Trading by Bank Insiders before and during the Financial Crisis

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Abstract

This paper investigates whether bank executives took excessive risks in the run-up to the recent financial crisis by analyzing their trading in their own bank's stock. I examine whether insiders of banks with the highest exposure to subprime risk changed their insider trading before the onset of the crisis. Two main findings emerge. First, there are large differences in insider trading patterns between high- and low-exposure banks starting in mid-2006, when US housing prices first declined. The economic effect is sizeable: insiders of high-exposure banks sell 30% more equity than insiders of low-exposure banks. This increase in insider sales precedes the fall of bank stock prices and the surge in banks' CDS spreads by at least 12 months. Second, there is no difference in insider trading patterns between banks with high and low exposure in 2004-2005. I conclude that insiders of high-exposure banks revised their views on the profitability of their banks' investments following the reversal in the housing market.

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I.   Introduction

There is considerable controversy about the extent to which bank executives consciously took excessive risks in the run-up to the recent financial crisis. Some argue that bank executives, acting in the interest of shareholders, took risks that they believed the market would reward, and had no foresight of the crisis (Fahlenbrach and Stulz (2011)). Others dispute that poor performance in the crisis was the result of an unforeseen shock, and argue that executive compensation arrangements induced excessive risk-taking (Cheng, Hong, and Scheinkman (2009), Bebchuk, Cohen, and Spamann (2010), Bhagat and Bolton (2011)). Understanding bank executives' thinking before the crisis is an important starting point for designing compensation contracts seeking to avert such failures in the future (John, Saunders, and Senbet (2000), Bolton, Scheinkman, and Xiong (2006), Bolton, Mehran, and Shapiro (2010), Jarque and Prescott (2010), Thanassoulis (2011)).

This paper sheds some light on bank executives' thinking by examining their insider trading decisions prior to the crisis.[1] Although the financial sector as a whole performed poorly during the crisis, the relative underperformance of banks showed large variation (Beltratti and Stulz (2011)). Using banks' performance during the crisis as an ex-post measure of risk exposure, this paper examines whether the bankers that took the most risk changed their insider trading before the onset of the crisis. The paper has two main findings: First, there are large differences in insider trading behavior between high- and low-exposure banks starting in 2006, when US housing prices indices first declined. During 2006, the number of insiders reducing their ownership increases by 12% in high-exposure banks, compared to low-exposure banks. Furthermore, insiders of high-exposure banks sell 5-7 million USD more of their bank's stock, on average, than insiders of low-exposure banks. In relative terms, this represents an increase of 30-40% in the total yearly value of stock sales. This increase in insider sales precedes the drop in banks' stock prices and the surge in banks' CDS spreads by at least 12 months. Second, there is no observable difference in insider trading behavior between high- and low-exposure banks in 2004-2005, before the US housing market weakened. The evidence offered in this paper suggests that while bank insiders regarded investments in mortgage-backed securities profitable given the

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[1] Based on the definition of the Securities and Exchange Commission I refer to legal, reported trades of corporate insiders as "insider trading" (http://www.sec.gov/answers/insider.htm). Illegal transactions of insiders, albeit relevant in the context of the financial crisis, are not the focus of the paper.

housing price growth, they altered their views on the profitability of these investments following the reversal in the housing market.

The origins and the unfolding of the recent financial turmoil have received considerable attention in the academic literature (Gorton (2009)). Recent empirical evidence suggests that banks altered their policies and started taking more risk well before the onset of the crisis in 2007 (Landier, Sraer, and Thesmar (2010), von Lilienfeld-Toal and Mookherjee (2011)). Much of the debate has focused on the role of bank executives' incentives in the financial meltdown. On the one hand, Fahlenbrach and Stulz (2011) do not find strong evidence to support the notion that incentive packages contributed to the crisis. Their results indicate that CEOs were holding sizeable equity stakes even as the crisis hit, and did not reduce their ownership in 2007 or during the peak of the crisis in 2008. They conclude that CEOs believed that the risks they took before the crisis would pay off, but that this turned out not to be the case. On the other hand, Bebchuk et al. (2010) criticize the incentive structures of bank managers. They point out that the top managers of Bear Stearns and Lehman Brothers cashed out a substantial amount of options in the period prior to the crisis. Bhagat and Bolton (2011) also dispute that managers had no awareness of the large risks they were facing. They analyze the compensation structure and CEO payoffs of the 14 largest US banks and argue that managerial incentives led to excessive risk-taking. This view is supported also by Cheng et al. (2009), who find a positive relation between excess executive compensation and risk taking. Their evidence suggests that overpaying bank managers who take high risks is positively associated with the level of institutional ownership of the bank.

My paper examines the individual trades of a wide range of bank insiders, which allows for a refined analysis of the timing of bankers' trades, and possible changes in their trading behavior. Specifically, I link trading by bank insiders to the developments in the housing market, which played a crucial role in starting the crisis. Whereas Fahlenbrach and Stulz (2011) conclude that CEOs did not reduce their ownership in 2007 or during the peak of the crisis in 2008, my paper reveals that bank executives did sell large amounts of stock in 2006, when housing prices started to decline. Therefore, I contribute to the literature by providing evidence that bank executives understood the exposures of their bank to housing prices and reduced their stockholdings during 2006.

The results of my paper also suggest, however, that the prescience of bank executives regarding the consequences of their policies was limited. Assuming perfect foresight, executives

of high-exposure banks should have increased their selling in anticipation, before housing prices started to fall. This prediction, however, is not borne out by the data. Thus, although my paper supports the argument put forward by Bebchuk et al. (2010) and Bhagat and Bolton (2011) that bank executives sold substantial amounts of stock preceding the crisis, it contrasts with their evidence regarding the timing of these sales. I find no evidence of abnormal selling activity prior to 2006. Hence, my findings are not supportive of the notion that bankers were perfectly aware of the risks implied by their policies right from the outset. Even so, they had more than 12 months to reduce their equity positions before the market gradually learned about the subprime risk exposures of their banks' portfolios. In sum, the empirical findings of the paper suggest that bank insiders' response to public information was influenced by their private information regarding the exposure of their bank to the subprime mortgage market. In this sense, bank insiders were able to exploit the lack of information on complex mortgage-backed securities.

Since different types of insiders have varying levels of information about the strategies of their firms (Seyhun (1986), Lin and Zhao (1990), Ravina and Sapienza (2011)), I first scrutinize transactions of all insiders of the bank, then disaggregate trades of executive officers, independent directors, and finally shift the focus to chief executive officers. The economic effects are sizeable for all insider groups, and largest for bank CEOs. In the case of CEOs, I directly measure the percentage change in their total shareholdings. In 2006, CEOs of high-exposure banks sold 9 percentage points more of their holdings, which, expressed in relative terms, is a 200% increase in selling compared to all other years. The paper suggests that the timing of stock sales in 2006 coincided with the fall in housing prices. In the first two quarters of housing price declines, executive officers of high-exposure banks sold 1.02 and 1.34 million USD more stock in the open market, a relative increase of 33 and 44%, respectively. Independent directors, who are not obliged to hold company stock (Bhagat and Tookes (2011)), sold 0.49 and 0.68 million USD more during these quarters, an increase of 59% and 82% relative to the mean.

The results of this paper are not explained by contrarian trading, portfolio rebalancing following price increases, differences in the compensation structures of the banks, riskiness of the bank's stock, time-invariant bank heterogeneity, or differences in executive turnover. To circumvent the difficulty of drawing inferences based on differences in traded stock values across banks of different size and varying compensation structures, I construct a measure, insider trading duration, which focuses solely on the timing of the trades, and is insensitive to the total

value traded over a period. The findings based on this measure are similar: insiders of high-exposure banks sold stock earlier during the 2006-2008 period, whereas insiders of low-exposure banks sold later.

The paper proceeds as follows. Section II describes the dataset used in the study. Section III presents the main results on bank risk-taking and insider trading prior to the crisis. Section IV examines the role of the housing market in bank insiders' trading behavior. Section V presents a battery of additional tests to complement the main results. Section VI discusses the interpretation of the results and the limitations of the analysis. Section VII concludes the paper.

II.   Data sources and sample selection

The initial sample comprises all firms with SIC codes 6000–6299 in the CRSP-Compustat merged file.[2] For these firms, I collect insider trading information from the Thomson Reuters database. Prices and delisting information are from CRSP, accounting data are from Compustat. These data are then merged with ExecuComp, which contains information on executive compensation packages and holdings of company stock and options. The data span the years 1995-2009. There are 1702 firms with SIC codes 6000–6299 in the CRSP-Compustat merged dataset that have at least one insider trade during the sample period, and 282 of these are present in ExecuComp. Finally, I exclude firms that cannot be classified as large lending institutions, following Fahlenbrach and Stulz (2011).[3] I obtain information on asset write-downs from Bloomberg.

To understand whether insiders were in possession of information about their bank's prospects, I first construct an ex-post measure of risk exposure. In the baseline analysis, this measure is the excess return on the bank's stock during the period July 2007 – December 2008. I use the excess returns to classify banks into terciles (performance groups).[4] Furthermore, if a bank is delisted from the stock exchange during this period, depending on the delisting code, I

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[2] SIC codes 6000-6299 are assigned to "depository institutions", "non-depository credit institutions"; and "security and commodity brokers, dealers, exchanges, and services".

[3] To ensure that the exclusion of certain firms is not driving the results, I repeat the analysis on all (282) firms with available information. The findings of this supplementary analysis are similar to those presented in the paper and are not reported to conserve on space.

[4] Using CAPM alphas, alpha from a Fama-French three-factor model, or a Carhart four-factor model yields similar results.

also assign it to the lowest performance group. The CRSP delisting codes for which I relegate banks to the lowest group are 200-290 ("mergers") and 500-591 ("dropped"). When analyzing insider trading during 2007, I allocate banks to groups based on excess returns during 2008. If the return measurement period overlapped with the period for which I analyze insider trades, it would not be clear whether insiders were trading in anticipation of stock returns or were merely reacting to observed returns. Repeating the group allocation based on 2008 excess returns does not alter the groups dramatically, the correlation between the excess returns measured over the two periods is higher than 94%. Finally, once the groups are set, I only keep banks for which there are observations both before and after 2006, to limit the effect of sample attrition on the results. This procedure leaves 100 banks in the final sample, with 966 bank-year observations.

Panel A of Table 1 summarizes the number of observations and stock return characteristics in each of the three performance groups.[5] One potential concern is that creating groups based on excess returns would favor banks that were exposed to higher systematic risk. Therefore, I also calculate risk-adjusted returns as alphas from CAPM, Fama-French, and Carhart models estimated on daily data. Panel A shows that the top (bottom) performance group in terms of excess returns also had the highest (lowest) alpha, regardless of the asset pricing model used. Panel A also exhibits market betas from all three asset pricing models, which unsurprisingly suggest that banks in the bottom performance group were exposed to the highest level of systematic risk.

– Insert Table 1 here –

In Panel B I display information on announced asset write-downs for each of the three performance groups. The structure of subprime mortgage-backed securities is such that holders of the lowest tranche take the first losses. Therefore, if my ex-post measure captures banks' risk exposures accurately, banks in the bottom group should have the highest amount of total write-downs. Keeping the total write-down value constant, they should also write down assets the earliest. Panel B confirms that both the number of banks with write-downs and the total value of asset write-downs are strongly associated with the groups created based on stock price performance. The average ratio of write-downs to total assets is also lowest for the top

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[5] To be conservative, I assume delisting returns are 0 for banks in the bottom group. Doing so should lead me to understate the true loss of investing in the stocks of these banks, as the average delisting returns for mergers are in the range of 1.9-3.9%, whereas the average for delisting due to poor performance is between -16.3% and -41.7% (Shumway (1997), CRSP (2001)).

performance group, while it is of similar magnitude in the middle and the bottom performance groups. This latter result hints that the banks in the bottom performance group are, on average, larger than those in the other two groups. The yearly breakdown of total write-down figures shows that banks in the bottom group announced write-downs the earliest, whereas the one bank with write-downs in the top performance group (Wells Fargo) announced later, mostly in 2009 and 2010. Figure 1 examines write-down dynamics across the three performance groups in greater detail. For each group, I plot the cumulative fraction of write-downs announced for every quarter between Q3 2007 and Q4 2010.[6] The graph reconfirms that banks in the bottom group announced a large fraction of their write-downs earlier than banks in the middle group, who in turn announced somewhat earlier than banks in the bottom group.

– Insert Figure 1 here –

The empirical analysis of the paper uses two measures of insider trading. The first measure is the number of insiders that increased their ownership in the bank, divided by the number of all insiders trading that year. In calculating this percentage, I take into account all ownership increases and decreases by the insider in a given year, whether they are open-market transactions or not. Consequently, this measure is not influenced by sales related to option exercises since the option exercise increases the insider's ownership, and the subsequent sale decreases it by the same amount.[7] This measure is also insensitive to the amount by which the insider increased or decreased their ownership. The second measure I use is the net dollar value of open market transactions, defined as positive if more stocks were bought than sold, and negative if the converse holds. Unlike the first variable, this measure takes into account the magnitude of transactions, and includes all open market sales, irrespective of whether they are related to option exercises or not. Blockholders are excluded from the analysis, because their information set may be quite different from that of board members and senior executives. The baseline analysis examines trading by non-blockholder insiders, to whom I refer as "insiders" in the remainder of the paper. Additional tests then focus on the trading of different types of insiders. Panel C provides a breakdown of the average value of insiders' open market transactions, and the percentage of insiders increasing their ownership per bank-year. Insiders of

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[6] Write-downs occurring before or after this period are negligible, equaling 0.07% of total overall write-downs.

[7] Assuming a full sale of the stocks acquired through the option exercise. Full sales account for approximately 98% of all option-related sales in the sample. In the remaining 2% of option-related sale transactions the insider sells only part of the shares received through the option exercise.

the bottom group sold the most stock in 2006 in terms of stock value, coupled with a fairly low percentage of insiders increasing their ownership, suggesting that the high value of stock sales was not just due to a few large transactions. By contrast, insiders of the top group had the highest average value of sales two years later in 2008. The average value of sales declined, and the percentage of insiders increasing their ownership rose for both groups in 2009, particularly for the bottom performers.

A possible concern is that compensation structures in the two groups differ substantially, and that these differences in turn drive insider trading activity. If executives of banks that performed poorly during the crisis period received more stock-based incentives before 2008, they would sell more stock also for liquidity reasons (Jenter (2005)). Furthermore, Cheng, Hong, and Scheinkman (2011) underscore that total executive compensation is positively related to bank riskiness. Holding the proportion of stock-based compensation constant, higher total compensation would, on average, also imply higher amounts of liquidity-motivated stock sales. Therefore, I use several controls for compensation structure. I include total compensation (measured in millions of US dollars) and the percentage change in total compensation from the previous year, to account for increases in portfolio wealth that may prompt insiders to adjust their position. The ratio of stock-based to total compensation captures liquidity-motivated trading that arises because insiders receive some part of their compensation in stock. As insiders may exercise stock options or sell restricted stocks vesting from earlier grants, I also include the average stock-based compensation granted over the preceding three years. I control for total executive ownership to capture diversification motives. Finally, I include the intrinsic value of unexercised options, both exercisable and unexercisable, to further account for existing exposure to company stock. In the bank-level analysis, compensation variables are measured as bank-year averages over all executives whose compensation is disclosed in ExecuComp.

The set of controls also includes bank-specific variables. Size has been shown to have a negative correlation with insider trading activity (Seyhun (1986)). Book-to-market and the past-year stock return address the issue of contrarian trading by insiders (Rozeff and Zaman (1998), Jenter (2005)). Because book-to-market ratios of banks are difficult to interpret, in alternative specifications I replace book-to-market with earnings-to-price ratios. The results of these tests (unreported) are identical to the ones in the paper. Moreover, earnings-to-price ratios appear to explain less of the variation in insider trading than book-to-market ratios. Past-year stock return

volatility is included to capture trading associated with the riskiness of the bank (Meulbroek (2000), Jenter (2005)). The change in return volatility from year *t-2* to year *t-1* (the past year) captures changes in holdings owing to shifts in bank riskiness (Aggarwal and Samwick (1999), Jin (1999), Jenter (2005)).

Panel D tabulates summary statistics for the insider trading measures and the covariates used in the regressions, separately for the top and the bottom performance group. Accounting and compensation data are measured at the end of the fiscal year preceding the insider trade. To reduce the impact of outliers, I winsorize the net value of open market trading at the 1st and 99th percentiles. A bank-year observation is included in the sample if it has data on all the explanatory variables.[8] The two rightmost columns of Panel D show significance values of two tests. First, I use a t-test to assess differences among the groups in the levels of the variables. Second, I test for differences in the time trends of each variable by estimating the regression

$$x_{i,t} = \alpha_1 + \alpha_2 \text{Grp} + \beta_1 t + \beta_2 t\text{Grp}, \tag{1}$$

using observations from the top and the bottom groups, with the omission of years 2008 and 2009. Data from these years are left out because the groups were chosen to be different during the crisis, so finding a difference owing to the divergence of the variables in 2008 and 2009 would be tautological. Grp is a binary variable equal to 1 if the observation is in the bottom group, whereas t is a linear time trend. The last column of Panel D shows the significance of the coefficient of the interaction term between the time trend and the ex-post performance group, β_2.

The average percentage of insiders increasing their ownership is 33.76 in the bottom group, approximately 6 percentage points lower than in the top group. Netting out purchases and sales, insiders of banks in the bottom group sold approximately 16.82 million USD worth of stock in the open market each year, significantly more than insiders of banks in the top group. This is unsurprising, as banks in the bottom group were also significantly larger, as reflected by the total value of their assets. Insider trading measures for the CEOs exhibit no significant difference between the two groups. On average, CEOs sold over 4% of their total stock stakes in the open market each year.

Turning to the covariates, the median bank in the top group had assets of approximately 6.2 billion USD, whereas the median size in the bottom group was approximately 26.0 billion USD, confirming that the institutions analyzed are indeed the largest lending institutions in the

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[8] A few observations are dropped in the analysis of CEO trading because of missing compensation data.

US. Total compensation had been rising during the sample period (Core and Guay (2010)), evidenced by the median year-on-year increase of 23.53% in the top group and 30.76% in the bottom group. The executives covered by ExecuComp owned on average 2.28% (top group) to 2.99% (bottom group) of their bank's stock, which closely matches the figure reported by Fahlenbrach and Stulz (2011). The tests of the difference in levels suggest that banks in the bottom group were on average larger and had lower market valuations, and more volatile stock returns. Proportionately to their size, they also granted larger compensation packages. Although the levels of the covariates differ across the two performance groups, the last column suggests that these differences were constant over time, as there are no significant differences between the time trends of the variables between the groups. Therefore, using group fixed effects in the insider trading regressions can to account for most of the differences between the groups.

Of the explanatory variables, the proportion of stock-based compensation is scrutinized in further detail in Table 2. Understanding the dynamics of stock-based incentives in the different groups during the sample period is important for several reasons. First, if bank insiders receive a high proportion of their compensation in stock and options, they are also likely to sell more stock for pure liquidity considerations (Jenter (2005)). Second, if stock-based incentives were relatively low for the bottom performers before the crisis, the lack of incentives may have caused poor performance. While this prediction is suggested by the compensation literature (Murphy (1999)), recent papers on financial institutions cast doubt on its validity for banks. Mehran and Rosenberg (2008) show that although stock option grants induce CEOs to undertake riskier investments, they also lead them to take less borrowing and higher capital ratios. Keys, Mukherjee, Seru and Vig (2009) provide evidence that CEO compensation does not impact the quality of loans made. Table 2 shows that banks in all three performance groups exhibit growth in the percentage of stock-based incentives. Furthermore, banks that performed poorly during the crisis have a higher proportion of stock-based compensation, but the difference is not statistically significant, except for two years.

– Insert Table 2 here –

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III.   Insider trading prior to the crisis and bank risk-taking

The empirical analysis relates the insider trading patterns in the pre-crisis period to the ex-post measure of risk exposure, realized stock returns during the crisis. First, Subsection III.1 illustrates the univariate relationship between risk-taking and pre-crisis insider trading. Subsection III.2 then examines this relationship in a regression setting. Subsection III.3 shows that the documented patterns are more strongly present in the trades of CEOs.

III.1.   Insider trading and bank risk-taking: Univariate analysis

In the period before the crisis, during 2006, there was no sharp decline in the US stock or bond market in general. Moreover, banks in the bottom group were actually enjoying high stock returns. However, in 2006 the Case-Shiller home price index declined for the first time in several years. There was also geographic variation in housing prices: the Boston index had been stagnating since June 2005, while prices in Cleveland and Dallas started sinking in February 2006.[9] Amid the continued decline of these three local indices, in April 2006 San Diego, San Francisco, Washington DC, and Detroit also registered a decline, after several months of growth. In May, housing price growth in Las Vegas, Minneapolis, and Los Angeles also reversed, and the Case-Shiller 20-City Composite Index decreased for the first time since its start in 2000. Figure 2 shows the Case-Shiller seasonally adjusted 20-City Composite Index of housing prices (left vertical axis), and the number of index constituent cities in which housing prices were decreasing for each month since January 2000 (right vertical axis).

– Insert Figure 2 here –

These developments in the housing market during the spring of 2006 would have been a concern for institutions with large, uninsured subprime loan portfolios. To understand whether the decline in housing prices led to significant differences in insider trading between the top and the bottom group, I first examine monthly insider trading and the simultaneous movements of banks' stock returns and of housing prices for the period 2005-2009 in Figures 3 and 4. I

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[9] The information on housing prices is taken from the seasonally adjusted housing indices, retrieved from: http://www.standardandpoors.com/indices/sp-case-shiller-home-price-indices/en/us/?indexId=spusa-cashpidff--p-us----

disaggregate insider trading data by insider type: Figure 3 contains insider trading data for executive officers, while Figure 4 plots data on the trades of independent directors.

– Insert Figures 3 and 4 here –

Panel A exhibits equally-weighted stock returns of banks in the top and the bottom group. Panel B plots the 20-city, seasonally adjusted Case-Shiller Home Price Index, retrieved from Standard & Poor's.[10] Panel C graphs the cumulative dollar value of net open market insider trades. The first dotted vertical line indicates May 2006, the first month in which the index declined. The second dotted line indicates July 2007, when banks' CDS spreads increased dramatically for the first time. Because banks in the top group are smaller, their compensation packages and hence the option and restricted stock grants given to executives, are commensurately lower, on average. To enhance comparability of insider trading values across performance groups, I rescale the cumulative net insider trading values of the top performance group by the ratio of executive compensation between the top and the bottom group in 2006, 2.5. To ensure that my inference does not hinge on extreme observations, in Figure 4 I replace the data point in November 2006 (-766 million USD) with the 95th percentile of the distribution of monthly net open market trading values in the bottom group (-52 million USD).[11]

Stock returns of banks in the two groups did not differ markedly during 2005-2006. The return on an equally-weighted portfolio of banks in the bottom group was 6.5% higher in 2005 and 5% higher in 2006 than the return on banks in the top group, as shown in Panel A.[12] Panel C shows that insider trading patterns in the two groups started to diverge significantly in mid-2006, because insiders of banks in the bottom group sold more stock. As stock returns of banks did not differ substantially, it is unlikely that the observed large differences in traded values during 2006 and 2007 are due to contrarian trading or portfolio rebalancing. The graphs shown in Panel C of both Figure 3 and Figure 4 indicate that stock sales by insiders of ex-post poor performers increased notably (the slope becomes steeper) after May 2006. This pattern suggests that both

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[10] This indicator is more comprehensive than the 10-City Index, but has monthly data available, unlike the National Index, which is updated every quarter. As the indices are highly correlated, the findings presented are invariant to the choice of housing price index.

[11] Most of this value is due to a transaction by a Citigroup independent director, reportedly undertaken for "estate tax planning purposes". The trade involved selling Citigroup shares worth $737,741,663 in the aggregate. It is beyond the scope of this work to assess the tax planning motives of insiders. Since the data are winsorized for the yearly regressions, this trade does not affect the regression results. Replacing it with a much smaller value from the distribution guarantees that the trade does not affect the inference drawn from the monthly data either.

[12] The return difference on a value-weighted basis (not shown) was -1% (i.e. banks in the top group performed better) in 2005, and 3% in 2006.

executive officers and independent directors disposed of sizeable stock holdings after housing prices started to decline. However, the effect appears to be more pronounced for independent directors, probably because they were not bound by contract clauses requiring them to own a specified amount of the bank's stock, and hence had been holding the shares voluntarily (Bhagat and Tookes (2011)). Independent directors may also be less worried about the signaling effect of their trades. The net value of sales was approximately zero, or slightly positive in the bottom group after March 2008. Subsection V.3 investigates the origins of this pattern.

III.2. Insider trading and bank risk-taking: Regression results

I now shift to a multivariate framework, which allows for differences between the two groups of banks, acknowledging that institutions performing poorly during the downturn may be inherently different from other banks. I control for factors other than private information that have been shown to impact insider trading. To capture time-invariant unobserved heterogeneity at the bank level, I also estimate regressions with bank fixed effects (FE). For similar reasons, I estimate a third set of models with year FE. The group effects are omitted from the specifications with bank FE due to collinearity. The regression equation is:

$$\text{Itr}_{i,t} = \alpha + \beta_1 \text{Grp}_i + \beta_2 \text{Yr}_t + \delta \text{Grp}_i \text{Yr}_t + \varphi' \mathbf{Comp_{i,t}} + \gamma' \mathbf{Control_{i,t}} + \varepsilon_{i,t} \qquad (2)$$

where the dependent variable, $\text{Itr}_{i,t}$, is one of the two insider trading proxies: the percentage of insiders increasing their ownership, or the value of net purchases. Both these variables are increasing in insiders' willingness to hold the bank's stock. Grp_i is the group effect, Yr_t is a year dummy, Comp is the vector of compensation variables and Control is the vector of other control variables. In regressions with bank or year FE, these FE replace the intercept, α. Since the dependent variable is a fraction ranging between 0 and 1, I also run tobit regressions that account for two-sided censoring: from below at 0, and from above at 1. The panel tobit regression with bank fixed effects uses the estimator developed in Alan, Honoré, Hu, and Leth-Pedersen (2011).

– Insert Table 3 here –

Table 3 shows results from regressions of the percentage of insiders increasing their ownership in the bank in any given year on indicators for good and bad crisis performance, as well as their interaction with year 2006 (column 1) and year 2007 (column 6), and various controls. The coefficient estimates show that the difference in the decrease in insider ownership

between banks with poor and good crisis performance was significant in 2006, and 2007. Coefficient estimates for 2007 especially suggest large differences between the two groups. The results are robust to the inclusion of bank FE (columns 2, 5, 7, and 10) and year FE (columns 3 and 8). As the specifications with bank FE are the most successful in explaining trading motives other than private information, I consider the results of these regressions the most reliable. The percentage of insiders increasing their ownership is approximately 4 percentage points lower in the bottom performance group during 2006, representing a relative decrease of approximately 12% (4/33.76 = 11.8%) compared to the mean of the bottom group. The magnitude of the effect is larger during 2007, at 11.65-13.75 percentage points, or 34-40% in relative terms. The tobit specifications provide similar coefficient estimates, and the effect is larger in the fixed-effect tobit model. Coefficients of the control variables also have the expected sign. If insiders have contrarian views on firm value (Jenter (2005), Piotroski and Roulstone (2005)), then they should increase their ownership as the book-to-market ratio increases and decrease their ownership after periods of stock price appreciation. Also, fewer insiders are expected to increase their ownership if stock-based compensation was high in past years, as insiders already own large amounts of stock due to the grants. Accordingly, coefficient estimates are positive on the book-to-market ratio, negative on the past-year stock return, and negative on stock-based compensation. Finally, I repeat the same regressions for 2004 and 2005 and find no significant differences in insider trading between groups. These results are untabulated.

– Insert Table 4 here –

To examine the economic magnitudes behind the trades, Table 4 shows regressions with the aggregated net dollar values of open market insider transactions as dependent variable. Trade values are winsorized at the 1% level to reduce the impact of extreme observations. Coefficient estimates imply that insiders in the bottom performance group sold significantly more stock in the open market during 2006 than did insiders of banks in the top performance group. The differences in 2006 insider trading between the bottom and top performance groups are highly significant both statistically and economically. The economic magnitude of the effect is a difference of 4.79-6.98 million USD, which amounts to 30-40% of the mean value of net sales in the bottom group (16.82). Finally, for the year 2007, the difference between the two groups in the net dollar value of open market sales reverses, and is significant at the 10% level in one specification. I explore the origins of this latter finding in detail in Section IV. The control

variables explain more than 40% of the variation in the dollar value of insider trading. Adding bank fixed effects improves the adjusted R^2 by 10 percentage points. Additional regressions (untabulated) find no difference in traded values between groups during 2004 or 2005.

As information available to different insiders of the same firm may vary (Seyhun (1986), Lin and Zhao (1990)), I repeat the analysis for different insider categories. Tables 5 and 6 repeat the regressions of the percentage of insiders increasing their ownership, shown in Table 3, distinguishing executives and independent directors. This partitioning of the sample is motivated by two considerations. On the one hand, executives have been shown to have an informational advantage over independent directors (Ravina and Sapienza (2011)). On the other hand, independent directors are not subject to minimum ownership requirements set by the firm (Core and Larcker (2002), Bhagat and Tookes (2011)). The regressions for executive officers are shown in Table 5.

– Insert Tables 5 and 6 here –

The coefficient of the interaction term between bad crisis performance and the year 2006 is negative and strongly significant in all specifications. Moreover, the economic magnitude is larger than in the regression of all insiders: the 8-10 percentage point decrease in the percentage of insiders is a relative difference of 30-35% (the mean, 28%, is not shown in Table 1). Thus, in relative terms, the difference in the percentage of insiders increasing their ownership is three times larger for executive directors than for all insiders. Lastly, the difference between the performance groups is smaller in 2007, but remains statistically significant. Table 6 contains similar regressions for independent directors. The percentage of independent directors increasing their ownership is not different in 2006, but is significantly lower in high-exposure banks in 2007. Overall, the results indicate that many executives, but few independent directors of high-exposure banks were shunning the bank's stock in 2006. By 2007, however, a large number of independent directors also chose to decrease their exposure to the bank's stock. As an additional test, I also repeat the regressions of net open market values, shown in Table 4, separately for executives and independent directors (results not shown). The net value of stock sales by executive officers does not differ between the two groups. However, there is some evidence that independent directors of high-exposure banks sold more stock in 2006. A possible explanation for these results is that aggregating trade values at the year level renders it more difficult to accurately identify time trends. Section IV therefore offers a more refined analysis of this matter.

III.3. Trading patterns of chief executive officers

Next, I analyze the trades of chief executive officers. Fahlenbrach and Stulz (2011), Bhagat and Bolton (2010), and Bebchuk et al. (2010) all emphasize the role of CEO compensation in starting the crisis. I therefore seek to determine whether, and if so to what extent, CEOs also exhibited the trading patterns documented in the previous section. Focusing on CEOs also renders the relationship between insider trading and the compensation proxies more precise: in these regressions I use the compensation and ownership of the CEO, without having to average across insiders for each bank-year.

– Insert Table 7 here –

Table 7 presents regressions of a binary variable equal to 1 if the CEO increased her stock ownership during the year on the same covariates as before, with the compensation and ownership controls measured for the CEO. Not all CEOs had transactions in the insider trading dataset every year. In these cases, the dependent variable is set to zero. Columns 1-3 and 6-8 show linear probability models, whereas the other columns show panel logit regressions.[13] Results indicate that CEOs of banks in the bottom group were significantly less likely to increase their ownership during 2006 than CEOs of banks in the top group. The economic significance of the difference is higher compared to all insiders, and even slightly higher than for executive officers. The OLS specification of column 1 suggests that CEOs in the bottom group were 11 percentage points less likely to increase their ownership in 2006. This change is a decrease of 40% relative to the mean (27.93%), as opposed to a relative decrease of 30-35% for executives and 10% for all insiders. These differences are consistent with the notion that CEOs have better information about the prospects of their bank than insiders in general. They are also consistent with the empirical observation that CEOs have higher stakes in their bank, and thus stand to lose more if the stock price falls. For CEO trading in 2007, there is no consistent difference between high-exposure and low-exposure banks. Regressions of an indicator equal to 1 if the CEO is a net buyer of the bank's stock (untabulated) yield qualitatively similar results.

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[13] On the one hand, linear probability models may underestimate the true effect of the covariates on the dependent variable, and yield predictions that are outside the (0,1) interval (Cameron and Trivedi (2005)). On the other hand, nonlinear panel data models such as the logit may have the incidental parameters problem (Neyman and Scott (1948), Heckman (1981)), which the linear model avoids. The fixed-effect logit models in columns 5 and 10 drop banks if the CEO always increased her ownership during the sample period, or never did. The estimated fixed effect for these banks would be +∞, and −∞, respectively (Heckman (1981)).

– Insert Table 8 here –

To further assess the economic significance of the patterns in CEO trading, I next use the net number of stocks bought in the open market, scaled by the number of stocks owned by the CEO as the dependent variable. The regression estimates thus indicate what percentage of their total stock ownership CEOs sold in the open market. The results are shown in Table 8.[14] The results buttress earlier findings that CEOs in the bottom group sold substantially more stock in 2006 than CEOs of the top group. The difference between the two groups is approximately 9 percentage points (8.53-9.14), i.e. almost one-tenth of the total existing equity exposure, which is significant also economically. Moreover, considering that the average CEO of a bank in the bottom group sold 4.11% of her holdings in the market each year, the relative increase in CEO selling is in excess of 200% (8.53/4.11 = 208%). Columns 5-10 repeat the analysis for 2007 and find no significant difference.

Taken together, insiders, and in particular CEOs, of high-exposure banks reduced their exposure to the bank's stock more during 2006 than did their peers at low-exposure banks. Results for 2007 are, however, ambiguous. While the number of insiders decreasing their ownership remain significantly different across the two performance groups, dollar values traded on the open market do not differ on a yearly basis. Nonetheless, Figures 3 and 4 suggest that insider trading patterns started to diverge around May 2006, when the housing slump began. Therefore, the next section attempts to capture more accurately the relevant patterns in insider trading, by analyzing information at the quarterly level.

IV. Quarterly dynamics of housing prices, stock returns and insider trading

The graphical analysis of the previous section suggests, and the regression results corroborate, that insiders of high-risk banks reduced their stock exposures significantly in 2006 but also that this effect faded or possibly reversed during 2007. This section offers a more fine-grained analysis of the dynamics of trading by bank insiders, by scrutinizing their trades at the quarterly level. This analysis may also shed light on the source and extent of insiders' informational

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[14] Since one of the covariates, CEO ownership is highly correlated with the denominator of the dependent variable, in untabulated analyses I estimate alternative specifications in which this covariate is omitted, and find qualitatively and quantitatively similar results.

advantage. To explicate the link between housing prices, insider trading, and subsequent stock returns, I analyze quarterly insider trading in a multivariate setting. While a quarterly analysis allows a more precise understanding of the timing of events, its drawback is that I cannot use information on executive compensation, as these data are yearly.

As an alternative to the ex-post risk measure used so far, which is based on stock returns, I now create a proxy for the sensitivity of banks' portfolios to the subprime mortgage market. I use the correlation between the return on the Barclays index of BBB-rated collateralized mortgage-backed securities (MBS) and the stock return of the bank during July 2007 – December 2008. As the BBB tranche takes losses before the higher-rated ones, this index should be more sensitive to the underlying asset pool, in this case mortgages, than indices of AA or AAA-rated collateralized MBS. As in the previous empirical setup, I once again group banks into three terciles based on the correlation coefficients.[15] I then test whether insiders of banks with a high exposure to the subprime mortgage market (high risk) reduced their ownership stakes significantly compared to insiders of banks with low subprime mortgage exposure, once housing prices started to decline.

There are several reasons for using this alternative proxy of bank risk. First, while the previous measure does not consider the reasons underlying banks' performance, this new proxy identifies one of the main sources of bank risk: exposure to subprime mortgages. Second, it addresses more precisely the nature of information available to bankers. This ex-post measure stresses risk stemming from the housing market. It therefore allows me to assess whether bankers understood that housing prices were a crucial driver of the value of their banks' portfolios. Third, to show that the results presented in Section III are insensitive to the treatment of delisted banks, in this analysis I ignore whether a bank was delisted between July 2007 – December 2008 or not. For banks delisted during this period, the correlations are measured based on the stock returns until the delisting date.

For banks with high exposures to the subprime mortgage market the impact of housing prices on insider trading is likely to not be linear. First, the information content of the first decrease in the 20-city housing price index, in May 2006, was qualitatively different than in December 2007, when it had been sinking for 9 months in a row. Second, insiders can adjust

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[15] To show that results are insensitive to the treatment of delisted banks, in this analysis I ignore whether a bank was delisted between July 2007 – December 2008 or not. For banks delisted during this period, the correlations are measured based on the stock returns until delisting date.

their positions relatively quickly once new information is available to them. It follows that, once they have adjusted their holdings by selling large amounts of stock, they may choose not to trade at all or to change their holdings only slightly. Therefore, specifications including the level or the return on the housing price index would not be able to accurately capture the effect. Instead, I use binary variables indicating whether housing prices declined in a given quarter. Furthermore, to allow for a non-linear effect, I use separate dummy variables for the first quarter in which the housing price index declined, the second quarter in which it declined, etc. up to the fifth quarter. Thereafter, I use a single dummy variable for all further decreases in the housing price index, i.e. the variable equals one in the sixth and all subsequent quarters with negative returns on the housing price index. The regressions I estimate on quarterly data take the form

$$\text{Itr}_{i,t} = \alpha + \beta_1 \text{Corr}_i + \beta_2 \text{HPD}_{jt} + \delta \text{Corr}_i \text{HPD}_{jt} + \gamma' \textbf{Control}_{i,t} + \varepsilon_{i,t} \tag{3}$$

where the dependent variable, $\text{Itr}_{i,t}$, is the net value of open market sales. Corr_i is the group effect, based on correlations between the stock price and the BBB-rated CMBS index. HPD_{jt} (housing price decline) is an indicator equaling one for the j-th quarter in which the housing price index declined, except for j=6, which equals one in the sixth quarter and all quarters thereafter in which the housing price index decreased. Control is the vector of control variables. I report two further specifications, one with bank FE and one with quarter FE. In these regressions, α_i, a bank fixed effect, or α_t, a quarter fixed effect replaces the intercept, α. For past stock returns, past return volatility and changes in past return volatility, I include two variables: one measured over the past quarter and the other measured over the past 252 trading days. Although past stock returns were not markedly different between the two groups in 2006, including these controls and book-to-market ratios ensures that the results are not driven by contrarian trading or portfolio rebalancing.

– Insert Table 9 here –

Table 9 summarizes the regression estimates. The strongly negative coefficients on the interaction terms suggest that insiders of banks with high exposure to subprime mortgages sold large amounts of stock in the open market immediately as housing prices started to decline. The economic effect is much (2-4 fold) larger than that estimated for banks with medium sensitivity to the subprime mortgage market. Furthermore, the economic magnitudes are larger or equal to those implied by the yearly regressions. The interaction terms for high-risk banks during the first three quarters of housing price declines suggest additional sales of 1.63, 2.66, and 1.81 million

USD, respectively. The average quarterly value of net stock sales for high-correlation banks is -5.8 million USD (untabulated). The relative increases in quarterly selling suggested by each of the coefficients can then be estimated at 28% (1.63/5.8), 46%, and 31%.[16] The effect reverses during the 5th quarter of housing price declines, Q3 of 2007, and the period thereafter. This result explains the decrease in insider selling found in the yearly regressions of Table 4. Although the fit of the models is lower than in the yearly analysis, the regression with bank fixed effects is still able to explain almost 30% of the variation in quarterly insider trading activity.

To understand if these results are particular to any group of insiders, I run similar regressions separately for executive officers and independent directors. The estimates, tabulated in Table 10 corroborate the inference drawn from the full sample regression. The interaction terms for the first, second, and third decline in housing prices are strongly negative for the group with the highest correlation. The difference between the interaction terms measured for the group with high and the group with middle correlation remains sizeable, at a factor of 2-4. In all specifications, I can reject that the interaction terms for each of the housing price declines are equal in the high and the middle-correlation group. In terms of economic magnitudes, the incremental selling by executive officers is 1.02, 1.34, and 1.13 million USD, amounting to an increase of 33, 43, and 36% relative to the mean. Consistent with the steeper decline in the graph in Figure 4, I find that independent directors' selling activity is more pronounced. Their additional selling of 0.49, 0.68, and 0.37 million USD per quarter represent relative increases of 59, 82, and 45%, compared to the mean. Regarding the timing of insider selling, executive officers stop selling large amounts in the fifth quarter of housing price declines, while independent directors continue to sell in this quarter. Differences in selling then reverse for both types of insiders, and become insignificant for the sixth and subsequent quarters of housing price declines for independent directors.

– Insert Table 10 here –

The results in Tables 9 and 10 are suggestive of the nature of information possessed by insiders. It appears that, while insiders responded to the publicly observable information of housing price decreases in 2006, the magnitude and sign of this response was different according to the exposure of the bank to the subprime mortgage market. Despite regulatory requirements

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[16] Since the criteria for sorting banks into groups differ in the two sections, finding similar magnitudes provides reassurance that the economic effects do not hinge on one specific group creation rule.

on the reporting of off-balance-sheet items, insiders still had a better understanding of these exposures than outside investors. For instance, data on the pool of mortgages underlying the MBSs held by the bank are crucial in evaluating these securities, but are not publicly available, nor was it straightforward to all investors how to value subprime mortgages and related instruments (Gorton (2009)). In sum, the empirical evidence suggests that bank insiders' response to public information was influenced by their private information regarding their exposure to the subprime mortgage market.

Combining this evidence on the dollar value of sales following housing price declines with the regressions of Tables 5 and 6 on the percentage of executives and independent directors increasing their ownership, the following conclusions emerge. During 2006, a high number of executive officers, but not independent directors, reduced their ownership in ex-post poor performers, while in 2007 insiders of both type were unwinding their exposures in their bank's stock. The extent of selling was, however, more intensive for independent directors. Hence, independent directors appear, on average, not as well-informed as executive directors (Ravina and Sapienza (2011)), but those who did understand the risks taken by the bank were able to sell large amounts of stock, as they were under no formal obligation to retain an equity exposure (Bhagat and Tookes (2011)), and may have been less concerned about the signaling effect of their trades.

V. Additional robustness tests

This section provides empirical evidence to complement the analyses of the previous sections. Subsection V.1 discusses robustness of the results to assuming a non-linear effect of past stock returns on insider trading, varying the measure used to form groups, and restricting the sample period. Subsection V.2 shows that the observed trading patterns are not driven by insiders that leave the bank. Subsection V.3 examines the causes of the reduction in insider selling activity in high-risk banks during 2008 and 2009. Subsection V.4 presents a new measure, insider trading duration, which offers a robustness test of the main result of the paper. Finally, as a further robustness check, Subsection V.5 uses a trading strategy to assess the economic content of insider trading prior to the crisis.

V.1.   The effect of past stock returns, group formation, and changing the sample period

The regressions presented in the paper rely on the assumption that the impact of covariates on insider trading activity is close to linear, and does not change over time. As high-risk banks were favored by the markets in 2006, a possible concern is that high stock returns prompted additional selling over and above the normal portfolio rebalancing effect. In untabulated results, I account for possible non-linearities in the relationship between prior stock returns and the value of stock sales by insiders by including the square and the cube of gross returns as regressors in Table 4. These variables are insignificant, while other coefficient estimates and significance levels remain unaffected. Also, from Figures 3 and 4 and Tables 9 and 10 it appears that strong insider selling started in mid-2006. If the upward trend in stock returns were the sole driver of the increase in insider selling, it is unclear why the surge in sales is present only in the second half of 2006, but not in the first.

As an additional test, I examine if results are sensitive to the measure used to form groups. First, the correlation between the tercile rankings based on stock price performance and correlation with the BBB-rated collateralized MBS index is -61%. Second, I repeat the yearly analysis using the correlation-based groups, and the quarterly analysis using the return-based groups. Estimates from these regressions are similar to those presented in the previous sections. I conclude that the main results of the paper are not sensitive to the measure used to form groups.

Finally, I also run all of the regressions discarding data points prior to 2000 (results are untabulated). This serves two related purposes. First, it is an attempt to mitigate the effect of time-variation in the coefficients of the control variables, if any. Second, it also serves to mitigate concerns of time-varying bank heterogeneity. If banks changed their profiles or policies over time, then reducing the length of the data set should alleviate the issue to the extent that these shifts would now have to take place within the span of 10 years, rather than 15. None of the results are sensitive to starting the sample in 2000, rather than 1996.

V.2.   Pre-crisis trading by insiders leaving the bank

The results so far suggest that insiders of ex-post poor performers sold significantly more stock during 2006 than insiders of banks emerging relatively well from the crisis. It is possible,

however, that the results are influenced by differences in insider turnover across the two groups. If the number of insiders leaving during 2006 or 2007 was higher in banks that performed poorly during the crisis, it would also lead to fewer insider purchases and to higher amounts of net open market sales, for two reasons. First, since executive stock options lapse if the executive departs from the firm, it is rational for them to exercise rather than forfeit the options. Second, insiders are no longer bound by firm-level policies to retain large amounts of stock (Core and Larcker (2002), Bhagat and Tookes (2011)). Thus, portfolio diversification suggests that they should reduce their exposure to the firm's stock.

I perform a robustness exercise to address the issue of selling by insiders that leave the bank. First, I estimate turnover ratios in both performance groups and test whether they differ significantly. I compute turnover ratios from the Thomson Reuters insider trading database. An insider is assumed to have left the bank if the last year in which they are in the sample precedes the last year in which the bank is in the sample. By construction, it is impossible to calculate the turnover ratio in the last year that the bank is in the sample, and consequently for any bank in 2009, the end of the sample period.

– Insert Table 11 here –

Table 11 tests the equality of turnover ratios between the top and bottom performance groups during the sample years. While turnover of insiders was significantly higher in the top group in 2000, the bottom group saw notably higher turnover ratios in 2007 and 2008. The difference between the two groups was insignificant in 2006, however. Therefore, it is unlikely that the 2006 results are affected by differences in trading, whereas turnover may have an impact on the 2007 results. To assess whether the differences in 2007 insider trading are due to the differences in the fraction of insiders leaving the bank, for each year I keep only insiders that stay at the bank, and re-estimate the regressions of Tables 3 and 4. Coefficient estimates and significance levels are largely similar to those reported for the full sample, and are omitted to conserve space. I conclude that although the proportion of insiders leaving the bank was higher in 2007 in the bottom group than in the top, this difference is not driving the observed divergence of insider trading patterns during 2007. Restricting the sample to insiders that do not leave does not produce different results from those obtained for the full sample.

V.3. Trading patterns in 2008

Figures 3 and 4 suggest that insider selling activity in high-risk banks slowed, or even showed a slight reversal during the crisis in 2008 and 2009. I investigate two explanations for this feature of the data.

– Insert Table 12 here –

First, Table 12 shows that option-related sales account for 30-50% of total stock sales. Following the large extent of selling during 2006 and part of 2007, insiders may not have had any options to exercise. Moreover, due to the slump in high-exposure banks' stock prices, a large part of their remaining option packages may have been underwater, as executive stock options are customarily granted at the money (Brenner et al. (2000)). Table 12 also shows that the value of stock sales related to option exercises, relative to all stock sales, dropped dramatically for the high-exposure group in 2008-2009. This provides backing for the conjecture that part of the reduction in the value of net sales is due to option packages that were out of the money as a result of continued negative returns.

Second, the effect may also be driven by insiders joining the firm. Firstly, they may have no inside information on the bank, or have less than incumbents. Secondly, they may be required by their employment contract, or company policies to purchase a certain amount of company stock (Core and Larcker (2002)). If newly hired executives were purchasing more stock than in previous years, then the increased purchase component would also drive up the net value sold (or purchased) in the open market. I investigate this conjecture in two ways.

– Insert Table 13 here –

First, I examine what fraction newly joined insiders accounted for in the total dollar value of stock purchases each year. I calculate this percentage by summing the value of stock purchases by insiders joining the bank for all banks in a performance group, in a given year. Next, I divide it by the total value of stock purchases by all insiders. This measure is thus available at the performance group-year level. I repeat the same calculation for sales transactions, to obtain additional insight into the transactions placed by joining insiders. The results, shown in Table 13 indicate that in most of the years after 2000, joining insiders usually account for no more than 5% of all sales, and no more than 15% of all purchases. These figures are plausible as these insiders have very little stock to sell, and may be required to obtain a stock

exposure in the bank. The fractions exhibited in Table 13 also show that neither the fraction of purchases by joining insiders, nor that of sales by joining insiders is consistently higher in either of the performance groups prior to the crisis. However, during 2008 and 2009, the fraction of purchases by joining insiders in the bottom group is remarkably higher compared to historic values of both the bottom and the top groups. The fraction of sales shows no similar change during the crisis. Thus, Table 13 confirms the second reason underlying the insider trading patterns in the bottom group during 2008-2009: insiders of high-risk banks purchased more stock.

Second, I regress the net value of open market sales placed by newly joined insiders on the bank-specific control variables of the baseline regression. For these regressions, only trades of newly joined insiders are considered in each of the bank-years, to ensure comparability. Compensation variables are not included in the regression, because these insiders received no compensation during the previous year. The results show that in 2008, insiders joining high-risk banks purchased (sold) a significantly higher (lower) amount of shares than insiders joining low-risk banks. Adding bank fixed effects does not alter this finding. These results substantiate the argument that insiders joining high-risk banks purchased more stock during the crisis, contributing to the convergence in cumulative traded stock values between the high-risk and low-risk groups of banks.

V.4.   Insider trading duration

Part of the analysis presented so far stresses the differences between the value of stock traded by insiders of different banks. Although the explanatory power of my regressions of net open market trades is reasonably high, especially for models including bank FE, I now show that the differences in insider trading patterns remain even if I abstract completely from differences in traded values between banks, and focus solely on the time dimension. I construct a measure to gauge more precisely the time elapsed between trades of insiders and adverse events in the economy. I apply a modified version of the Macaulay duration used in the analysis of bonds. Specifically, I define the bankruptcy of Bear Stearns on March 16, 2008 as a reference point, and measure the time elapsed between each trade and this event, weighted by the dollar value of the trade. For each bank, I define

$$D = \sum_{i=1}^{n} t_i \frac{PV_i}{V} \qquad (4)$$

where t_i is the time span between trade and the reference point, measured in days, PV_i is the value of the transaction, corrected by the appropriate discount factor, and $V = \sum_{i=1}^{n} PV_i$ is the total discounted value of all transactions occurring during the measurement period.[17] To dispense with the difficulty of averaging both positive (purchases) and negative (sales) transaction values, I restrict the analysis to open market sales occurring after May 1, 2006.

Because D is a measure of time and is normalized by the total transaction value V, it is completely insensitive to differences in total traded values between banks, and focuses instead on how the "unit" of total value was traded over time. In the regressions presented in Tables 4, 11 and 12, the relation between bank size and the value of stock sold in the open market is parametric. Therefore, analyzing insider trading duration serves as a robustness test to accompany the regressions. Specifically, this analysis relaxes the assumption that the value of insider sales is linearly related to the log of total assets. I convert the information embedded in the dynamics of trading into a single measure that is independent of bank size. The measure is higher if insiders sell stock predominantly around the time the housing prices decrease, and lower if they sell later, during 2007 or the first months of 2008.

– Insert Table 14 here –

Table 14 shows duration values for open market sales in each of the three performance groups of the baseline analysis. Banks in the bottom group that were delisted during the return measurement period (July 2007-December 2008) are excluded from the duration calculations, because their duration values are, by construction, higher than those of other banks. The mean and all three quartiles are highest for banks that performed worst during the crisis. Their selling activities, on average, occurred earliest and therefore the longest before the bankruptcy of Bear Stearns. When comparing the difference between the top and the bottom groups by means of a t-test, the null hypothesis of equality of the two duration values can be rejected at the 5% level. The non-parametric Mann-Whitney-Wilcoxon test also rejects the equality, albeit at the 10% level. I conclude that stock sales were concentrated more towards the beginning of the interval between May 2006 and March 2008 for insiders of high-exposure banks. Coupled with the

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[17] To simplify calculations I use a constant discount rate of 4.37%, which is the average yield on the one-month treasury bill during this period.

results of the graphs and the regressions, this means that insiders of high-exposure banks sold not only more stock during 2006, but they were also quicker to decrease their exposures after housing prices began to decrease.

V.5.   Returns to portfolio strategies based on insider trading information

Considering the results of the previous sections, a further question that arises is whether insider trading up to and including 2006 was an economically meaningful source of information for subsequent stock investments. I explore the profitability of an investment strategy that relies on insider trading information using a two-step method. In the first step, I estimate residuals from a regression model of insider trading on control variables capturing trading motives other than private information. In the second step I use the residuals, which I call abnormal insider trading (AIT), to construct portfolios of bank stocks. The first step obtains estimates of AIT by regressing the total value of net open market purchases on the control variables detailed in Section II. AIT is defined as the residual, $\varepsilon_{i,t}$ in each of the three the regressions

$$\text{Itr}_{i,t} = \alpha + \varphi' \textbf{Comp}_{i,t} + \gamma' \textbf{Control}_{i,t} + \varepsilon_{i,t} \tag{5}$$

To guard against look-ahead bias, I omit data from the years after 2006 when estimating these models. Furthermore to ensure that the results are not sensitive to the specification used, I estimate two additional models: a regression with bank FE and one with year FE.

I then use information on 2006 AIT to sort banks into portfolios. I employ two sorting methods: the first considers the 2006 AIT from all three regressions, and places banks in the positive (negative) AIT portfolio if their estimate 2006 AIT is positive (negative) in all three regression models (OLS, bank FE and year FE). While this method is intuitive and translates the information embedded in the 2006 AIT directly (i.e. it purchases stocks that insiders appear to have bought more heavily, and sells stocks that insiders appear to have sold more heavily), it results in portfolios containing unequal numbers of banks. To obtain portfolios with equal numbers of banks, the second method creates a ranking of banks based on their 2006 AIT values, separately for each three regression models. Next, it sorts banks into quintile portfolios based on their average ranks. Finally, I examine the value-weighted returns to investing in each of these seven portfolios (positive AIT, negative AIT, and 5 quintile portfolios), as well as two long-short portfolios, *(positive AIT – negative AIT)*, and *(quintile 5 – quintile 1)*. To control for the riskiness

of these investment strategies I also calculate CAPM alphas, and alphas from three-factor and four-factor models. The returns to and the alphas on these investment strategies are evaluated during the two periods used earlier in the paper, July 2007 – December 2008, and January 2008 – December 2008. Table 15 exhibits the annualized returns and alphas.

– Insert Table 15 here –

The estimates show that a portfolio constructed on the basis of 2006 abnormal insider trading information yielded an annualized return of 33.65–34.66% during July 2007 – December 2008. Despite using two qualitatively different methods, the returns on the constructed long-short portfolios are remarkably similar. Moreover, the performance of the portfolios does not sink much after adjusting for risk factors: alphas are approximately 30%. The annualized performance is considerably higher during January 2008–December 2008: it is estimated between 51.61 and 53.89%. Annualized alphas are around 50%, and again, the two long-short portfolios produce very similar performance. Regarding the economic interpretation of the results, on the one hand, most of the reported results lack statistical significance, with t-statistics of 1.3–1.6. On the other hand, both returns and alphas increase gradually from the first quintile to the fifth, (although returns in the third quintile are somewhat higher), suggesting that abnormal insider trading in 2006 did contain information about future stock returns.[18]

VI.   Discussion and limitations

The empirical analysis of the paper relies on the assumption that the variables driving high-exposure banks' risk-taking before 2006 do not also drive bank executives' insider sales in 2006. The evidence suggests that bankers' trades during 2006 were driven by their information regarding the risk exposures they had built up. However, the same unobserved variable that was driving risk-taking before 2006 might also drive, directly or indirectly, the additional insider selling in 2006 and later. Despite using several controls in the regression analysis that have been shown to impact insider trading activity, there may be a factor that the analysis does not incorporate correctly.

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[18] As in section II, I assume that the delisting returns on the stocks are 0, which should lead me to understate the returns on the long-short portfolio, because the first quintile portfolio and the negative AIT portfolio contain most of the delisted banks.

My paper suggests that insiders of high-exposure banks increased their stock sales as housing prices started decreasing. Did outsiders understand the significance of the mid-2006 housing price declines for the fate of the banks? First, Figures 3 and 4 suggest that bank stock prices did not exhibit a marked and lasting reaction to housing prices. Therefore, stock market investors did not appear worried about the effects of the housing market on banks' prospects. Second, as pointed out by Gorton (2009), the ABX.HE index (an index of subprime residential mortgage-backed securities) dropped steeply only in the first part of 2007. Thus, institutional investors' views on the value of subprime mortgages did not alter dramatically during 2006, implying that not even institutions possessed completely accurate and up-to-date information on banks' exposures. Third, the complexity of mortgage-backed securities rendered it easy for most entities to conceal their exposures by opaque reporting (Gorton (2009)).

A further caveat to the interpretation of the results is that insiders may hedge their stock exposures (Bettis, Bizjak and Lemmon (2001), Jagolinzer, Matsunaga and Yeung (2007), Gao (2009), and Bettis, Bizjak and Kalpathy (2011)). However, Fahlenbrach and Stulz (2011) report that they find no disclosures of such transactions for the sample banks. It is nonetheless possible that bankers traded (derivatives on) instruments other than their bank's stock to reduce the impact of their equity exposures. They could have taken positions, possibly through intermediaries, in the CDS market (Acharya and Johnson (2007)), or placed transactions in their competitors' stocks (Tookes (2008)). If any of these forms of hedging were pervasive among the examined banks, it is intuitive that insiders of high-risk banks should make more use of such instruments. Therefore, any result I found on their insider trading would be attenuated, compared to a setting without hedging. Insofar as the entire portfolio of bank insiders cannot be observed, it is difficult to verify whether they had direct or indirect positions in competitors' stocks, or CDSs.

Finally, it is possible that although bankers understood the risks embedded in their banks' portfolios before 2006, they also anticipated that their informational advantage would allow them sufficient time to decrease their stock holdings before stock prices slumped. The literature on sophisticated investors riding bubbles (Abreu and Brunnermeier (2002, 2003), Brunnermeier and Nagel (2004)) motivates this basic idea. However, Brunnermeier and Nagel (2004) also indicate that hedge funds were able to outperform the market by timing investments in technology stocks with quarterly accuracy. If bank insiders were riding a bubble, it remains unclear why they started selling large amounts of equity 12 months prior to the fall of their banks' stock prices.

VII.   Conclusion

This paper provides evidence that insiders of banks that had the highest risk exposure going into the crisis sold significantly more stock in 2006, before the crisis hit. Specifically, I show that insiders of high-exposure banks were 12% more likely to decrease their ownership, and sold 30% more stock in the open market during 2006, than insiders of low-exposure banks. Changes in insider trading behavior were stronger for chief executive officers: the likelihood of reducing their ownership increased by 40% relative to the mean. Moreover, the amount of stock CEOs sold as a fraction of their total stock ownership increased by 200%. These results are not explained by contrarian trading, portfolio rebalancing following price increases, differences in the compensation structures of the banks, riskiness of the bank's stock, time-invariant bank heterogeneity, or differences in executive turnover.

The paper is the first to document that developments in the housing market had a close temporal correlation with the trading decisions of bank insiders. My results show that sales by insiders in banks with high subprime exposures accelerated in the 2nd quarter of 2006, when housing prices at the national level registered their first decline since 2000. The economic effects are sizeable, as bankers increase their sales by 30-45% during each of the first three quarters of housing price declines. The results of the paper also have implications for investments. A simple portfolio strategy based on insider trading information up to 2006 earns an annualized, risk-adjusted return of 30-50% during the crisis.

The empirical evidence suggests that the complexity of mortgage-backed securities created an informational asymmetry that insiders used to their advantage. The results are difficult to reconcile with the view that bank insiders continued to believe the investments they made prior to the crisis would pay off after housing prices started to fall in 2006. However, there is no evidence of increased selling activity before the housing market weakened, in 2004-2005. This result suggests that bank insiders' foresight regarding the consequences of their policies was limited. Notwithstanding, they had more than 12 months to reduce their equity positions before the market gradually learned about the subprime risk exposures of their banks' portfolios. I conclude that bank insiders regarded investments in mortgage-backed securities profitable given the housing price growth, but revised their valuations of these investments following the reversal in housing prices.

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Figure 1: Asset write-down dynamics across performance groups
The data are from Bloomberg. The graphs show the cumulative percentage of total write-downs that occurred until the quarter on the vertical axis.
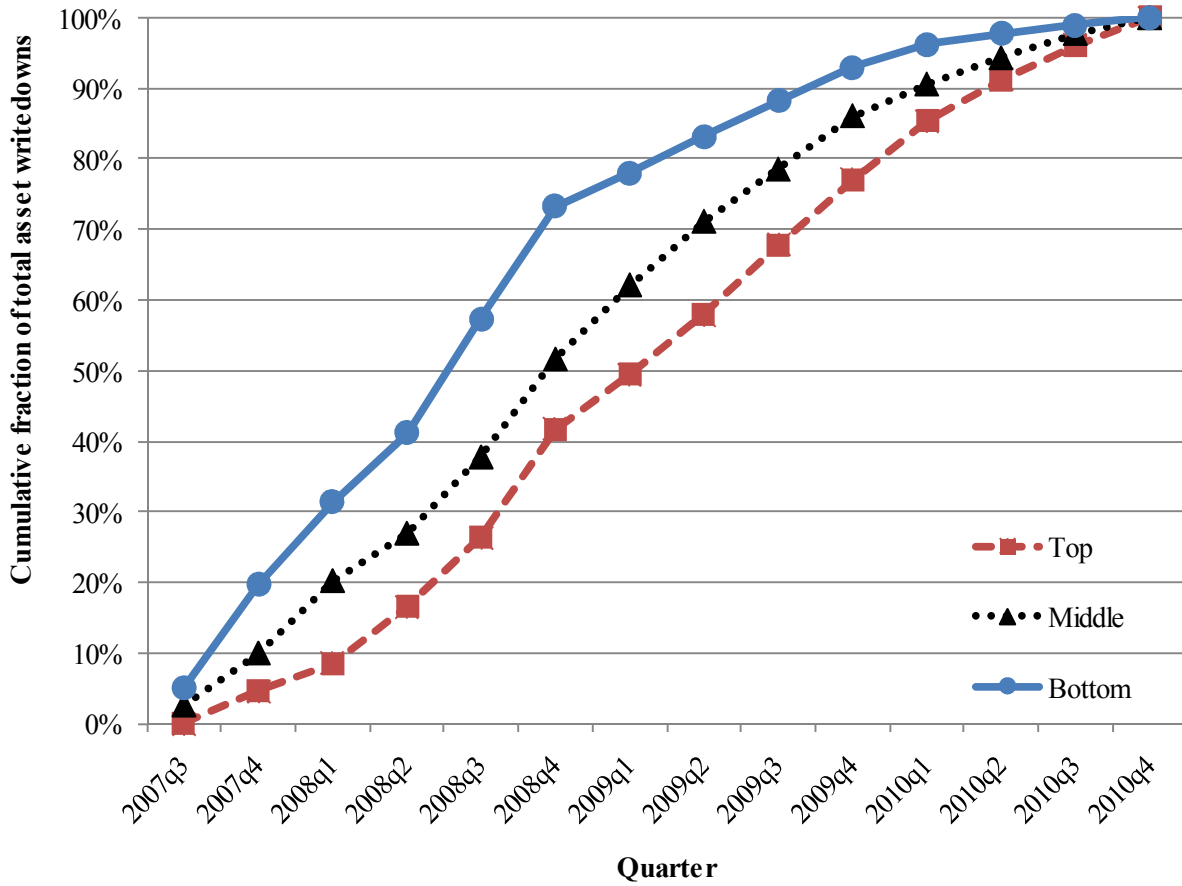
Figure 2: Housing price dynamics from 2000: aggregate trend and geographic variation

Data are from the Case-Shiller seasonally adjusted housing price indices. The solid line, scaled on the left vertical axis, shows the Case-Shiller 20-city Composite Index. The bar chart, scaled on the right vertical axis, represents the number of cities, out of the 20 index constituents, in which housing prices decreased.

33
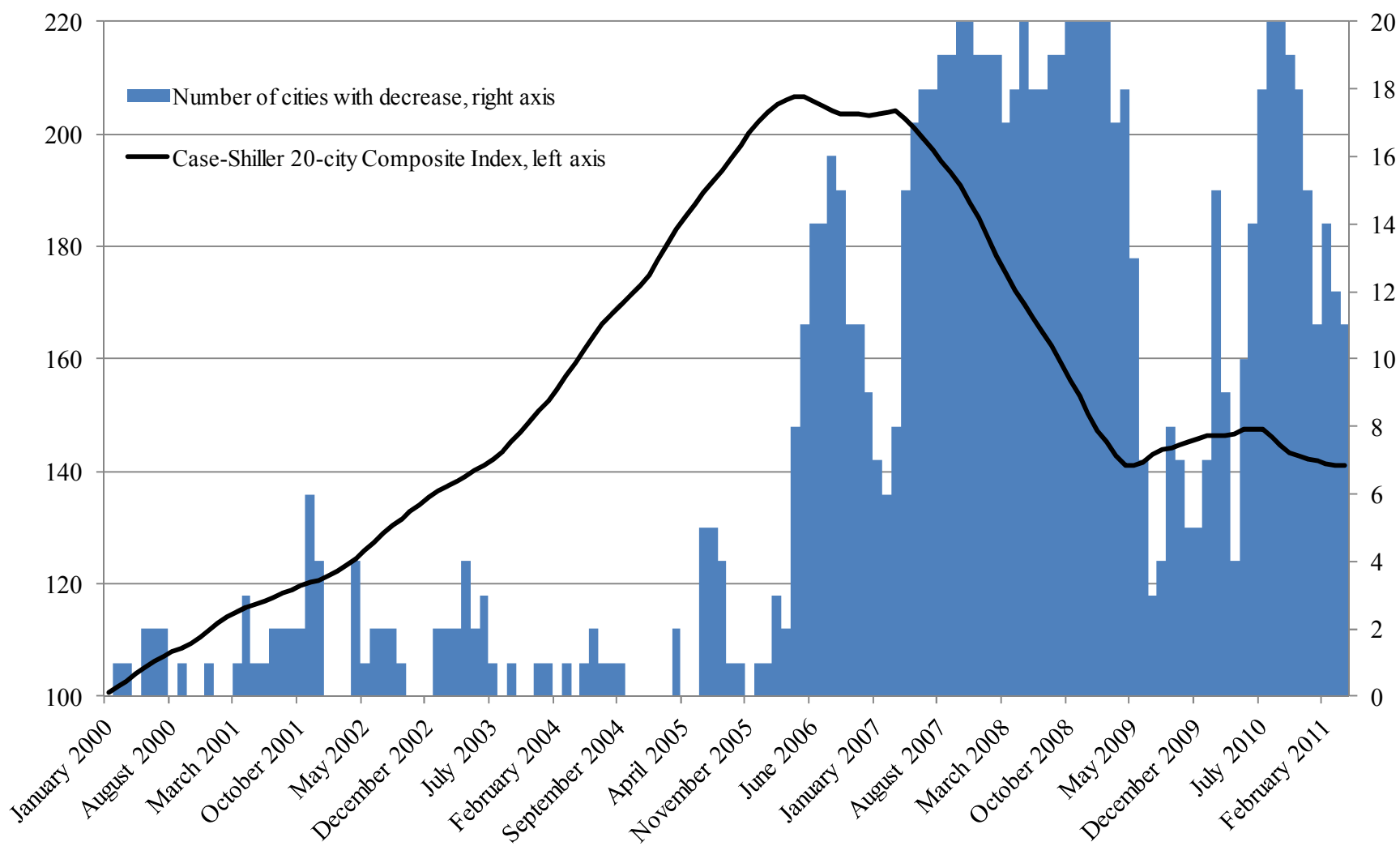
Figure 3: Housing prices, stock returns, and insider trading – executive officers
Panel A shows equally-weighted, cumulative stock returns for the bottom and the top performance groups, calculated using data from CRSP. The base date is January 1, 2005. *Panel B* graphs the Case-Shiller 20-City Composite Index of housing prices. *Panel C* plots the cumulative net open market value of insider trading by executive officers, retrieved from Thomson Reuters. The series for the executives of the top performance group is scaled up by 2.5, the ratio of total executive compensation between the two groups in 2006, to account for the difference in bank size.

Panel A: Stock returns

50%

0%

-50%

-100%

—— Bottom

- - - Top

Panel B: Home Price Index

220

200

180

160

140

—— Case-Shiller 20-City Composite Index

Panel C: Insider trading

0

-500

-1,000

-1,500

-2,000

-2,500

-3,000

Dec-04 Mar-05 Jun-05 Sep-05 Dec-05 Mar-06 Jun-06 Sep-06 Dec-06 Mar-07 Jun-07 Sep-07 Dec-07 Mar-08 Jun-08 Sep-08 Dec-08 Mar-09 Jun-09 Sep-09 Dec-09

—— Executives, bottom   - - - Executives, top
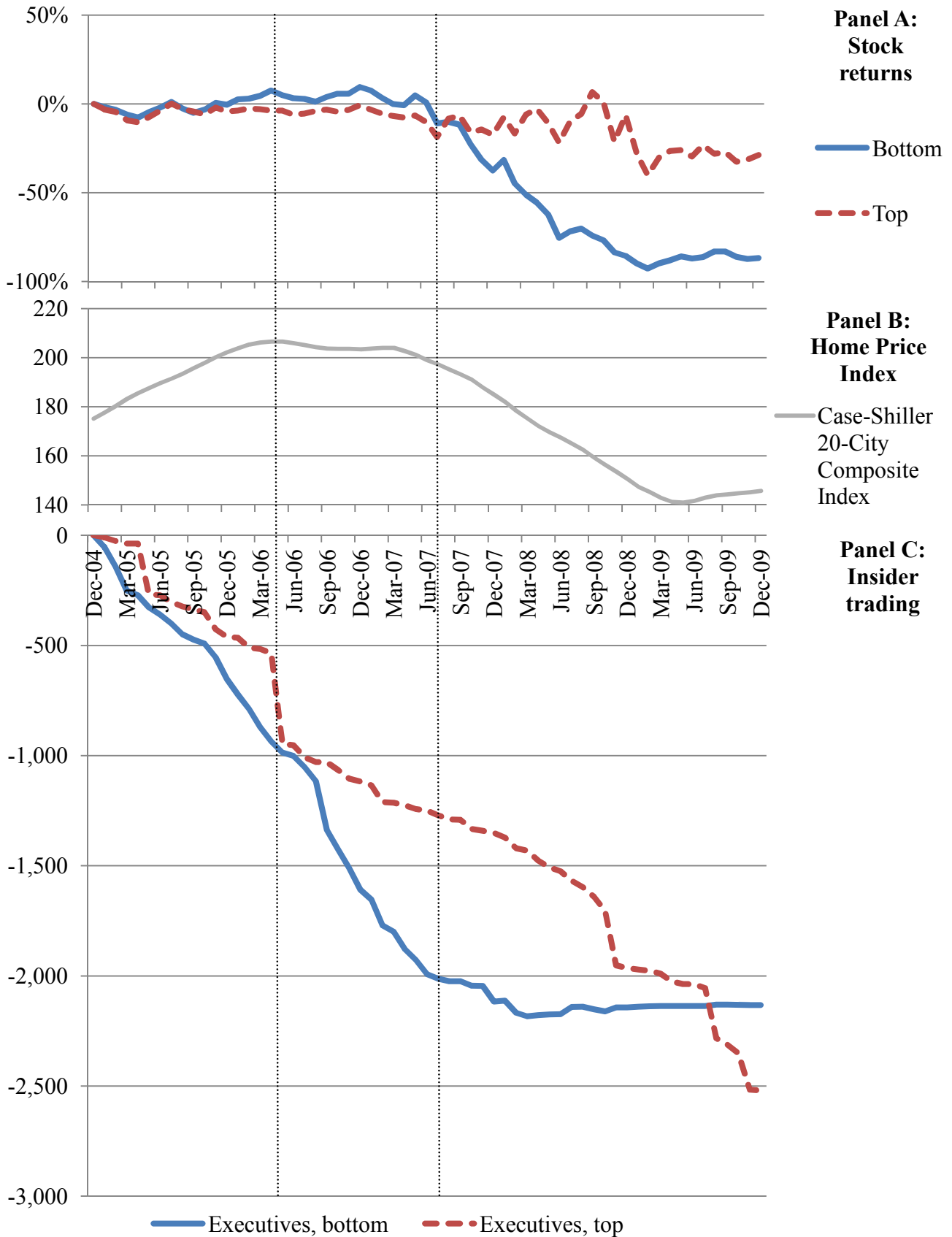
Figure 4: Housing prices, stock returns, and insider trading – independent directors
Panel A shows equally-weighted, cumulative stock returns for the bottom and the top performance groups, calculated using data from CRSP. The base date is January 1, 2005. *Panel B* graphs the Case-Shiller 20-City Composite Index of housing prices. *Panel C* plots the cumulative net open market value of insider trading by independent directors, retrieved from Thomson Reuters.

Panel A: Stock returns

—— Bottom

- - - Top

Panel B: Home Price Index

—— Case-Shiller 20-City Composite Index

Panel C: Insider trading

—— Independent, bottom

- - - Independent, top

37
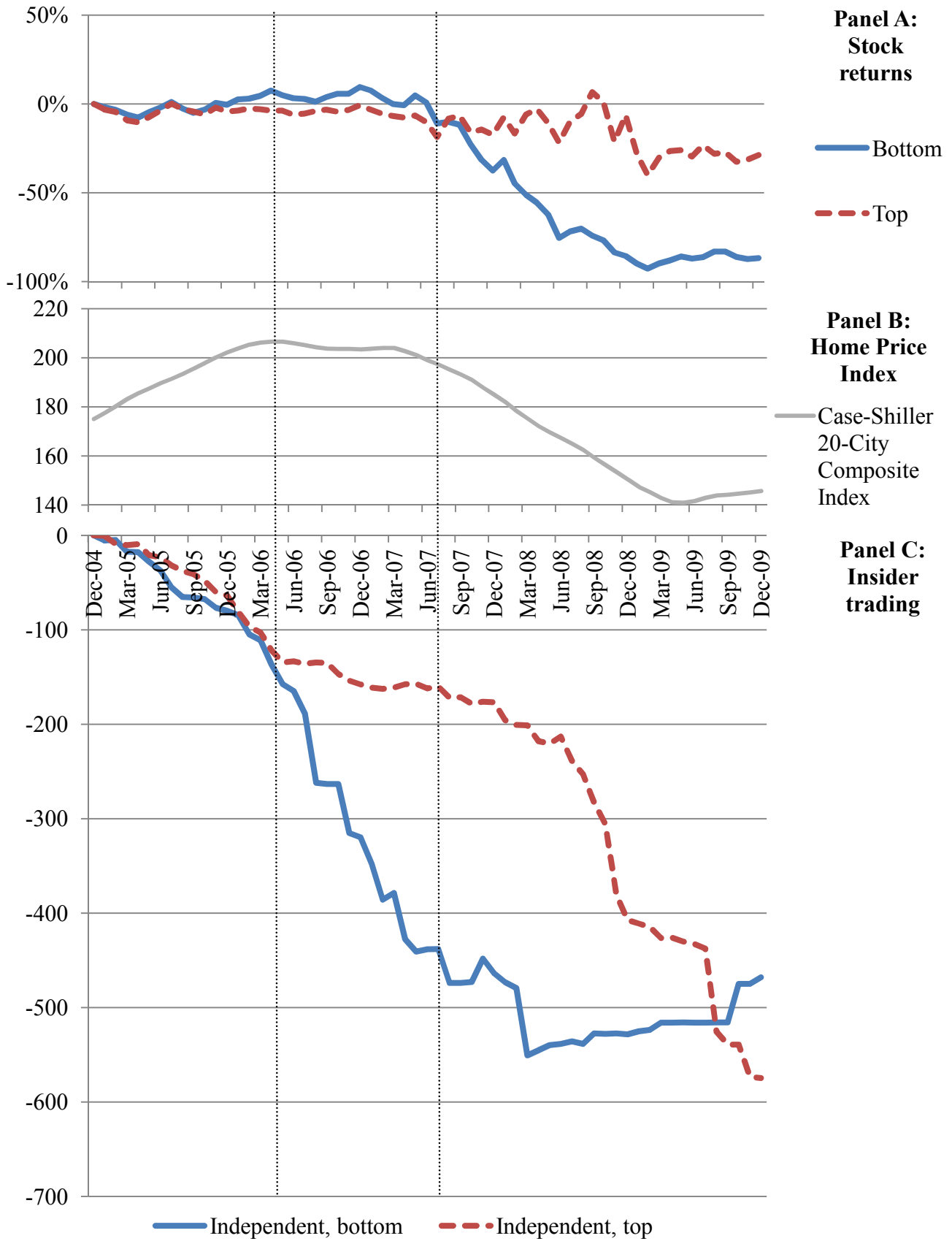
Table 1. Sample descriptives
Insider trading data are from Thomson Reuters and span 1996-2009. Accounting data are collected from Compustat, and information on executive compensation from ExecuComp. Stock returns are taken from CRSP. Asset write-down data are recovered from Bloomberg. Banks are assigned to terciles based on their excess returns (returns less the risk-free rate) estimated for the period July 2007-December 2008. Banks delisted during that period with CRSP delisting codes 200-290 ("mergers") and 500-591 ("dropped") are relegated to the bottom group. *Panel A* reports the number of observations, daily excess returns, alphas, and market betas from a CAPM, Fama-French three-factor model, and Carhart four-factor model. The market beta is the loading on the market factor in each of the asset pricing models, estimated on daily data. *Panel B* shows the dynamics of asset write-downs. *Panel C* contains information on insider trading over the sample period. Percentage increasing ownership is the percentage of insiders that increased their ownership in the bank. *Panel D* shows descriptive statistics for the variables used in the regression analysis. Traded stock values are winsorized at the 1% level. Accounting, and executive compensation data are lagged one year, therefore these data are for the fiscal years 1995-2008. Similarly, stock returns and volatility are calculated for the calendar years 1995-2008. Difference between the two groups is assessed using a t-test. "Different trend" tests if the independent variables had different time trends in the top and the bottom performance groups prior to the crisis. The column shows the significance of the slope coefficient β_2 from the regression $x_{i,t} = \alpha_1 + \alpha_2 Grp + \beta_1 t + \beta_2 tGrp$, estimated using observations from the top and the bottom groups, with the omission of years 2008 and 2009. *Grp* is a binary variable equal to 1 if the observation is in the bottom group, whereas t is the time-series variable. ** and *** denote significance at the 5% and the 1% level.

Panel A: characteristics of groups based on excess returns during July 2007 – December 2008

	Top	Middle	Bottom	Total	Average
		Performance group			
	Top	**Middle**	**Bottom**	**Total**	**Average**
Bank-years	173	398	395	966	
Banks	22	37	41	100	
Excess return	0.0006	-0.0009	-0.0036		-0.0017
CAPM alpha	0.0019	0.0007	-0.0023		-0.0002
Fama-French alpha	0.0020	0.0007	-0.0026		-0.0002
Carhart alpha	0.0022	0.0010	-0.0018		0.0002
CAPM beta	1.18	1.39	1.70		1.47
Fama-French market beta	1.06	1.12	1.55		1.26
Carhart market beta	0.98	0.96	1.26		1.08

Table 1 – continued

Panel B: Asset write-downs across performance groups

	Performance group		
	Top	Middle	Bottom
Total value of asset write-downs (billion USD)	56.0	163.5	523.4
fraction occurring in 2007	4.64%	9.91%	19.65%
fraction occurring in 2008	37.14%	41.71%	53.61%
fraction occurring in 2009	35.36%	34.50%	19.68%
fraction occurring in 2010	23.04%	13.48%	6.44%
Average ratio of write-downs to total assets	0.21%	1.55%	1.33%
Number of banks with asset write-downs	1	11	13

Panel C: Average transaction values and the percentage of insiders increasing their ownership across performance groups

	Top group				Bottom group			
Year	Value of purchases	Value of sales	Net value	Percentage increasing ownership	Value of purchases	Value of sales	Net value	Percentage increasing ownership
1996	233,207	-3,782,575	-3,549,368	58.26%	463,535	-7,375,362	-6,911,827	54.91%
1997	1,228,701	-4,539,977	-3,311,276	50.60%	1,575,632	-15,800,000	-14,224,368	24.23%
1998	275,786	-6,567,943	-6,292,157	50.83%	891,971	-24,000,000	-23,108,029	46.28%
1999	1,243,064	-11,800,000	-10,556,936	43.02%	6,327,148	-26,900,000	-20,572,852	41.90%
2000	2,625,531	-13,300,000	-10,674,469	40.34%	1,124,246	-19,400,000	-18,275,754	37.18%
2001	1,706,912	-13,300,000	-11,593,088	35.70%	568,582	-28,400,000	-27,831,418	22.61%
2002	611,120	-9,790,518	-9,179,398	32.41%	512,129	-12,400,000	-11,887,871	26.68%
2003	454,869	-6,795,573	-6,340,704	33.12%	442,680	-17,400,000	-16,957,320	28.32%
2004	252,152	-10,800,000	-10,547,848	28.87%	811,133	-23,800,000	-22,988,868	28.82%
2005	496,170	-5,121,430	-4,625,260	38.29%	611,421	-18,500,000	-17,888,579	33.98%
2006	316,819	-7,562,016	-7,245,197	36.72%	610,773	-47,000,000	-46,389,227	25.57%
2007	1,284,887	-6,159,704	-4,874,817	50.52%	2,077,753	-19,600,000	-17,522,247	36.03%
2008	1,273,509	-13,900,000	-12,626,491	40.02%	3,854,335	-7,027,131	-3,172,796	37.99%
2009	3,128,726	-4,140,296	-1,011,570	42.25%	4,647,014	-79,086	4,567,928	53.29%

Table 1 – continued

Panel D: Descriptive statistics for variables used in the baseline regressions

Dependent variable	Top group Mean	Std. Dev.	Median	N	Bottom group Mean	Std. Dev.	Median	N	t-test difference	t-test different trend
% increasing ownership	39.65	27.53	35.29	173	33.76	25.12	29.69	395	2.50**	0.19
net purchases (mUSD) - winsorized	-7.50	14.00	-3.05	173	-16.82	37.69	-2.76	395	4.29***	-0.98
CEO increasing ownership	33.95	47.50	0	162	27.93	44.92	0	376	1.40	0.41
net volume of CEO purchases scaled by CEO ownership (%) - winsorized	-4.55	19.07	0	162	-4.11	20.51	0	376	-0.23	-1.40
Independent variable										
log total assets	9.12	1.33	8.76	173	10.41	1.84	10.24	395	-9.39***	1.20
book-to-market	0.45	0.20	0.40	173	0.65	0.58	0.56	395	-6.19***	-0.53
stock return in year (t-1)	0.13	0.28	0.07	173	0.11	0.44	0.10	395	0.68	-0.12
stock return volatility in year (t-1)	0.0191	0.0089	0.0168	173	0.0219	0.0135	0.0186	395	-2.89***	-1.43
change in stock return volatility from year (t-2) to year (t-1)	0.0020	0.0083	0.0000	173	0.0024	0.0123	-0.0004	395	-0.47	-1.61
total compensation (thousand USD)	1,853	2,631	924	173	5,121	8,654	1,706	395	-6.82***	0.17
year-on-year change in total compensation (%)	50.90	128.02	23.53	173	59.68	138.17	31.23	395	-0.71	-0.99
stock-based compensation (%)	31.34	20.31	30.02	173	36.54	20.20	36.69	395	-2.82***	-0.47
average stock-based compensation during the past three years (thousand USD)	678	1,100	279	173	2,346	4,098	684	395	-7.50***	-0.47
total executive ownership (%)	2.33	2.55	1.38	173	3.01	5.94	0.59	395	-1.91*	-0.02
intrinsic value of unexercised, exercisable options (thousand USD)	3,454	5,094	1,420	173	6,502	11,709	1,816	395	-4.32***	1.19
intrinsic value of unexercised, unexercisable options (thousand USD)	1,027	1,936	321	173	2,128	5,044	331	395	-3.75***	-0.50

Table 2: Stock-based compensation across performance groups over time

The data are from ExecuComp. Banks are assigned to terciles based on their excess returns estimated for July 2007-December 2008. Banks delisted during that period with CRSP delisting codes 200-290 ("mergers") and 500-591 ("dropped") are relegated to the bottom group. Percentages are calculated by adding the value of restricted stock and option grants, and dividing by total compensation, and taking bank-year averages. Data are then winsorized at the 1%. The t-statistic tests whether the percentage of stock-based compensation is different in the top and bottom group.

Fiscal year	Average stock-based to total compensation by performance group			
	Top	Middle	Bottom	t-statistic difference (bottom-top)
1995	20.71%	16.20%	27.77%	0.86
1996	24.71%	23.97%	35.32%	1.41
1997	27.83%	30.75%	42.68%	1.72*
1998	35.00%	32.47%	41.78%	0.89
1999	41.24%	36.28%	41.27%	0.00
2000	38.48%	36.89%	34.81%	-0.43
2001	31.78%	34.34%	41.72%	1.23
2002	24.30%	35.10%	38.80%	2.01**
2003	30.30%	31.51%	35.74%	0.91
2004	30.52%	28.90%	32.87%	0.45
2005	24.52%	28.78%	31.88%	1.58
2006	31.98%	32.13%	31.10%	-0.19
2007	29.79%	36.57%	37.92%	1.56
2008	39.29%	38.56%	34.97%	-0.55

Table 3. Performance during the financial crisis and ownership increases
The data span the period 1996-2009. Banks are assigned to terciles based on their excess returns estimated for the period July 2007-December 2008 for columns 1-3, and 2008 for columns 4-6. Banks delisted during that period with CRSP delisting codes 200-290 ("mergers") and 500-591 ("dropped") are relegated to the bottom group. The dependent variable is the ratio of insiders who increased their ownership of the bank's stock. *Bottom performance group* is an indicator variable equaling 1 if the bank is in the bottom performance group. *Middle performance group* is an indicator variable equaling 1 if the bank is in the middle performance group. The base category is if the bank is in the top group based on its crisis performance. *Yr06* and *Yr07* are indicator variables equal to 1 if the bank-year observation is from 2006 and 2007, respectively. *Size* is the natural logarithm of total assets, *B/M* is the book to market ratio. *Past year return* is the return measured over the past calendar year. *Past year return volatility* is the realized volatility of the stock return measured over the past calendar year. *Change in return volatility* is the difference between stock return volatility between the past calendar year and the calendar year before. *Total compensation* is the bank-year average of the total compensation of all executives for whom data are available in ExecuComp. *% growth in total compensation* is the bank-year average year-on-year growth in total compensation. *% stock-based compensation* is the average ratio of the value of restricted stock grants and option grants divided by total executive compensation. *Past three-year stock-based compensation* is the average value of restricted stock grants and option grants received over the past three years. *% executive ownership* is the fraction of the company's shares owned by executives. *Value of exercisable options* is the bank-year average of the intrinsic value of unexercised, exercisable stock options held by executives. *Value of unexercisable options* is the bank-year average of the intrinsic value of unexercised, unexercisable stock options held by executives. Compensation data are measured in million USD. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: % of insiders increasing ownership									
	OLS	OLS	OLS	Tobit	Tobit	OLS	OLS	OLS	Tobit	Tobit
Bottom performance group	-0.42		-1.11	-0.33		-1.17		-2.03	-1.27	
	(-0.192)		(-0.612)	(-0.143)		(-0.584)		(-1.258)	(-0.610)	
Middle performance group	6.37**		5.53**	6.37***		5.44**		4.32**	5.29***	
	(2.816)		(2.714)	(2.618)		(2.992)		(2.506)	(2.850)	
Yr06	-7.99***	-7.50***		-0.10***	-0.07**					
	(-4.197)	(-3.087)		(-4.805)	(-2.527)					
Bottom performance group × yr06	-4.11**	-4.34**	-3.57**	-2.64	-6.76***					
	(-2.432)	(-2.203)	(-2.479)	(-1.531)	(-3.212)					
Middle performance group × yr06	1.48	3.27	2.15	3.00	2.85					
	(0.721)	(1.458)	(1.203)	(1.397)	(1.168)					
Yr07						11.57***	13.91***		0.12***	0.14***
						(4.737)	(6.024)		(4.901)	(5.313)
Bottom performance group × yr07						-13.45***	-13.75***	-11.65***	-15.01***	-13.60***
						(-6.746)	(-5.191)	(-7.789)	(-7.253)	(-4.488)
Middle performance group × yr07						-4.14*	-7.42**	-1.69	-4.40*	-7.37***
						(-1.866)	(-2.795)	(-0.869)	(-1.931)	(-2.706)

Table 3 - continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Size	-2.64***	-5.04*	-2.50***	-2.69***	-5.25	-2.45***	-6.23**	-2.48***	-2.46***	-6.60**
	(-3.380)	(-1.986)	(-3.392)	(-3.130)	(-1.525)	(-3.188)	(-2.342)	(-3.592)	(-2.971)	(-2.048)
B/M	2.51	6.48	1.05	2.76	7.01	2.31	6.43	1.06	2.60	7.09
	(1.276)	(1.588)	(0.534)	(0.780)	(0.788)	(0.983)	(1.467)	(0.468)	(1.115)	(0.803)
Past year return	-4.56	-1.82	-11.38***	-4.98	-2.57	-2.71	-0.92	-11.07**	-2.97	-1.39
	(-0.987)	(-0.455)	(-3.175)	(-0.931)	(-0.459)	(-0.516)	(-0.220)	(-3.009)	(-0.521)	(-0.238)
Past year return volatility	-406.21***	-568.36***	12.73	-465.71***	-645.34***	-217.59	-403.91*	52.28	-269.02	-438.59
	(-3.148)	(-3.315)	(0.0993)	(-2.771)	(-2.763)	(-1.259)	(-1.794)	(0.413)	(-1.412)	(-1.556)
Change in return volatility	426.40**	538.53***	-228.23	473.966**	619.49***	305.44	447.44**	-279.49	348.313*	498.37**
	(2.837)	(3.761)	(-1.354)	(2.385)	(3.073)	(1.759)	(2.529)	(-1.688)	(1.786)	(2.277)
Total compensation	-0.202	-0.179	-0.233	-0.266	-0.21	-0.214	-0.191	-0.190	-0.276	-0.22
	(-1.106)	(-1.147)	(-1.285)	(-1.281)	(-0.947)	(-1.089)	(-1.183)	(-1.012)	(-1.266)	(-1.113)
% growth in total compensation	-0.004	-0.005	-0.004	-0.004	-0.004	-0.004	-0.004	-0.005	-0.004	-0.003
	(-0.774)	(-1.091)	(-1.015)	(-0.746)	(-0.805)	(-0.853)	(-0.837)	(-1.409)	(-0.852)	(-0.560)
% stock-based compensation	-0.129**	0.016	-0.132***	-0.133***	0.026	-0.126**	0.024	-0.143***	-0.130**	0.036
	(-2.624)	(0.304)	(-3.236)	(-2.782)	(0.486)	(-2.540)	(0.455)	(-3.657)	(-2.530)	(0.638)
Past three-year stock-based compensation	-0.091	-0.382	-0.133	-0.15	-0.423	-0.052	-0.389	-0.048	-0.12	-0.469
	(-0.216)	(-0.974)	(-0.302)	(-0.316)	(-0.861)	(-0.146)	(-1.011)	(-0.129)	(-0.320)	(-0.978)
% executive ownership	0.04	-0.39	0.01	0.024	-0.363	0.03	-0.48	0.04	0.014	-0.450
	(0.247)	(-1.257)	(0.0546)	(0.152)	(-0.884)	(0.165)	(-1.490)	(0.239)	(0.0732)	(-1.165)
Value of exercisable options	-0.158**	0.016	-0.150**	-0.204***	-0.00	-0.199***	-0.013	-0.157***	-0.243***	-0.04
	(-2.549)	(0.144)	(-2.729)	(-3.005)	(-0.00462)	(-3.283)	(-0.126)	(-3.127)	(-4.065)	(-0.321)
Value of unexercisable options	0.431**	0.029	0.526***	0.598***	0.053	0.421**	0.075	0.468***	0.590***	0.109
	(2.954)	(0.125)	(3.759)	(3.610)	(0.198)	(2.621)	(0.305)	(3.335)	(3.437)	(0.398)
Constant	75.76***	98.95***	68.71***	0.772***		69.62***	106.32***	69.24***	0.705***	
	(10.37)	(3.589)	(9.586)	(8.652)		(7.421)	(3.818)	(9.060)	(6.976)	
Bank FE		Yes				Yes		Yes		Yes
Year FE			Yes					Yes		
Observations	966	966	966	966	966	966	966	966	966	966
Adjusted R^2	11.2%	42.6%	15.3%			10.4%	42.3%	15.3%		

Table 4. Performance during the financial crisis and dollar value of open market trading
The data span the period 1996-2009. Banks are assigned to terciles based on their excess returns estimated for the period July 2007-December 2008 for columns 1-3, and 2008 for columns 4-6. Banks delisted during that period with CRSP delisting codes 200-290 ("mergers") and 500-591 ("dropped") are relegated to the bottom group. The dependent variable is the dollar value of net open market purchases by insiders, winsorized at the 1% level, measured in millions of US dollars. *Bottom performance group* is an indicator variable equaling 1 if the bank is in the bottom performance group. *Middle performance group* is an indicator variable equaling 1 if the bank is in the middle performance group. The base category is if the bank is in the top group based on its crisis performance. *Yr06* and *Yr07* are indicator variables equal to 1 if the bank-year observation is from 2006 and 2007, respectively. *Size* is the natural logarithm of total assets, *B/M* is the book to market ratio. *Past year return* is the return measured over the past calendar year. *Past year return volatility* is the realized volatility of the stock return measured over the past calendar year. *Change in return volatility* is the difference between stock return volatility between the past calendar year and the calendar year before. *Total compensation* is the bank-year average of the total compensation of all executives for whom data are available in ExecuComp. *% growth in total compensation* is the bank-year average year-on-year growth in total compensation. *% stock-based compensation* is the average ratio of the value of restricted stock grants and option grants divided by total executive compensation. *Past three-year stock-based compensation* is the average value of restricted stock grants and option grants received over the past three years. *% executive ownership* is the fraction of the company's shares owned by executives. *Value of exercisable options* is the bank-year average of the intrinsic value of unexercised, exercisable stock options held by executives. *Value of unexercisable options* is the bank-year average of the intrinsic value of unexercised, unexercisable stock options held by executives. Compensation data are measured in million USD. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: value of net open market purchases, million USD					
Bottom performance group	-0.47		-1.12	-2.81*		-3.19*
	(-0.355)		(-0.821)	(-1.814)		(-1.876)
Middle performance group	0.60		0.44	-0.33		-0.44
	(0.432)		(0.304)	(-0.406)		(-0.494)
Yr06	-3.49***	-4.64***				
	(-3.064)	(-6.441)				
Bottom performance group × yr06	-5.76***	-6.98***	-4.79**			
	(-3.492)	(-4.876)	(-2.693)			
Middle performance group × yr06	-1.14	-1.14	-0.97			
	(-0.693)	(-0.680)	(-0.588)			
Yr07				5.55***	5.83**	
				(4.661)	(2.853)	
Bottom performance group × yr07				3.77	1.73	4.32*
				(1.599)	(0.597)	(1.704)
Middle performance group × yr07				-4.64***	-6.19***	-4.32***
				(-4.454)	(-4.019)	(-3.607)
Size	-0.83	-0.50	-0.55	-0.62	-1.67	-0.50
	(-1.062)	(-0.270)	(-0.655)	(-0.828)	(-0.685)	(-0.584)
B/M	2.09	3.69	0.24	2.22	4.12	0.56
	(0.933)	(1.277)	(0.121)	(0.973)	(1.312)	(0.290)
Past year return	-4.36**	-3.23**	-3.40**	-3.07	-2.37	-3.21*
	(-2.839)	(-2.521)	(-2.172)	(-1.670)	(-1.612)	(-1.965)
Past year return volatility	-75.44	-251.47	306.34	81.86	-90.10	347.46
	(-0.546)	(-1.627)	(1.512)	(0.518)	(-0.461)	(1.636)
Change in return volatility	85.27	210.76	-35.36	-26.86	103.21	-76.75
	(0.774)	(1.335)	(-0.179)	(-0.214)	(0.605)	(-0.376)
Total compensation	-1.572***	-1.334***	-1.662***	-1.638***	-1.376***	-1.673***
	(-3.772)	(-3.121)	(-3.903)	(-3.860)	(-3.215)	(-3.948)
% growth in total compensation	0.001	-0.001	0.001	0.001	-0.000	0.001
	(0.153)	(-0.185)	(0.213)	(0.275)	(-0.0348)	(0.152)
% stock-based compensation	0.003	0.032	0.017	0.016	0.047	0.020
	(0.0834)	(1.071)	(0.491)	(0.414)	(1.348)	(0.568)
Past three-year stock-based compensation	0.452	0.722	0.394	0.457	0.718	0.433
	(0.514)	(0.839)	(0.452)	(0.521)	(0.836)	(0.496)
% executive ownership	-0.14	-0.19	-0.19	-0.17	-0.25	-0.19
	(-1.132)	(-0.818)	(-1.455)	(-1.405)	(-1.109)	(-1.481)
Value of exercisable options	-0.692***	-0.691***	-0.728***	-0.735***	-0.732***	-0.742***
	(-3.217)	(-3.093)	(-3.385)	(-3.492)	(-3.341)	(-3.495)
Value of unexercisable options	-0.909	-0.809	-0.845	-0.845	-0.754	-0.846
	(-1.651)	(-1.595)	(-1.532)	(-1.568)	(-1.474)	(-1.538)
Constant	7.50	4.52	-2.00	2.26	11.43	-2.66
	(1.046)	(0.263)	(-0.230)	(0.331)	(0.555)	(-0.294)
Bank FE		Yes			Yes	
Year FE			Yes			Yes
Observations	966	966	966	966	966	966
Adjusted R^2	40.5%	50.6%	40.8%	40.4%	50.1%	41.0%

Table 5. Performance during the financial crisis and ownership increases of executives

The data span the period 1996-2009. Banks are assigned to terciles based on their excess returns estimated for the period July 2007-December 2008 for columns 1-5, and 2008 for columns 5-10. The dependent variable is the ratio of executives who increased their ownership of the bank's stock. *Bottom performance group* is an indicator variable equaling 1 if the bank is in the bottom performance group. *Middle performance group* is an indicator variable equaling 1 if the bank is in the middle performance group. The base category is if the bank is in the top group based on its crisis performance. *Yr06* and *Yr07* are indicator variables equal to 1 if the bank-year observation is from 2006 and 2007, respectively. All regressions control for size, B/M, past year return, past year return volatility, change in return volatility, total compensation, % growth in total compensation, the ratio of stock-based to total compensation, past three-year stock-based compensation, fraction of executive ownership, value of exercisable options, and value of unexercisable options. These variables are defined in Table 3. Coefficients of these control variables are not reported. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: % of executive officers increasing ownership									
	OLS	OLS	OLS	Tobit	Tobit	OLS	OLS	OLS	Tobit	Tobit
Bottom performance group	-0.39		-2.04	0.28		0.51		-1.25	1.09	
	(-0.148)		(-0.941)	(0.0711)		(0.182)		(-0.573)	(0.301)	
Middle performance group	2.01		0.47	2.79		3.64		1.60	5.03	
	(0.869)		(0.219)	(0.864)		(1.320)		(0.619)	(1.554)	
Yr06	-3.97	-5.72*		-0.08**	-0.05					
	(-1.770)	(-1.938)		(-2.536)	(-1.353)					
Bottom performance group × yr06	-10.85***	-8.11***	-9.36***	-9.67***	-19.94***					
	(-5.097)	(-3.706)	(-4.638)	(-2.982)	(-4.987)					
Middle performance group × yr06	-9.28***	-4.72*	-7.68***	-9.79***	-10.05***					
	(-4.255)	(-1.981)	(-3.681)	(-3.196)	(-2.726)					
Yr07						9.00***	12.61***		0.13***	0.18***
						(4.143)	(5.561)		(4.132)	(5.409)
Bottom performance group × yr07						-6.59**	-6.05*	-3.76*	-8.40**	-6.22
						(-2.375)	(-2.000)	(-1.853)	(-2.267)	(-1.276)
Middle performance group × yr07						-8.77**	-9.21*	-4.83	-12.04***	-11.87*
						(-2.634)	(-1.877)	(-1.713)	(-2.978)	(-1.773)
Constant	74.57***	125.90***	68.40***	0.735***		68.04***	136.34***	68.93***	0.634***	
	(7.941)	(4.200)	(9.968)	(4.755)		(7.114)	(4.359)	(9.292)	(4.199)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE		Yes			Yes		Yes			Yes
Year FE			Yes					Yes		
Observations	962	962	962	962	962	962	962	962	962	962
Adjusted R^2	10.6%	32.4%	16.0%			9.4%	31.6%	15.9%		

Table 6. Performance during the financial crisis and ownership increases of independent directors

The data span the period 1996-2009. Banks are assigned to terciles based on their excess returns estimated for the period July 2007-December 2008 for columns 1-3, and 2008 for columns 4-6. Banks delisted during that period with CRSP delisting codes 200-290 ("mergers") and 500-591 ("dropped") are relegated to the bottom group. The dependent variable is the ratio of independent directors who increased their ownership of the bank's stock. *Bottom performance group* is an indicator variable equaling 1 if the bank is in the bottom performance group. *Middle performance group* is an indicator variable equaling 1 if the bank is in the middle performance group. The base category is if the bank is in the top group based on its crisis performance. *Yr06* and *Yr07* are indicator variables equal to 1 if the bank-year observation is from 2006 and 2007, respectively. All regressions control for size, B/M, past year return, past year return volatility, and change in return volatility. These variables are defined in Table 3. Coefficients of these control variables are not reported. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: % of independent directors increasing ownership									
	OLS	OLS	OLS	Tobit	Tobit	OLS	OLS	OLS	Tobit	Tobit
Bottom performance group	-1.00		-0.51	-0.90		-2.57		-2.32	-3.52	
	(-0.378)		(-0.207)	(-0.250)		(-0.964)		(-1.041)	(-1.103)	
Middle performance group	8.68**		8.78***	9.94***		5.04		5.23	5.14	
	(2.910)		(3.135)	(2.700)		(1.436)		(1.580)	(1.317)	
Yr06	-6.89**	-5.87**		-0.08**	-0.07**					
	(-2.499)	(-2.529)		(-2.293)	(-2.266)					
Bottom performance group × yr06	-0.09	-4.17	-0.90	-0.68	-5.95**					
	(-0.0358)	(-1.652)	(-0.373)	(-0.186)	(-2.017)					
Middle performance group × yr06	6.30*	5.64	5.64**	7.04*	6.07					
	(2.155)	(1.712)	(2.174)	(1.913)	(1.588)					
Yr07						14.33***	14.78***		0.20***	0.16***
						(5.531)	(6.474)		(6.634)	(5.787)
Bottom performance group × yr07						-17.08***	-19.71***	-16.41***	-24.00***	-21.74***
						(-6.435)	(-6.312)	(-7.682)	(-7.615)	(-5.803)
Middle performance group × yr07						-2.21	-6.32**	-1.70	-6.86*	-5.78
						(-0.656)	(-2.173)	(-0.528)	(-1.854)	(-1.520)
Constant	71.61***	49.85	63.01***	0.76***		68.14***	54.54*	62.97***	0.72***	
	(13.20)	(1.757)	(15.33)	(10.42)		(14.05)	(1.932)	(14.66)	(11.06)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE		Yes			Yes		Yes			
Year FE			Yes					Yes		Yes
Observations	970	970	970	970	970	970	970	970	970	970
Adjusted R^2	4.9%	38.9%	7.1%			4.4%	39.1%	6.7%		

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Table 7. Performance during the financial crisis and CEO trading

The data span the period 1996-2009. Banks are assigned to terciles based on their excess returns estimated for the period July 2007-December 2008 for columns 1-5, and 2008 for columns 6-10. The dependent variable is an indicator equal to 1 if the CEO increased her stock ownership in the bank. *Bottom performance group* is an indicator equaling 1 if the bank is in the bottom performance group. *Middle performance group* is an indicator equaling 1 if the bank is in the middle performance group. The base category is if the bank is in the top group based on its crisis performance. *Yr06* and *Yr07* are indicator variables equal to 1 if the bank-year observation is from 2006 and 2007, respectively. All regressions control for size, B/M, past year return, past year return volatility, change in return volatility, total compensation, % growth in total compensation, the ratio of stock-based to total compensation, past three-year stock-based compensation, fraction of executive ownership, value of exercisable options, and value of unexercisable options, as. These variables are defined in Table 3. Compensation is measured for the CEO. Coefficient estimates are multiplied by 100 for convenience. Columns 4, 5, 9, and 10 show panel logit regressions. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: CEO ownership increase									
	OLS	OLS	OLS	Logit	Logit	OLS	OLS	OLS	Logit	Logit
Bottom performance group	-0.01		-0.04	0.24		0.06*		0.04	0.60	
	(-0.331)		(-1.116)	(0.504)		(1.895)		(1.333)	(1.197)	
Middle performance group	-0.02		-0.03	0.12		0.10***		0.09**	0.80**	
	(-0.434)		(-0.596)	(0.300)		(3.589)		(2.966)	(2.250)	
Yr06	-0.06	0.01		-0.33	-0.11					
	(-0.952)	(0.0817)		(-0.649)	(-0.205)					
Bottom performance group × yr06	-0.11**	-0.22***	-0.07*	-1.03**	-1.24**					
	(-2.601)	(-3.997)	(-2.101)	(-2.332)	(-2.183)					
Middle performance group × yr06	0.17***	0.07	0.18***	0.75**	0.47					
	(3.374)	(1.587)	(3.463)	(1.984)	(1.159)					
Yr07						-0.17***	0.04		-0.28	1.69
						(-4.641)	(0.698)		(-0.525)	(0.246)
Bottom performance group × yr07						0.07*	-0.21***	0.10***	-0.60	-2.66
						(2.084)	(-4.168)	(3.497)	(-1.297)	(-0.398)
Middle performance group × yr07						0.23***	-0.03	0.24***	0.41	-1.73
						(8.728)	(-0.673)	(8.358)	(1.285)	(-0.261)
Constant	0.532***	0.568	0.375**	0.664		0.496**	0.514	0.336*	0.305	
	(3.101)	(1.546)	(2.240)	(0.482)		(2.939)	(1.381)	(2.006)	(0.195)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE		Yes			Yes		Yes			Yes
Year FE				Yes					Yes	
Observations	825	825	825	825	665	825	825	825	825	665
Adjusted R^2 or pseudo-R^2	1.9%	23.3%	3.1%		8.5%	2.2.%	22.7%	3.3%		7.8%

Table 8. Performance during the financial crisis and the value of the CEO's open market transactions

The data span the period 1996-2009. Banks are assigned to terciles based on their excess returns estimated for the period July 2007-December 2008 for columns 1-3, and 2008 for columns 4-6. The dependent variable is the net number of sales purchased by the CEO in the open market, scaled by their initial stock ownership. *Bottom performance group* is an indicator variable equaling 1 if the bank is in the bottom performance group. *Middle performance group* is an indicator variable equaling 1 if the bank is in the middle performance group. The base category is if the bank is in the top group based on its crisis performance. *Yr06* and *Yr07* are indicator variables equal to 1 if the bank-year observation is from 2006 and 2007, respectively. All regressions control for size, B/M, past year return, past year return volatility, change in return volatility, total compensation, % growth in total compensation, the ratio of stock-based to total compensation, past three-year stock-based compensation, fraction of executive ownership, value of exercisable options, and value of unexercisable options. These variables are defined in Table 3. Compensation variables are measured for the CEO. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: CEO net open market purchases scaled by total holdings					
Bottom performance group	1.08		1.12	0.85		1.06
	(0.770)		(0.772)	(0.463)		(0.533)
Middle performance group	1.47		1.54	-1.30		-1.15
	(0.848)		(0.837)	(-0.764)		(-0.617)
Yr06	3.18*	1.39				
	(1.978)	(1.091)				
Bottom performance group × yr06	-8.92***	-8.53***	-9.14***			
	(-4.770)	(-4.382)	(-4.837)			
Middle performance group × yr06	-9.76***	-8.98***	-10.10***			
	(-6.110)	(-5.687)	(-5.854)			
Yr07				5.58***	4.32*	
				(3.831)	(2.038)	
Bottom performance group × yr07				0.75	2.17	0.47
				(0.365)	(1.025)	(0.214)
Middle performance group × yr07				-2.81*	1.12	-3.07*
				(-1.892)	(0.498)	(-1.887)
Constant	-13.50**	-23.31	-14.40***	-13.80**	-13.94	-11.84**
	(-2.606)	(-1.372)	(-3.223)	(-2.650)	(-0.855)	(-2.398)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE		Yes			Yes	
Year FE			Yes			Yes
Observations	825	825	825	825	825	825
Adjusted R²	8.0%	22.1%	8.4%	8.0%	21.4%	8.3%

Table 9. Housing market exposures and insider trading during times of housing price declines
The data span the period 1996-2009. The unit of observation is a bank-quarter. The dependent variable is the dollar value of net open market purchases by insiders, winsorized at the 1% level, measured in millions of US dollars. Banks are assigned to terciles based on the correlation between their stock return and the return on the Barclays index of BBB-rated collateralized mortgage-backed securities estimated during the period July 2007-December 2008. For banks delisted during that period, the correlations are measured based on the stock returns up to the delisting date. *High correlation* is an indicator variable equaling 1 if the bank is in the highest group based on correlations. *Medium correlation* is an indicator variable equaling 1 if the bank is in the middle group based on correlations. Regressions include six dummy variables for the 1st-5th, and all subsequent *decreases in housing prices*. These variables are based on the Campbell-Shiller 20-City Composite Housing Price Index. *Size* is the natural logarithm of total assets, *B/M* is the book to market ratio. *Past quarter return* is the stock return measured over the past calendar quarter. *Past 252-day return* is the stock return measured over the 252 trading days ending on the last day of the past calendar quarter. *Past quarter return volatility* is the realized volatility of the stock return measured over the past calendar quarter. *Past 252-day return volatility* is the realized volatility of the stock return measured over the 252 trading days ending on the last day of the past calendar quarter. *Change in return volatility, quarterly* is the difference between stock return volatility during the past calendar quarter and the calendar quarter before. *Change in return volatility, 252-day* is the difference between stock return volatility during the past 252 trading days and the 252 trading days before. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: value of net open market purchases, million USD		
High correlation	-0.34		-0.22
	(-1.481)		(-0.840)
Medium correlation	0.36**		0.36**
	(2.316)		(2.385)
1st decrease in housing prices	0.08	0.57***	
	(0.569)	(3.423)	
2nd decrease in housing prices	0.25*	0.74***	
	(1.695)	(4.061)	
3rd decrease in housing prices	-0.56***	0.02	
	(-3.670)	(0.106)	
4th decrease in housing prices	0.02	0.59***	
	(0.132)	(2.911)	
5th decrease in housing prices	0.81***	1.44***	
	(4.700)	(7.124)	
6th and further decreases in housing prices	-0.53	-0.09	
	(-1.276)	(-0.221)	
High correlation × 1st decrease in housing prices	-1.63***	-1.53***	-1.72***
	(-5.474)	(-5.098)	(-5.992)
High correlation × 2nd decrease in housing prices	-2.66***	-2.63***	-2.71***
	(-8.815)	(-8.766)	(-9.290)
High correlation × 3rd decrease in housing prices	-1.81***	-1.77***	-1.88***
	(-6.208)	(-6.040)	(-6.485)
High correlation × 4th decrease in housing prices	-1.39***	-1.44***	-1.43***
	(-4.630)	(-4.806)	(-4.661)

Table 9 – continued

High correlation × 5th decrease in housing prices	1.64***	1.46***	1.65***
	(4.650)	(4.410)	(4.635)
High correlation × 6th and further decreases in housing prices	2.55**	2.44**	2.71**
	(2.533)	(2.504)	(2.641)
Medium correlation × 1st decrease in housing prices	-0.66***	-0.53***	-0.72***
	(-4.289)	(-3.641)	(-4.646)
Medium correlation × 2nd decrease in housing prices	-0.37**	-0.25*	-0.41**
	(-2.362)	(-1.689)	(-2.625)
Medium correlation × 3rd decrease in housing prices	-0.80***	-0.73***	-0.83***
	(-5.066)	(-5.069)	(-5.239)
Medium correlation × 4th decrease in housing prices	-1.16***	-1.15***	-1.18***
	(-7.247)	(-7.725)	(-7.517)
Medium correlation × 5th decrease in housing prices	0.15	0.22	0.14
	(0.923)	(1.390)	(0.896)
Medium correlation × 6th and further decreases in housing prices	0.70*	0.80*	0.69*
	(1.902)	(1.984)	(1.831)
Size	-1.25***	-1.60***	-1.26***
	(-12.04)	(-9.058)	(-11.41)
B/M	0.43	0.19	0.39
	(1.395)	(0.633)	(1.577)
Past quarter return	-0.68	-1.02*	-0.25
	(-1.100)	(-1.857)	(-0.329)
Past 252-day return	-2.29***	-1.69***	-3.25***
	(-5.479)	(-4.725)	(-7.152)
Past quarter return volatility	-42.97	-23.69	-29.81
	(-1.133)	(-0.650)	(-0.763)
Past 252-day return volatility	12.36	24.11	-33.85
	(0.297)	(0.619)	(-0.722)
Change in return volatility, quarterly	-12.28	-7.39	-23.82
	(-0.591)	(-0.390)	(-1.365)
Change in return volatility, 252-day	149.12***	82.50*	152.40***
	(2.975)	(1.739)	(3.306)
Constant	10.26***	12.90***	11.10***
	(10.31)	(7.669)	(8.815)
Bank FE		Yes	
Quarter FE			Yes
Observations	5041	5041	5041
Adjusted R^2	14.6%	29.5%	16.2%

Table 10. Housing market exposures and trading by executives during times of housing price declines

The data span the period 1996-2009. The unit of observation is a bank-quarter. The dependent variable is the dollar value of net open market purchases by executives, winsorized at the 1% level, measured in millions of US dollars. Banks are assigned to terciles based on the correlation between their stock return and the return on the Barclays index of BBB-rated collateralized mortgage-backed securities estimated during the period July 2007-December 2008. For banks delisted during that period, the correlations are measured based on the stock returns up to the delisting date. *High correlation* is an indicator variable equaling 1 if the bank is in the highest group based on correlations. *Medium correlation* is an indicator variable equaling 1 if the bank is in the middle group based on correlations. Regressions include six dummy variables for the 1st-5th, and all subsequent *decreases in housing prices*. These variables are based on the Campbell-Shiller 20-City Composite Housing Price Index. All regressions control for size, B/M, past quarter return, past 252-day return, past quarter return volatility, past 252-day return volatility, change in quarterly return volatility, and change in 252-day return volatility. These variables are defined in Table 9. Coefficients of these control variables are not reported. Coefficient estimates are multiplied by 100 for convenience. T-statistics, based on heteroskedasticity-robust standard errors clustered at the year level, are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level.

	Dependent variable: value of net open market purchases, million USD					
	Executive officers			Independent directors		
High correlation	-0.24		-0.12	-0.06		-0.06
	(-1.209)		(-0.566)	(-0.816)		(-0.780)
Medium correlation	0.33***		0.34***	0.04		0.03
	(3.115)		(3.156)	(0.607)		(0.589)
1st decrease in housing prices	0.28**	0.71***		-0.20***	-0.16**	
	(2.497)	(6.217)		(-4.105)	(-2.549)	
2nd decrease in housing prices	0.09	0.52***		0.17***	0.22***	
	(0.837)	(4.243)		(3.172)	(3.232)	
3rd decrease in housing prices	-0.56***	-0.07		0.01	0.07	
	(-4.857)	(-0.599)		(0.146)	(1.085)	
4th decrease in housing prices	-0.10	0.39***		0.14**	0.20***	
	(-0.774)	(2.846)		(2.421)	(2.720)	
5th decrease in housing prices	0.38***	0.91***		0.43***	0.50***	
	(2.867)	(6.872)		(6.956)	(6.411)	
6th and further decreases in housing prices	-0.51*	-0.11		0.00	0.04	
	(-1.798)	(-0.409)		(0.0127)	(0.314)	
High correlation × 1st decrease in housing prices	-1.02***	-0.89***	-1.12***	-0.49***	-0.49***	-0.50***
	(-3.856)	(-3.479)	(-4.330)	(-6.420)	(-5.950)	(-6.718)
High correlation × 2nd decrease in housing prices	-1.34***	-1.22***	-1.40***	-0.68***	-0.73***	-0.68***
	(-4.971)	(-4.676)	(-5.335)	(-8.806)	(-8.681)	(-9.070)
High correlation × 3rd decrease in housing prices	-1.13***	-1.03***	-1.20***	-0.37***	-0.39***	-0.37***
	(-4.315)	(-4.084)	(-4.584)	(-4.989)	(-4.922)	(-4.999)
High correlation × 4th decrease in housing prices	-1.06***	-1.03***	-1.09***	0.10	0.06	0.09
	(-4.001)	(-4.023)	(-4.012)	(1.327)	(0.692)	(1.206)

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Table 10 – continued

High correlation $\times$ 5th decrease in housing prices	2.33***	2.30***	2.38***	-0.54***	-0.64***	-0.58***
	(7.683)	(8.134)	(7.709)	(-5.739)	(-6.562)	(-6.398)
High correlation $\times$ 6th and further decreases in housing prices	1.98***	1.99***	2.17***	0.45	0.44	0.44
	(2.852)	(2.947)	(3.118)	(1.446)	(1.341)	(1.381)
Medium correlation $\times$ 1st decrease in housing prices	-0.52***	-0.38***	-0.58***	-0.18***	-0.18***	-0.18***
	(-4.447)	(-3.476)	(-4.975)	(-2.962)	(-3.101)	(-3.004)
Medium correlation $\times$ 2nd decrease in housing prices	-0.35***	-0.22*	-0.40***	-0.10	-0.11*	-0.09
	(-2.999)	(-1.996)	(-3.377)	(-1.565)	(-1.789)	(-1.585)
Medium correlation $\times$ 3rd decrease in housing prices	-0.71***	-0.62***	-0.74***	-0.20***	-0.23***	-0.20***
	(-5.963)	(-5.597)	(-6.207)	(-3.303)	(-3.863)	(-3.304)
Medium correlation $\times$ 4th decrease in housing prices	-0.71***	-0.66***	-0.72***	-0.01	-0.04	-0.01
	(-5.916)	(-5.896)	(-6.093)	(-0.189)	(-0.710)	(-0.216)
Medium correlation $\times$ 5th decrease in housing prices	0.28**	0.36***	0.27**	-0.18***	-0.20***	-0.19***
	(2.277)	(3.133)	(2.249)	(-2.877)	(-3.184)	(-3.051)
Medium correlation $\times$ 6th and further decreases in housing prices	0.54*	0.67*	0.54	0.09	0.07	0.08
	(1.684)	(1.885)	(1.648)	(0.981)	(0.669)	(0.913)
Constant	8.49***	11.17***	9.33***	1.29***	1.20**	1.29***
	(10.99)	(8.757)	(9.356)	(4.936)	(2.501)	(4.379)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE		Yes			Yes	
Quarter FE			Yes			Yes
Observations	5041	5041	5041	5041	5041	5041
Adjusted R^2	14.1%	30.2%	15.3%	4.0%	11.2%	5.1%

Table 11. Turnover of insiders in the two performance groups over time
This table shows the percentage of insiders leaving the bank in the top and the bottom performance group. Turnover information is extracted from the Thomson Reuters Insiders database. The percentages reported are calculated by dividing the number of insiders that left the bank with the total number of insiders trading in each calendar year. An insider is assumed to have left the bank in the year after which no transactions of hers are reported in the database. Accordingly, the sample is right-censored in 2009. **, and *** denote significance at the 5% and 1% level.

	Fraction of insiders leaving				Fraction of insiders joining		
Year	Top	Bottom	t-test difference	Year	Top	Bottom	t-test difference
1996	9.47%	11.46%	0.44	1996	36.63%	24.45%	-1.10
1997	8.18%	17.15%	1.40	1997	10.73%	15.71%	0.95
1998	20.87%	23.30%	0.52	1998	32.88%	22.20%	-1.04
1999	9.73%	9.16%	-0.20	1999	10.72%	15.83%	1.21
2000	15.86%	11.44%	-2.14**	2000	7.44%	10.56%	1.29
2001	13.84%	14.13%	0.07	2001	12.16%	11.78%	-0.09
2002	12.80%	14.05%	0.33	2002	9.93%	10.52%	0.16
2003	15.59%	13.71%	-0.48	2003	6.32%	13.92%	2.09**
2004	10.97%	15.23%	1.33	2004	9.21%	14.29%	1.58
2005	13.40%	9.26%	-1.26	2005	10.51%	12.79%	0.69
2006	16.90%	14.87%	-0.48	2006	8.64%	13.38%	1.38
2007	7.05%	19.68%	3.63***	2007	13.22%	9.74%	-0.77
2008	13.28%	33.48%	2.84***	2008	8.90%	9.86%	0.29
				2009	4.70%	18.48%	3.26***

Table 12. Option-related stock sales across performance groups
This table shows the average fraction of insider sales in which the insider first exercised stock options, then sold all the shares obtained through the option exercise. Data are from Thomson Reuters.

Year	Top	Bottom
1996	18.28%	24.78%
1997	21.14%	28.00%
1998	43.00%	36.07%
1999	30.59%	29.90%
2000	17.66%	41.90%
2001	50.10%	39.39%
2002	39.36%	47.18%
2003	33.03%	41.68%
2004	39.70%	42.49%
2005	34.40%	42.25%
2006	41.54%	41.44%
2007	40.40%	38.79%
2008	28.17%	12.28%
2009	23.34%	3.02%

Table 13: Fraction of stocks sold and purchased by joining insiders
This table shows the fraction of purchases and sales which were made by insiders joining the bank in a given bank-year. Total purchase (sale) values for joining insiders are aggregated each year for the performance group, then divided by total purchase (sale) values of all insiders in the performance group, yielding the fractions in the table. An insider is assumed to have joined the bank in a given year if her first insider transaction is observed in that year. Data are from Thomson Reuters.

	Purchases			Sales	
Year	Top	Bottom		Top	Bottom
1996	39.30%	50.95%		10.70%	19.11%
1997	70.79%	78.12%		25.22%	3.11%
1998	21.29%	6.64%		21.22%	53.44%
1999	2.33%	1.79%		1.72%	1.71%
2000	42.37%	6.92%		3.96%	3.61%
2001	3.33%	5.39%		0.00%	10.09%
2002	13.04%	4.32%		1.64%	4.09%
2003	3.58%	2.82%		10.33%	4.55%
2004	37.85%	9.21%		1.46%	3.80%
2005	2.53%	17.64%		0.97%	0.41%
2006	2.91%	7.71%		1.02%	0.20%
2007	25.00%	9.27%		6.39%	1.74%
2008	3.51%	48.12%		0.68%	1.61%
2009	5.99%	79.42%		0.01%	2.34%

Table 14. Average time span (duration) between open market sales by insiders and the bankruptcy of Bear Stearns
All open market sales made by insiders between May 1, 2006 and March 16, 2008 are included in the calculation. The average time span is calculated analogously to Macaulay duration, as described in Section V.4. Banks in the bottom group that were delisted during July 2007-December 2008 are excluded from the calculations. *Panel A* presents means and quartiles of the distribution of duration across performance groups. *Panel B* shows statistical tests assessing if the duration values calculated for the top and the bottom groups are significantly different.

Panel A: Means and quartiles of duration by performance group

	Mean	Std. dev.	Bottom quartile	Median	Top quartile
Top	388.97	135.58	279.67	430.80	469.73
Middle	396.50	119.50	350.93	407.81	472.16
Bottom	474.18	85.94	466.97	513.15	518.88

Panel B: Comparing duration values of banks in the top and the bottom group

t-test $D_{top} = D_{bottom}$	2.07**	p-value	0.0496
Wilcoxon-test $D_{top} = D_{bottom}$	1.92*	p-value	0.0544

Table 15: Returns to trading strategies based on 2006 insider trading information

Banks are grouped into quintile portfolios based on the average rank of their abnormal insider trading (AIT) in 2006, estimated in three different regressions: OLS, bank FE, and year FE. Negative (positive) AIT portfolios include all banks whose AIT was negative (positive) in all three regressions. This table presents annualized average returns to and alphas on value-weighted portfolios. All estimates are based on daily stock return data, and conservatively assume a delisting return of 0. *t*-statistics are shown in parentheses. * indicates significance at the 10% level.

Panel A: July 2007 - December 2008	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile	q5-q1	negative AIT	positive AIT	positive AIT - negative AIT
Average returns	-52.12	-33.90	-26.57	-29.10	-18.24	33.88	-55.91	-21.30	34.61
	(-0.840)	(-0.674)	(-0.527)	(-0.592)	(-0.281)	(1.420)	(-0.890)	(-0.357)	(1.636)
Standard deviation	4.77	3.87	3.87	3.77	5.01	1.83	4.83	4.60	1.63
CAPM alpha	-4.02	4.58	9.13	6.07	31.42	35.45	-7.72	24.69	32.38
	(-0.107)	(0.150)	(0.270)	(0.186)	(0.774)	(1.490)	(-0.199)	(0.675)	(1.538)
Fama-French alpha	-8.70	1.97	8.93	4.68	27.15	35.85	-12.42	21.20	33.62
	(-0.365)	(0.0742)	(0.377)	(0.208)	(0.988)	(1.510)	(-0.495)	(0.894)	(1.619)
Carhart alpha	2.73	13.11	16.09	12.32	36.79	34.05	-0.23	30.87	31.09
	(0.125)	(0.529)	(0.701)	(0.569)	(1.402)	(1.433)	(-0.010)	(1.390)	(1.501)
Number of banks	20	20	19	20	19	39	22	62	84
Number of trading days	380	380	380	380	380	380	380	380	380

Panel B: January 2008 - December 2008	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile	q5-q1	negative AIT	positive AIT	positive AIT - negative AIT
Average returns	-53.64	-43.77	-17.71	-18.11	0.26	53.89	-55.66	-4.00	51.66*
	(-0.594)	(-0.618)	(-0.247)	(-0.260)	(0.003)	(1.536)	(-0.606)	(-0.046)	(1.667)
Standard deviation	5.68	4.46	4.50	4.39	5.95	2.21	5.76	5.43	1.94
CAPM alpha	18.57	12.17	34.74	33.67	74.66	56.09	16.98	64.59	47.61
	(0.338)	(0.278)	(0.711)	(0.720)	(1.261)	(1.594)	(0.299)	(1.219)	(1.546)
Fama-French alpha	-19.66	-7.92	3.34	2.23	34.96	54.65	-21.99	27.30	49.28
	(-0.584)	(-0.213)	(0.100)	(0.0718)	(0.895)	(1.550)	(-0.620)	(0.828)	(1.617)
Carhart alpha	-10.95	1.92	8.53	7.72	41.77	52.73	-12.62	34.26	46.88
	(-0.352)	(0.0560)	(0.262)	(0.256)	(1.103)	(1.496)	(-0.386)	(1.092)	(1.544)
Number of banks	20	20	19	20	19	39	22	62	84
Number of trading days	253	253	253	253	253	253	253	253	253