the relationship between CEO compensation and EPS over a longer time series. We collect compensation data for the CEOs of banks in our sample from 1993 (i.e., the first year of reporting in the Executive Compensation database) till 2006. We estimate the same compensation-EPS regression model as before and provide results in Model 1 of Table 11. The relation between EPS and compensation remains positive and strong for the entire period. In Model 2, we interact EPS with a time dummy variable that takes a value of one for years 2000 and forward, and zero otherwise. The interaction terms measures the sensitivity of compensation to the bank's EPS during our sample period as compared to the pre-2000 period. We find an insignificant coefficient on this term, indicating that the CEOs' reward for a dollar of EPS remained the same across these two periods. In Models 3 and 4, we only use bonus compensation and show that even though bonus compensation increases with stock returns, EPS still remains an important determinant of the CEO's bonus payments. In fact, the sensitivity of bonus payment to short term earnings *increased* during the post-2000 period as indicated by a positive and significant coefficient on the interaction term $eps \times after$. Thus, even when the investment opportunity set and the banks' ability to boost short term earnings at the expense of higher risks changed in a fundamental manner during our sample period, compensation contracts remained unresponsive to these changes. This stickiness in compensation contracts indicates a possible governance failure that may be partly responsible for excessive risk-taking by banks.

To sum up, while the risk characteristics of banks changed dramatically over the pre-crisis period, compensation contracts of bank CEOs did not change adequately to counteract perverse risk-taking incentives that arose due to the changed environment. Critics who have pointed out that bank CEOs had high powered compensation contracts both before and during the post-2000 period have missed the fact that the *composition* of bank risks changed dramatically over the period. In a dynamic world, shareholders would have needed to optimally modify compensation contracts to ensure that CEO incentives remained in line with shareholder value maximization in this changed scenario. Our results suggest that bank boards failed to act in their shareholders' interest by reducing the incentives offered to managers to undertake short term profit boosting activities by engaging in overly risky lending activities.

In our next test, we directly analyze the link between securitization-driven earnings and CEO compensation. Our goal is to examine the relationship between compensation and the component of EPS that comes specifically from securitization activity. We adopt a two-stage regression framework for this empirical task. In the first stage, we estimate the following bank fixed-effect model:

$$eps_{it} = a_i + s * \sigma_{it} + b * return_{it} + logta_{it} + \epsilon_{it} \quad (8)$$

σ is the measure of idiosyncratic risk based on the market-model residual. We use σ as an instrument for the extent of securitization activity undertaken by a bank because of the theoretical argument linking securitization activities to reduction in idiosyncratic risks. Our earlier results establish this connection empirically as well. The predicted values of *eps* in this regression model provides us with a measure of EPS that come from changes in idiosyncratic risk of a bank. We use the predicted EPS as a right-hand side variable in the second stage regression using different measures of CEO compensation as the dependent variable.[21] Table 12 presents the results. In column 1, we provide the first stage regression estimates. Consistent with our hypothesis, banks with large reductions in idiosyncratic risk earned considerably higher earnings per share as evident by a significant negative coefficient on *sigma*. In Model 2 we use log of one plus total compensation as the dependent variable; Model 3 uses log one plus bonus as the dependent variable. We find that the component of earnings that varies with securitization has a strong positive effect on CEO compensation, both total compensation as well as the short term bonus part. In Model 4, we use the ratio of bonus-to-total compensation as the dependent variable and find that the fraction of bonus payment increases significantly with securitization driven EPS. These results suggest that most of the compensation from the increased securitization activity came through short-term bonus payments to the CEOs. These findings are consistent with the idea that managers benefitted considerably by engaging in

[21] Note that our approach is same as an instrumental variable approach, where we instrument earnings with a proxy for securitization activities.

activities that boosted their banks' short-term earnings through securitization activity.

In our final test, we directly analyze the relation between CEO's short term focus and post-crisis mortgage default rates. For every bank with available data, we compute two simple measures of CEO compensation's sensitivity to short term earnings. First, we compute the annual total compensation to EPS ratio for each bank from 2000 to 2006 and take their average as the measure of sensitivity of compensation to short term earnings. In the second measure, we replace total compensation by annual bonus payments to the CEO. We winsorize these measures at 1% from both tails to minimize the effect of outlier observations. Using these measures as explanatory variables, we estimate cross-sectional regression models with the mortgage default rate in 2007 as the dependent variable.[22] Results are provided in Table 13. We find that banks with higher compensation-to-short term earnings sensitivity have higher mortgage default rates in the post-crisis period. These results are consistent with our assertion that managerial short-term focus was partly responsible for the origination of riskier loans during the housing boom.

4 Conclusion

We document that U.S. commercial banks' risk profiles changed dramatically over the period 2000 to 2006: their systematic risk exposure more than doubled and their measured idiosyncratic risk approximately halved over this period. These changes were intimately related to their measured exposure to risks through the residential mortgage market. Even though EPS levels of mortgage-heavy banks did increase significantly during the years leading up to the crisis, markets did not ignore the possibility that some of the earnings came from excessively risky activities. In fact, the market's response to a unit of earnings surprise by mortgage-heavy banks was considerably lower during our sample period, indicating a possible awareness of boosting short term earnings performance through excessive risk taking. In added support of this interpretation, we show that stock returns of high mortgage banks were relatively lower in years closer to the crisis.

As a possible explanation of excessive levels of risk taking, we show that it was in the interest of bank CEOs to boost their banks' short-term earnings by taking on greater levels of systematic

[22] See our discussion on ERR and mortgage default rate for the exact construction of this variable.

risk in a booming market as their compensation depended heavily on EPS. In fact, we show that the sensitivity of CEO compensation to EPS, after controlling for the stock returns, remained the same during 1993-2000 and 2000-2006. We conjecture that financial innovations in recent years changed the investment opportunity set of banks in a fundamental way, allowing bank managers to more easily manufacture short term earnings at the expense of shareholder value. However, shareholders did not properly account for the changes in the environment while setting compensation contracts. In our view, such a failure in adjusting incentive contracts appropriately points to a major governance problem that might be at the root of the recent financial crisis.

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Table 1: **Summary Statistics**

This table presents summary statistics of the sample. *TA* is the total assets of the consolidated bank holding company. *Mortgage/TA* is the ratio of 1-4 family residential mortgage loans scaled by the total assets of the bank. Mortgage Growth rate gives the annual growth rate in 1-4 family residential mortgage lending of a bank. *CIL/TA* measures the ratio of commercial and industrial loans to total assets. *TD/TA* measures the ratio of deposits (excluding demand deposits) to total assets. *DD/TA* measures the ratio of demand deposits to total assets. *ROE* is annual return on equity. EPS measures the annual earnings per share. *BETA* measures yearly beta of a market model regression. *SUE* stands for standardized unexpected earnings. Return measures the annual return of banks. *CAR* measures the cumulative abnormal return around a two day event window surrounding the earnings announcement date of the bank. All accounting variables are measured as of December 31 of the calendar year. CAR and SUE are from quarterly earnings announcement data.

variable	**N**	**mean**	**median**	**min**	**max**
TA ($ Billion)	1836	21.79	2.09	0.03	1376.14
Mortgage/TA	1836	0.17	0.17	0.00	0.48
Mortgage Growth	1424	0.14	0.08	-0.46	2.14
CIL/TA	1836	0.12	0.10	0.00	0.38
TD/TA	1836	0.67	0.68	0.35	0.84
DD/TA	1836	0.09	0.08	0.01	0.26
ROE(%)	1836	13.11	13.06	-1.92	27.28
EPS	1836	1.82	1.70	-0.06	5.51
BETA	1835	0.70	0.66	-0.13	2.13
Return	1836	0.18	0.16	-1.06	1.66
SUE	5733	0.01	0.02	-1.39	0.65
CAR(%)	5733	-0.04	-0.05	-10.94	9.99

Table 2: **Mortgages and Risk**

This table presents regression results relating bank's systematic and idiosyncratic risk to mortgage lending activities. The dependent variable in Models 1 and 2 is the bank's beta estimated using market model on annual basis. In Models 3 and 4, the dependent variable is the natural logarithm of the standard deviation of market model residual. All models are estimated with bank fixed-effects and standard errors are clustered at the bank level. Sample covers yearly bank observations from 2000 to 2006. *peak* is an indicator variable that equals one for years 2003 to 2005 and zero otherwise. *after* is an indicator variable that equals one for years 2003 to 2006 and zero otherwise. *mort/ta* is the ratio of 1-4 family residential mortgage to total assets, *logta* is the log of total assets, *cil/ta* is the ratio of commercial and industrial loans to total assets, *td/ta* is the bank's total deposits, excluding demand deposits, to total asset ratio, *dd/ta* is the ratio of demand deposits to total assets. Adjusted R-squared and number of observations are provided in the bottom rows.

	CAPM Beta				Idiosyncratic Risk			
	Model 1		Model 2		Model 3		Model 4	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
$mort/ta$	-1.3372	(-2.27)	-0.6600	(-1.39)	1.4803	(3.40)	0.8428	(2.75)
$peak$	0.0841	(2.11)			-0.1314	(-4.21)		
$mort/ta * peak$	0.5577	(2.70)			-0.3085	(-2.01)		
$logta$	1.4470	(1.82)	1.5500	(2.18)	0.9957	(2.19)	0.8908	(2.57)
$logta^2$	-0.0311	(-1.21)	-0.0423	(-1.85)	-0.0469	(-2.92)	-0.0355	(-2.88)
cil/ta	0.0726	(0.11)	0.6391	(1.07)	1.7624	(3.31)	1.1884	(2.74)
td/ta	0.6451	(1.50)	0.2041	(0.54)	-0.5276	(-1.79)	-0.0909	(-0.40)
dd/ta	-0.0015	(-0.00)	0.0788	(0.13)	0.8840	(2.00)	0.7911	(2.22)
$after$			0.2927	(4.61)			-0.3186	(-7.23)
$mort * after$			0.4527	(1.54)			-0.3583	(-1.93)
R^2	0.590		0.632		0.569		0.663	
N	1835		1835		1835		1835	

Table 3: **Mortgages and Risk: Alternative Specification**

This table presents regression results relating bank's systematic and idiosyncratic risk to mortgage lending activities. In Model 1, the dependent variable is the bank's beta estimated using market model on annual basis. Model 2 uses logarithm of market model's residual as the dependent variable. Both models are estimated with bank fixed-effects and standard errors are clustered at the bank level. Sample covers yearly bank observations from 2000 to 2006. *after* is an indicator variable that equals one for years 2003 to 2006 and zero otherwise. *logmort* is the log of 1-4 family residential mortgage held by the banks, *logta* is the log of total assets, *cil/ta* is the ratio of commercial and industrial loans to total assets, *td/ta* is the bank's total deposits, excluding demand deposits, to total asset ratio, *dd/ta* is the ratio of demand deposits to total assets. Adjusted R-squared and number of observations are provided in the bottom rows.

	Model 1		Model 2	
	Estimate	t-val	Estimate	t-val
$logmort$	-0.0893	(-1.40)	0.0804	(1.80)
$logta$	0.4771	(5.76)	-0.2202	(-3.57)
$after$	1.4689	(5.34)	0.7418	(4.94)
$logmort * after$	0.0843	(2.16)	-0.0486	(-2.03)
$logta * after$	-0.1476	(-3.50)	-0.0325	(-1.30)
cil/ta	0.6581	(1.16)	0.8334	(2.07)
td/ta	0.2998	(0.79)	0.1138	(0.49)
dd/ta	0.1021	(0.16)	0.6385	(1.78)
R^2	0.639		0.679	
N	1812		1812	

Table 4: **Mortgages and Risk: With OTD Lending**

This table presents regression results relating bank's systematic and idiosyncratic risk to the volume of originate-to-distribute model of lending in the residential mortgage market. In Model 1, the dependent variable is the bank's beta estimated using market model on annual basis. Model 2 uses logarithm of the standard deviation of the market model's residuals as the dependent variable. Both models are estimated with bank fixed-effects and standard errors are clustered at the bank level. The sample covers yearly bank observations from 2000 to 2006. *after* is an indicator variable that equals one for years 2003 to 2006 and is zero otherwise. *logotd* is the log of (one plus) mortgages originated to be distributed/securitized by the bank during the first quarter of 2007, *logta* is the log of total assets, *cil/ta* is the ratio of commercial and industrial loans to total assets, *td/ta* is the bank's total deposits, excluding demand deposits, to total asset ratio, *dd/ta* is the ratio of demand deposits to total assets. Adjusted R-squared and number of observations are provided in the bottom rows.

	Model 1		Model 2	
	Estimate	t-val	Estimate	t-val
$logta$	0.3122	(3.93)	-0.1136	(-2.56)
$after$	1.7118	(6.40)	0.7093	(4.64)
$logotd * after$	0.0160	(4.89)	-0.0035	(-1.69)
$logta * after$	-0.0935	(-5.35)	-0.0725	(-7.25)
cil/ta	0.4107	(0.78)	0.8386	(2.21)
td/ta	0.1501	(0.41)	0.1687	(0.77)
dd/ta	-0.1533	(-0.25)	0.7888	(2.28)
R^2	0.648		0.678	
N	1835		1835	

Table 5: **Mortgages and Earnings Per Shares: Yearly Estimates**

This table presents regression results relating bank's yearly earnings per share to mortgage lending activities. Both models use bank fixed-effects and all standard errors are clustered at the bank-level. $yr02$ to $yr06$ are indicator variables that equal one for the respective years (2002 to 2006) and zero otherwise. *mort/ta* is the ratio of 1-4 family residential mortgage to total assets, *logta* is the log of total assets, *logta2* is its squared value, *cil/ta* is the ratio of commercial and industrial loans to total assets, *td/ta* is the bank's total deposits, excluding demand deposits, to total asset ratio, *dd/ta* is the ratio of demand deposits to total assets. $mort * yr02$ to $mort * yr06$ are the interactions of *mort/ta* with the respective year indicator variables. Adjusted R-squared and number of observations are provided in the bottom rows.

	Model 1		Model 2	
	Estimate	t-stat	Estimate	t-stat
$yr02$	-0.0725	(-0.74)	-0.0951	(-0.97)
$yr03$	-0.1208	(-1.15)	-0.1560	(-1.45)
$yr04$	-0.1280	(-1.07)	-0.1644	(-1.34)
$yr05$	0.0362	(0.28)	-0.0096	(-0.07)
$yr06$	0.0327	(0.22)	-0.0242	(-0.16)
$mort/ta$	0.2725	(0.40)	0.0887	(0.13)
$mort * yr02$	1.1670	(2.63)	1.1820	(2.65)
$mort * yr03$	1.5463	(2.96)	1.6038	(3.03)
$mort * yr04$	1.0020	(1.79)	1.0508	(1.85)
$mort * yr05$	0.6803	(1.16)	0.7203	(1.21)
$mort * yr06$	0.3448	(0.53)	0.3809	(0.58)
$logta$	-0.0484	(-0.06)	-0.1661	(-0.20)
$logta^2$	0.0088	(0.31)	0.0129	(0.45)
cil/ta			-1.1258	(-1.35)
td/ta			0.3223	(0.60)
dd/ta			-0.8637	(-1.10)
R^2	0.741		0.743	
N	1836		1836	

Table 6: **Mortgages and Earnings Per Shares**

This table presents regression results relating bank's yearly earnings per share to mortgage lending activities. Both models are estimated with bank fixed effects. All standard errors are clustered at the bank-level. Sample covers yearly bank observations from 2000 to 2006. *peak* is an indicator variable that equals one for years 2003 to 2005 and zero otherwise. *after* is an indicator variable that equals one for years 2003 to 2006 and zero otherwise. *mort/ta* is the ratio of 1-4 family residential mortgage to total assets, *logta* is the log of total assets, *cil/ta* is the ratio of commercial and industrial loans to total assets, *td/ta* is the bank's total deposits, excluding demand deposits, to total asset ratio, *dd/ta* is the ratio of demand deposits to total assets. Adjusted R-squared and number of observations are provided in the bottom rows.

	Model 1		Model 2	
	Estimate	t-stat	Estimate	t-stat
$peak$	-0.0829	(-1.44)		
$mort/ta * peak$	0.6924	(2.31)		
$mort/ta$	0.3978	(0.62)	0.4040	(0.62)
$logta$	-0.1297	(-0.16)	-0.0880	(-0.10)
$logta^2$	0.0122	(0.44)	0.0108	(0.38)
cil/ta	-1.3745	(-1.66)	-1.4444	(-1.73)
td/ta	0.2304	(0.44)	0.1506	(0.29)
dd/ta	-1.0049	(-1.28)	-0.9860	(-1.25)
$after$			-0.0741	(-0.85)
$mort/ta * after$			0.5597	(1.32)
R^2	0.739		0.738	
N	1836		1836	

Table 7: **Mortgages and Earnings Response Coefficients**

In this table we analyze the Earnings Response Coefficients of banks during the sample period. The dependent variable is the cumulative abnormal return around (-1,+1) window of the quarterly earnings announcement date. *sue* measures the earnings surprise; *after* is an indicator variable that equals one for years 2003 to 2006, and zero otherwise; *logta* is the natural logarithm of total assets; *mort/ta* measures the ratio of residential mortgage loans to total assets. Adjusted R^2 and the number of observations are reported in the last two rows. Models 1 and 2 are estimated with the entire sample, Models 3 and 4 are for sub-samples with non-negative and negative earnings surprises, respectively. Model 1 does not include bank fixed-effects. All other models are estimated with these fixed effects. All standard errors are clustered at the bank-level.

	Model 1		Model 2		Model 3		Model 4	
	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
sue	3.4552	(5.24)	3.6911	(4.51)	1.9279	(1.27)	3.1565	(1.67)
logta	-0.5285	(-1.42)	2.4146	(1.46)	3.5894	(1.50)	-1.9094	(-0.52)
*logta*2	0.0156	(1.35)	-0.0977	(-1.78)	-0.1275	(-1.57)	0.0262	(0.22)
mort/ta	0.9177	(1.24)	3.1037	(1.51)	3.9830	(1.36)	2.0657	(0.48)
after	0.2541	(1.34)	0.4512	(1.99)	0.1809	(0.53)	0.5984	(0.87)
$sue * after$	4.0300	(3.57)	4.0611	(3.24)	6.2659	(2.90)	0.9764	(0.42)
$mort * after$	-1.3825	(-1.66)	-1.2225	(-1.23)	-0.6698	(-0.45)	-1.3201	(-0.40)
$mort * sue$	-0.0583	(-0.02)	-0.1135	(-0.03)	7.1659	(1.20)	-3.9229	(-0.47)
$mort * sue * after$	-16.6966	(-3.39)	-17.1010	(-3.24)	-18.2419	(-1.99)	-8.1974	(-0.76)
R^2	0.079		0.089		0.069		0.092	
N	5733		5733		3963		1770	

Table 8: **Bank ERR and Ex-Post Default**

This table provides the cross-sectional regression results of the regression of mortgage default rate in 2007 on bank level ERR (earnings response residuals) during pre-crisis periods. The dependent variable is the percentage of non-current loans in a bank's residential mortgage portfolio as of the end of 2007. $Bank-ERR$ is defined as the average value of residuals for a bank from the regression of CAR on SUE estimated using all bank's data from 2003-2006 period. Model 1 uses the raw average values, whereas Model 2 uses decile ranking of this variable as the explanatory variable. $meanlogta$ is computed as the average value of the log of a bank's total assets during the pre-crisis period. $meanmortta$ is the corresponding average value for the $mort/TA$ ratio. Adjusted R^2 and the number of observations are reported in the last two rows.

	Model 1		Model 2	
	Estimate	t-stat	Estimate	t-stat
$Bank-ERR$	-0.1945	(-2.38)	-0.0882	(-2.23)
$meanlogta$	0.2247	(2.58)	0.2190	(2.52)
$meanmortta$	-0.0617	(-0.05)	-0.0759	(-0.06)
R^2	0.035		0.037	
N	259		259	

Table 9: **Mortgages and Stock Return**

This table presents regression results relating bank's yearly stock returns to mortgage lending activities. The dependent variable is the annual return of the bank holding company computed by summing the monthly stock returns of a bank during the year. Models 1 and 2 use pooled regression model, whereas Models 3 and 4 use bank fixed-effect model. All standard errors are clustered at bank level. Sample covers yearly bank observations from 2000 to 2006. *peak* is an indicator variable that equals one for years 2003 to 2005 and zero otherwise. *after* is an indicator variable that equals one for years 2003 to 2006 and zero otherwise. *mort/ta* is the ratio of 1-4 family residential mortgage to total assets, *logta* is the log of total assets, *cil/ta* is the ratio of commercial and industrial loans to total assets, *td/ta* is the bank's total deposits, excluding demand deposits, to total asset ratio, *dd/ta* is the ratio of demand deposits to total assets. Adjusted R-squared and number of observations are provided in the bottom rows.

	Model 1		Model 2		Model 3		Model 4	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
$mort/ta$	-0.0271	(-0.42)	0.3052	(1.10)	-0.0180	(-0.22)	0.3777	(1.30)
$peak$	0.0599	(3.40)	0.0849	(4.00)				
$mort/ta * peak$	-0.2502	(-2.72)	-0.2645	(-2.40)				
$logta$	-0.0561	(-1.85)	0.0198	(0.10)	-0.0549	(-1.81)	0.0039	(0.02)
$logta^2$	0.0010	(1.03)	-0.0054	(-0.78)	0.0009	(0.99)	-0.0056	(-0.79)
eps	0.0319	(4.68)	0.0598	(3.85)	0.0324	(4.80)	0.0599	(3.82)
cil/ta	-0.0336	(-0.49)	0.1132	(0.34)	-0.0618	(-0.91)	0.1086	(0.32)
td/ta	-0.0258	(-0.40)	-0.2900	(-1.25)	-0.0196	(-0.30)	-0.3518	(-1.49)
$ddfrac$	-0.0488	(-0.47)	-0.4489	(-1.22)	-0.0484	(-0.47)	-0.4115	(-1.10)
$after$					0.0233	(1.18)	0.0913	(3.08)
$mort/ta * after$					-0.2262	(-2.20)	-0.2638	(-1.87)
R^2	0.034		-0.011		0.033		-0.013	
N	1836		1836		1836		1836	
Fixed-Effects	No		Yes		No		Yes	

Table 10: **EPS and Compensation**

This table presents regression of CEO's compensation on the bank's annual returns and earning per share. In Model 1 and 2, the dependent variable is log of total annual compensation, whereas in Models 3 and 4 the dependent variable is the log of bonus compensation. All models include bank fixed effect and all standard errors are clustered at the bank level. Sample is from 2000-2006.

	Model 1		Model 2		Model 3		Model 4	
	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
eps	0.1727	(2.47)	0.1566	(2.07)	1.6810	(3.35)	1.8623	(3.54)
return	-0.0129	(-0.53)	-0.0120	(-0.47)	0.7153	(2.77)	0.7250	(2.73)
logta	0.1701	(1.61)	0.1541	(1.42)	-2.3814	(-2.45)	-2.5481	(-3.18)
cil/ta			0.4518	(0.34)			-13.1625	(-1.34)
td/ta			0.1209	(0.20)			-15.6700	(-2.26)
dd/ta			-1.9555	(-1.52)			10.9991	(0.83)
R^2	0.823		0.824		0.135		0.157	
N	452		452		452		452	

Table 11: **EPS and Compensation: Before and After 2000**

This table presents regression of CEO's compensation on the bank's annual returns and earning per share. In Model 1 and 2, the dependent variable is the log of total annual compensation, whereas in Models 3 and 4 the dependent variable is the log of bonus compensation. We add one dollar to both total and bonus compensation to ensure that CEOs with zero bonus compensation included in the sample. include All models include bank fixed effect and all standard errors are clustered at the bank level. Sample is from 1993-2006.

	Model 1		Model 2		Model 3		Model 4	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
eps	0.0875	(2.52)	0.0777	(2.15)	0.9931	(3.40)	0.6678	(2.39)
$after$			0.0976	(1.18)			-0.4486	(-0.95)
$eps * after$			0.0521	(0.65)			1.1772	(2.06)
$logassets$	0.6928	(10.89)	0.6295	(7.44)	-0.0484	(-0.20)	0.1568	(0.43)
$return$	-0.0040	(-0.22)	-0.0072	(-0.38)	0.6308	(4.13)	0.6120	(4.25)
R^2	0.734		0.735		0.345		0.358	
N	1059		1059		1059		1059	

Table 12: **Compensation and Predicted EPS**

This table presents regression results relating CEO compensation to the component of EPS that comes from securitization activities of the bank. We first estimate a bank fixed effect model of EPS with idiosyncratic volatility as the instrument for securitization activities. The predicted EPS gives us the variation in EPS that arises due to changes in idiosyncratic risk over this time period. The first stage estimation result is provided in Model 1. In the next three columns we regress measures of CEO compensation on the predicted EPS and other control variables. Model 1 uses log total compensation, Model 2 log bonus compensation, and Model 3 uses the ratio of bonus-to-total compensation as the dependent variable. Sample covers yearly bank observations from 2000 to 2006. *sigmaepsilon* is the yearly measure of idiosyncratic risk measured with respect to the market-model. *logta* is the log of total assets, *return* measures the annual stock return. Adjusted R-squared and number of observations are provided in the bottom rows.

	Model 1 EPS		Model 2 Total Comp		Model 3 Bonus		Model 4 Bonus/Total	
	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
eps			0.2551	(1.98)	3.2935	(2.19)	0.0804	(2.00)
logta	0.2084	(2.03)	0.1245	(1.67)	-3.1530	(-3.62)	-0.0601	(-2.59)
return	0.1663	(3.75)	-0.0297	(-0.98)	0.4314	(1.23)	0.0231	(2.46)
sigmaepsilon	-34.0512	(-4.40)						
R^2	0.708		0.0615		0.0324		0.0314	
N	452		452		452		452	

Table 13: **Compensation-EPS Sensitivity and Defaults**

This table provides the cross-sectional regression results relating mortgage default rates to the sensitivity of CEO compensation to short term earnings during the pre-crisis periods. The dependent variable is the percentage of non-current loans in a bank's residential mortgage portfolio as of the end of 2007. *tdc/eps* is defined as the average value of CEO's total compensation (in million dollars) to EPS ratio measured from 2000 to 2006. *bonus/eps* is similarly defined using only the bonus component of the compensation. *logta* is computed as the average value of the log of a bank's total assets during the pre-crisis period. Adjusted R^2 and the number of observations are reported in the last two rows.

	Model 1		Model 2		Model 3		Model 4	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
tdc/eps	0.2133	(3.46)	0.1772	(2.06)				
logta			0.0901	(0.50)			0.0991	(0.61)
bonus/eps					0.8735	(5.57)	0.7484	(3.21)
R^2	0.087		0.073		0.109		0.097	
N	54		54		54		54	