Lessons from Times of Crisis: Anticipation, Risk Taking and Portfolio Management

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TESI DOCTORAL UPF / 2013

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Annem'e ve Babam'a

Acknowledgements

First and foremost, I would like to express my gratitude and thanks to my supervisors. I am extremely grateful to José-Luis Peydró for his guidance, patience and continuous support. I am especially deeply thankful for his encouraging attitude. I am sincerely grateful to José M. Marín for introducing me to the research and for his insightful guidance. I am thankful to Xaiver Freixas for his help and advices. I also would like to thank to my co-authors José García Montalvo, Jaume García Villar and Josep Maria Raya in the third essay. I am eternally thankful to Marta Araque for all her administrative help. I also would like to express my gratitude to all of my friends.

I am forever indebted to my parents and to my sister Özge.

This thesis would not have been possible without the love and endless support of Onur.

Özlem Akın, Barcelona, June 2013

Abstract

This thesis consists of three essays. In the first essay, we analyze bank insiders' trading in the securities of their own bank in the run-up to the 2007-08 financial crisis. We show that on average ex-ante bank insiders' net sell of shares implies worse performance in the crisis. Our result points out that the bankers, at least to some extent, were aware of the risks they were taking. In the second essay, I analyze the bank insiders' trading in their own portfolio during the crisis and find that insiders trade in a contrarian manner. In the third essay, we analyze the cycle in lending conditions and standards using a unique dataset on mortgage loans in Spain and find that lending standards are softer in the boom than in the bust. Also, we analyze the mechanism by which banks could increase the supply of mortgage loans despite of regulatory restrictions. Our evidence is consistent with banks encouraging appraisers to introduce an upward bias in appraisal prices, to meet LTV regulatory thresholds.

Keywords: Insider trading; agency problems; contrarian beliefs; excessive risk-taking; bank incentives; financial crises; real estate bubble; credit supply; lending standards.

Resum

La tesis tiene contiene tres ensayos: En el primer ensayo, analizo el uso de información privilegiada a la hora de comerciar con los valores de su propio banco en el período previo a la crisis financiera de 2007-08. Se muestra que, en promedio, la venta neta de acciones ex ante por parte de los 'insiders' de los bancos implica un peor rendimiento durante la crisis. El resultado indica que los banqueros, por lo menos en cierta medida, eran conscientes de los riesgos que estaban tomando en el boom. En el segundo ensayo, analizo las operaciones bancarias de los 'insiders' en su cartera de activos durante la reciente crisis y se encuentra que los 'insiders' comercian de una manera contraria, lo que sugiere que en las acciones bancarias bajaron por debajo de sus fundamentales. En el tercer ensayo, analizo el ciclo en las condiciones y estándares de préstamos usando una base de datos única de los préstamos hipotecarios en España y encuentro que las condiciones de crédito son más relajadas en el auge que en la recesión. Asimismo, analizo el mecanismo por el cual los bancos podían aumentar la oferta de créditos hipotecarios a pesar de las restricciones regulatorias. La evidencia es consistente con la hipótesis de que los bancos alentaron a los tasadores a introducir un sesgo al alza en los precios de tasación, para cumplir con los umbrales reglamentarios de 'LTV', y así poder dar más préstamos.

Palabras clave: Abuso de información privilegiada; problemas de agencia; creencias contrarias; toma de riesgos excesivos en la banca; incentivos bancarios; crisis financieras; burbuja inmobiliaria; oferta de crédito; normas de préstamo.

Contents

Chapter 1

ANTICIPATING THE FINANCIAL CRISIS: EVIDENCE FROM INSIDER TRADING (WITH JOSÉ M. MARÍN AND JOSÉ-LUIS PEYDRÓ)

1.1. Introduction

In 2007-2008 the United States was overwhelmed by a financial (notably banking) crisis, which was followed by a severe economic recession. Banking crises are recurrent phenomena and often trigger deep and long-lasting recessions (Reinhart and Rogoff (2009)). Importantly, banking crises are not exogenous events but regularly come on the heels of periods of strong credit growth and bank risk-taking, especially associated to bubbles (Kindleberger (1978); Gourinchas and Obstfeld (2012); Schularick and Taylor (2012)). The recent crisis was not different and hence banks also took high risk in the run-up of the bubble (Brunnermeier (2009); Rajan (2010); Calomiris (2009); Acharya et al. (2010a)).

The key question for policy and for the academic literature is why banks take on so much risk. There are two views: (1) the moral hazard view (see e.g. Allen and Gale (2000) and Allen and Gale (2007); and Freixas and Rochet (2008)) implies that agency problems mainly between banks and the state due to explicit and implicit bank guarantees such as deposit insurance and bail-outs make rational for banks to take on excessive risk-taking.

Consistent with this view, bankers understand risks and it is optimal for them to take on high risks. Moreover, bankers' incentives were affected by the bonuses which were tied to short term profits rather than to the long-term profitability of their bets (Acharya et al. (2010a)). (2) The behavioural view states that banks take on high risk because of neglecting unlikely tail risks and, in general, optimistic beliefs (Gennaioli et al. (2012); Akerlof and Shiller (2010)).[1] In the limit case of this view, banks were not aware of the high risks they were taking.

Though the recent crisis affected massively the banking system (average bank performance was very poor during the crisis), there was substantial bank heterogeneity in problems as risk-taking was not uniform across the board (Beltratti and Stulz (2012)). If bank insiders understood the risks they were taking, we should find that bank insiders in the most risky banks (the ones with worse returns during the crisis) sold more shares prior to bad news in the real estate sector (the drop in real estate prices) were publicly observed in May 2006. Moreover, this effect should be stronger the higher the bank was exposed to the real estate sector, the more information the insiders have (top officers vs. other officers and directors) and the larger the bank as the agency problems with the state are higher. This is what we test in this paper.

We analyze bank stock performance in the crisis (July 2007-December 2008) based on bank insiders net sells during 2005 and the first half of 2006, controlling for other important bank characteristics as balance sheet variables, pre-crisis bank stock performance and others.[2] We obtain the insiders' trades from the insider trading database Thomson Financial, which provides the detailed information on each trade (date, size, price..etc) and

[1] Their argument is based on the idea that given the long-term upward trend in house prices, executives did not believe that they are engaging in excessively risky positions. Foote et al. (2012) and Gerardi et al. (2009) argue that the analysts reports before the downturn show us all market participants understood that a fall in house prices would lead to a huge increase in foreclosures. But the probability of this event were low from their point of view and they just did not take that possibility into consideration. In the end, the crisis was a realization of an extreme event. In other words, it was just a bad luck.

[2] Subprime mortgage origination in 2005 and 2006 was about $1.2 trillion of which 80 percent was securitized (See Gorton (2010) for various statistics regarding the subprime mortgages). Gerardi et al. (2009) mentions that most of the foreclosures stemmed from loans originated in 2005 and 2006, leading many to suspect that lenders originated a large volume of extremely risky loans during this period. Hence we focus our attention on this period. However our hypothesis requires to focus on the period in which house prices were still rising. So we define the first drop in May 2006 in Case Shiller composite 10 home price index as the major event that could have changed the view about the future of real estate market (see Case (2008) for regional house price trends). Our methodology relies on testing the relationship between insider trading prior to the initial fall in house prices (January 2005 to May 2006) and bank performance during the crisis period. However we also analyse the relationship between the transactions in the period subsequent to the peak of house price index (June 2006 to June 2007) and bank performance (in mid 2006 some other problems also started to appear. For instance, subprime lender Ameriquest announced job cuts and closed many retail branches).

the role rank of insiders in their firm. Based on the roles of corporate insiders and their differential access to private information about bank operations, we are able to classify insiders into two categories: officers and directors. At first step, we pooled all insiders together; then, we analyse these two groups separately as insiders such as CEO and CFO could be more informed than directors. We also analyse the top 5 officers separately.

We follow the approach suggested in insider trading literature to set up our empirical strategy. Primary focus of the literature is to investigate insiders' use of non-public information in their trades. Since we do not have their private information set or any variable that is related to it, the literature use forward-looking variables. To the extent that insiders trade based on private information, these trades will have a predictive power of the future performance of the firm such as return in next period.[3] Our empirical methodology relies on the same idea. We perform cross-sectional OLS estimation and predict bank crisis period performance including the ex-ante insider measure in the econometric equation.

We find that on average insiders' net sell of shares in the period prior to drop in house prices implies worse bank performance during the crisis. Importantly, the negative relationship becomes statistically significant only for officers thus suggesting that banks in which we observe high selling by informed insiders (i.e., the officers) are the ones that performed worse in the crisis. Moreover, the statistical and economic significance is larger when we only take into account the top five executives, i.e. the ones with highest set of information. One standard deviation movement in top five officers' sell implies -5.34% drop in bank crisis period performance. All the results are robust to the inclusion of the bank characteristics that has been associated to bank crisis performance (Beltratti and Stulz (2012), Fahlenbrach and Stulz (2011) , Fahlenbrach et al. (2012)). Finally, we find that the impact of ex-ante insiders' sell on worse performance during the crisis is stronger for larger financial institutions, large depository banks and for banks with higher exposure to the real estate sector.

The main contribution of this paper is the following: there is anecdotal evidence that some insiders of banks with high risk sold their shares before the crisis hit, but there is lack of evidence across the board.[4] Our paper provides sector-wide analysis of the insid-

[3]Insider trading literature provides evidence on insiders' ability to forecast aggregate stock market movements (Seyhun (1988), Seyhun (1992) and Lakonishok and Lee (2001)) and also to predict future abnormal stock price changes in their own firm stock (Seyhun (1986), Lin and Howe (1990)).

[4]Bebchuk et al. (2010) provide a case study of compensation in Bear Stearns and Lehman Brothers during 2000-2008 and document that both CEO and also top five executives in these banks cashed out large amounts of performance based compensation during these period. Similarly, Bhagat and Bolton (2013) analyse the compensation structure at the 14 US too-big-to-fail institutions during 2000s. Consistent with Bebchuk et al. (2010) they find that executive compensation led to excessive risk taking and prior to the

ers' trading before the initial problems in house prices. Our sample constitutes not only too-big-to fail institutions but also mid-size and smaller banks. The closest paper to ours is Cziraki (2013) who analyses insider trading in banks before and during the recent financial crisis. Our work is different from his paper in several important ways: not only on the sample and data but especially on the methodology as we try to explain the crisis bank performance with insider trading before the realization of bad public news on real estate (i.e. 2005) whereas he tries to explain insider trading. His main finding is that insiders started to sell their bank shares after they saw a reversal in house price index in mid-2006. Contrary to him we find evidence from the period 2005 and the beginning of 2006. Our methodology and sample are different and this explains the difference of results. Moreover, our motivation is different. Our results are consistent with bank insiders understanding the risks they were taking and, therefore, our evidence implies that moral hazard in the banking industry is important for driving risk-taking and, therefore, the recent policy initiatives on bank capital and the policy discussions on the size of banks and the compensation structure may be useful for limiting excessive bank risk-taking.

The remainder of the paper is organized as follows. Section 2 provides the details of data sources, sample construction, and empirical strategy. In section 3, we present the results and robustness checks. Finally in section 4 we conclude.

1.2. Data and Empirical Strategy

This section first explains the data and sample construction. Next, it describes the empirical methodology, bank performance measure, insider trading measure and control variables.

1.2.1. Data

The data used in this paper come from several sources. Bank balance sheet and income statement variables are obtained from Bankscope. Price and shares outstanding data come from CRSP Monthly and Daily Stock Files. Fiscal year end accounting data is obtained from CRSP/Compustat Merged database. Finally, the corporate insider transactions data comes from Thomson Financial Insider Filing Data.

crisis top executives sold a large number of shares.

Our initial sample comes from Bankscope. Using this database, we select all U.S. financial institutions with asset size at least $2 billion as of 2004. We require banks to be listed on one of the major national stock exchanges such as NASDAQ, NYSE or AMEX in 2004 and to have share price information available for the full period from January 2003 until the beginning of the crisis, July 2007. We further go through our list and eliminate the banks that Fahlenbrach and Stulz (2011) excludes. Our final sample includes 166 financial institutions. We are able to define the type of each institution utilizing from "specialisation" information that Bankscope database provides. Our sample includes two Real Estate/Mortgage banks (Fannie Mea and Freddie Mac) and six Investment banks. The remaining 158 institutions are commercial banks and bank holding companies. Out of 166, 28 institution were delisted between July 2007 and December 2008.

Our sample covers both small and large financial institutions. 67 institutions have assets ranging from $2 - $5 billion at 2004 fiscal year end. Dodd-Frank Wall Street Reform and Consumer Protection Act defines systemically important bank as a bank with asset size larger than $50 billion. As of 2004 our sample includes 26 institutions that can be classified as systemically important based on this criteria.

We obtain corporate insider transactions data from Thomson Financial Database. According the Securities and Exchange Act of 1934, the term corporate insiders refers to corporate officers, directors and large shareholders who own more than 10 percent of the firms' stock. If insiders buy or sell their firms' stock, they are mandated to file with the Securities and Exchanges Commission (SEC) within the first ten days of the next month after their transactions. Starting from August 29, 2002, insiders are required to report their trades within two business day.[5] The insider trading records Thomson database provides are the transactions of persons subject to the disclosure requirements of Section 16(a) of the Securities and Exchange Act of 1934 reported on SEC Forms 3, 4, 5 and 144. The transactions on which this paper focus come from Form 4 which is filled out when insider's ownership position changes. The information provided in Form 4 includes: the name and address of corporate insider, issuer name and ticker or trading symbol of the security, relationship of insider to the issuer (officers, directors or other positions held by insider in issuers), whether it is an acquisition or disposition, the transaction code which describes the nature of the transaction, the transaction date and price. The transaction reported on Form 4 could be a purchase, sale, option grant, option exercise, gift or any other transaction that causes a change in ownership position. Among these transactions, we only take into account insiders' Open Market purchases and sales. All other types of

[5]See Agrawal and Nasser (2012) and Bainbridge (2012) for an overview of insider trading regulations.

transactions, such as exercises of options, shares acquired through a plan, and so forth, are excluded since it is expected that insiders' open market sales and purchases are more likely to represent actions as a result of insider information.

Since it has been documented that this database contains a number of data errors[6], before merging transaction data with our sample, we filter the data to eliminate the reporting errors by following Lakonishok and Lee (2001). We use CRSP daily file to be able to identify and eliminate non-meaningful records. Thomson database provides eight digit CUSIP number as an identifier for each security. We merge the trade information of each security on each date with CRSP daily file using CUSIP. We exclude transactions whose trade price was not within 20% of CRSP closing price on that day. We also remove trades for which the number of shares traded exceeded 20% of the number of shares outstanding as reported in CRSP. Additionally, transactions with less than 100 shares and also all the amended records (Amendment Indicator is A) and filings marked as inaccurate or incomplete by the database are eliminated (Cleanse code is "S" or "A"). From the overall common stock trades, transactions that have incomplete information such as no date, price or amount of transactions are also excluded. As a final step, we investigate the nature of the each transaction. We focus on open market sale transactions and eliminate option-driven sales.[7]

One of the main trader characteristics that this database provides is the role rank (data item "rolecode") of insiders in their firm. This data item enables us to identify the position of the insider in the bank i.e. officer, director, chairman of the board, large shareholder...etc.[8] Based on the roles of corporate insiders and their differential access to private information about firm operations, insiders may be classified into two main categories: Officers and Directors. In our analysis we pooled all the insiders together but also we analyse the transactions of each group separately as the previous insider trading literature documents that high-level insiders has more information and in result of this earn higher abnormal returns.[9] Finally, we are going to focus our attention on the most informed insiders i.e. Chairman of Board, CEO, CFO, COO and President (Beneish and Vargus (2002); Core et al. (2006); Adams et al. (2012)).[10]

[6] See, for example, Jeng et al. (2003)

[7] Thomson provides a data field which gives information whether the sale transaction is related to an option exercise. We eliminate any sale transaction if the sell transaction is totally or partially related to an option exercise (optionsell "A" or "P").

[8] See Yermack (2009) footnote10 for insiders title reporting practices.

[9] See, among others; Baesel and Stein (1979); Nunn et al. (1983); Seyhun (1986); Lin and Howe (1990); Seyhun (1998).

[10] Corresponding relationship codes in Thomson are "CEO" "CFO" "CB" "COO" "P".

1.2.2. Empirical Strategy

In order to test the relationship between early period insider transactions and bank performance, we estimate the following cross-sectional regression:

$$Return_{i,2007-08} = \beta_0 + \beta_1 Net\_Sales_{i,2005-06} + BankCharacteristics_{i,2004} + \epsilon_i \quad (1.1)$$

where i denotes the bank.

We are going to discuss the variables included in our regression equation and interpret summary statistics presented in Table 1.1.

Dependent and Main independent variable

The crisis period is defined as July 2007 to December 2008 (Fahlenbrach and Stulz (2011),Fahlenbrach et al. (2012)). Dependent variable, $Return_{i,2007-08}$, is the bank (i) performance during the crisis period that is measured with buy-and-hold return on bank's stock.[11] If a bank were delisted during the crisis period, we put proceeds into a cash account.[12] Not surprisingly, on average bank's crisis period performance is highly negative (-34%).

In Equation 1.1. we are mainly interested in the estimation of the coefficient of our insider trading measure, *Net_Sales*. The literature defines several measures for insider trading. The number of insiders who did a transaction in a given period, number of shares sold (purchased) in a period, the dollar value of sell (purchase), the number of transactions (or separately the number of sell/buy transactions) are the most common ones. We are going to use net dollar value of sell transactions as a measure of insider trading. We construct our measure at bank level as follows:

$$Net\_Sales_{i,2005-06} = [\$Sell_{i,2005-06} - \$Buy_{i,2005-06}]/MarketCapitalization_{i,2004} \quad (1.2)$$

2005-06 represents the the pre-crisis period that is defined as January 2005 to May 2006. In each bank, first we go through all open market sell and purchase transactions held in this period and compute the value of each transaction (# shares $\times$ transaction price). Then

[11] For each bank, crisis period buy-and-hold return computed as the product of one plus each month return, minus one. Monthly buy and hold returns are directly obtained from CRSP Monthly Stock file.

[12] We incorporate delisting return if it is available in CRSP. Alternative to this methodology, we use Fama-French Bank industry portfolio return after the delisting month until December 2008. Fama-French Bank Industry portfolio return is downloaded from Kenneth R. French's website.

we sum the value of sell and purchase transactions separately at bank level. In the end, we obtain the insider trading measure for each bank by subtracting the total dollar value of insiders' open market purchases form that of sells. We adjust this measure with market capitalization to make it comparable across banks. Market capitalization at December 2004 is calculated by multiplying the price of bank share (prc) by the number of shares outstanding (shrout) that is obtained from CRSP monthly stock file.

We compute this measure with pooling all insiders together in each bank as well as for two subgroup of insiders officers and independent board directors separately. In the final case we only take into account top five officers i.e. Chairman of Board, Chief Executive, Financial and Operating officers and also President.

The largest value of our measure shown in equation 2 is 7.96 meaning that insiders net sell dollar value is 7.96% of the market capitalization. In the same period on average insiders net sell is 0.42% of bank's stock December 2004 market capitalization.

Bank Characteristics

We capture the capital adequacy of the bank with tangible common equity that is the ratio of tangible common equity (ceqt) to total assets (at). The average tangible equity ratio in our sample is 6.62% at fiscal year end 2004. The largest financial institution in terms of asset size has about $1.157.248 million in assets while median bank's total assets is $6336 million. Fahlenbrach et al. (2012) shows that faster growing banks are more vulnerable to the crises. In our sample, median bank asset growth from 2003 to 2004 is 13%. Loans of each bank in asset side is captured with loan to asset ratio. On average bank's loan ratio is 60%. We use an approximate leverage measure of Acharya et al. (2010b). It is book value of assets minus book value of equity plus market value of equity divided by market value of equity.

As a measure of bank's riskiness, each bank's beta is obtained from monthly market model of monthly returns from January 2003 to December 2004 where market is represented by value-weighted CRSP index. Also we use bank's exposure to US Real Estate market that is measured with beta estimated using a regression of monthly returns during 2003-2004 on the value weighted CRSP index and real estate market index proxied by Fama French real estate industry portfolio.

Other control variables are previous period return, size and book-to-market ratio that are well-known determinants of stock return. Previous twelve month return is included to

control for recent price run-up. Average buy and hold stock return of our sample banks from January to December 2004 is 18%.[13]

In the moral hazard hypothesises testing, we focus our attention on the large banks defined as a bank with total assets in excess of $6 billion (median bank asset size) and also large depository institutions. A financial institution is defined as a deposit-taking bank if deposit to asset ratio is above 20% and loan to assets ratio is above 10% (Beltratti and Stulz (2012)). In total 88 banks in our sample are classified as deposit-taking under this criteria and 78 of them included in the large bank sample.

1.3. Results

This section presents cross-sectional OLS regression analysis results that allow us to investigate the relationship between insiders' early period abnormal trading and bank crisis period performance while controlling for several bank characteristics that has been already discussed as the determinants of bank crisis period performance.

Table 2 presents our cross-sectional OLS estimation results. In all regressions, the dependent variable is the buy-and-hold return from July 2007 to December 2008 and the control variables are as of 2004 fiscal year end. We find that, consistent with the recent studies, size, asset growth and leverage are significant determinants of bank crisis performance. Banks that are larger, growing faster and highly leveraged performed worse in the crisis. Our results with values as of 2004 are consistent with the recent studies that are providing evidence with 2006 characteristics.

Column one shows that the coefficient of our insider trading measure that is computed with pooling all insiders (officers and directors) together is negative. It suggests that banks with higher net sell of shares performed worse. But the coefficient is not statistically significant.

[13] Insider trading literature also use size, book-to-market ratio and price run up as control variables. Seyhun (1986) shows that size is negatively correlated with insider trading. Li and Zhang (2011) discuss that firm size is positively correlated with the relative amount of public information which reduces information asymmetry. On the other hand, firm size could also proxy for the complexity of business operation, which may be negatively correlated with corporate transparency and positively correlated with information asymmetry between insiders and outsiders. Previous studies find that insider trading intensity is higher for firms with greater information asymmetry as proxied by size. Moreover, the literature documents that insiders tend to sell in growth stocks and buy more in value stocks. Rozeff and Zaman (1998) shows that insiders sell heavily when book-to-market ratio is high.

The second column examines the predictive ability of officers' and directors' sells separately.[14] The coefficient on officers' net sell is -9.679 and it is statistically significant at 10% significance level. The standard deviation of this variable is 0.00453. One standard deviation movement in officers' sells implies -4.38% drop in bank crisis period return (0.00453 $\times$ -9.679) whereas the coefficient on the measure for independent directors is not significant suggesting that the net sell of independent directors does not have any predictive ability for bank crisis performance.

In column three, we focus our attention only on five top ranking officers' sells (Chairman of Board, CEO, CFO, COO and President). The coefficient on the insider trading measure is statistically significant at 5% level. The standard deviation of this variable is 0.003780 and one standard deviation movement in top officers' sells implies -5.34% drop in bank crisis period return (0.003780 $\times$ -14.13)

Column one through three show us that on average higher sells by all officers and more significantly top five officers implies worse performance in the crisis. We expect that if insiders were fully aware of their exposure then the predictive ability of sell transactions should become more severe in highly exposed banks. We test this hypothesis in column 4 by including an interaction term between our main insider trading variable, top five officers' net sell, and real estate exposure in our equation and the coefficient on the interaction term is negative and statistically significant at 5% level. Our findings are consistent with the agency view and the most informed insiders are ,at least to some extent, were aware of the risks they were taking and unload the shares from their own portfolio.

Column 5 and 6 aim at testing our main hypothesis in large banks and only in large depository institutions. We define large bank as a bank with assets above the sample median ($6 billion) as of 2004 fiscal year end. We perform the same OLS analysis with this sub-sample and in column 5 we see that the coefficient is negative and statistically significant at 5% level. The standard deviation of top five officers' net sell is 0.002606 in this sub-sample. One standard deviation movement in top officers' sell implies -6.11% drop in bank crisis period return (0.002606 $\times$ -23.44). In column 6, we keep only large depository institutions in the sample and economic significance is getting slightly larger. One standard deviation (0.0025276) movement in top officers' net sell implies -6.93% (0.0025276 $\times$ -27.43) in crisis period stock return performance. These results show that in large and also large depository institutions, on average top officers' sells in pre-crisis

[14] Seyhun (1986) finds that insider's position in the firm is one of the most important determinants of insiders' abnormal profits. The results suggest that insiders who are more familiar to operations of the firm trade on more valuable information.

period implies more severe drops in return during the crisis.

1.3.1. Robustness checks

So far we documented strong negative relationship between top five most informed officers' sell in pre-crisis period and bank crisis period performance. In this section we are going to test whether our insider trading measure have any predictive ability for the period following the transactions i.e. 2006 that can be defined as *normal times*. One could argue that once insiders unload their shares they might have behaved more freely in the next period (f.e. increase the leverage substantially) which in the end caused the bank to perform poorly in the crisis. In order to test this, we are going to analyse the relationship between insider trading measure and bank characteristics in the next period.

In Table 3, through column 1 to column 3 all regressions include the same independent variables. Our main variable is the insider trading measure computed with only top five officers' trades. In the first column, the dependent variable is the buy-and-hold return from June 2006 to June 2007. We do not observe any significant relationship between top insiders' sell and return in the next one-year period. Further we test whether the increase in net sell of insiders in early period leads increase in leverage or asset growth from 2005 fiscal year end to the end of 2006. One could argue that once insiders unload their shares they might have increased the leverage more freely that in the end caused the bank to perform poorly in the crisis. In all regressions we do not observe any significant relationship.

1.3.2. Further Results

So far we document strong and robust evidence on the relationship between insiders sell in the period prior to initial drop in real estate prices (January 2005 to May 2006) and bank crisis period performance (July 2007 to December 2008). In this section we are going to present the evidence in more details and further we discuss the predictive ability of sell in the period subsequent to the drop in house prices (June 2006 to June 2007).

We construct the same measure at bank level as follows:

$$Net\_Sales_{i,t} = [\$Sell_{i,t} - \$Buy_{i,t}]/MarketCapitalization_{i,t-1} \tag{1.3}$$

The pre-crisis period t, is defined as January 2005 to June 2007. We divide the pre-crisis period (t) into two sub-periods: t_1 and t_2. First period (t_1) is defined as January 2005 to May 2006. We are primarily interested in testing the relationship between executive transactions in this early period and the performance of bank in the crisis period. In this case we use market capitalization as of December 2004 to adjust the measure with size (i.e. t-1 in Equation 1.3 is December 2004). The second sub-period (t_2) is defined as June 2006 to June 2007 and t-1 corresponds to May 2006.

Column 1 of Table 1.5. shows results from the regression of buy-and-hold return of bank's stock in crisis period on insider trading measure computed in the period prior to house price drop (t_1). The accounting variables are as of 2004 fiscal year end. The coefficient on our measure, Net_Sales, is negative but not statistically significant. In the same table, columns 2 through 6 include other determinants of bank performance. Through column 4 to 6 we see that financial institutions with higher tangible equity ratio, less short-term debt and less leverage performed better. These results confirm the recent studies findings related to bank characteristics.

Table 1.6. shows the results of the same analysis as Table 1.5. but this time the insider trading measure computed in the period of June 2006 to June 2007 i.e. after the first drop in house price index (t_2). The coefficient on our main variable is still negative and also larger but standard errors are also larger. The control variable values are as of 2005 fiscal year end but the coefficients' signs are similar.

So far we present the results with our measure computed by pooling all insiders' transactions together. Now, in Table 1.7 we analyse the predictive ability of our measure for officers and directors separately. In the first column we regress the bank performance measure only on insider trading measures computed for officers and independent directors separately. The coefficient for officers is negative and statistically significant at 5% level. In the column 6, once we include the leverage we see that officers' trading coefficient is smaller but still statistically significant at 10% significance level. Whereas the coefficient on the measure for independent directors is not significant suggesting that the transactions of independent directors does not have any predictive ability for bank crisis performance. In Table 1.8 we see that in the post period coefficient is still negative but not statistically significant.

Finally, we focus our attention only on top five officers (CEO, CFO, COO and President). In Table 1.9 column 1 points out a significant negative relationship and it is robust to the inclusion of several control variables. Table 1.10 shows that the significant relationship

also holds in the post period i.e. from May 2006 to June 2007. However this significance does not robust to inclusion of all control variables.

Next we discuss the large banks and large depository institutions. Table 1.11 and Table 1.12 reports results for large banks. The first column indicates significant negative relationship and it is robust to inclusion of several bank characteristics. The significant relationship also holds in period t_2. Next tables 1.13 and 1.14 present the results for large depository institutions. We document robust significant relationship for both period. The results show that also in the post period higher selling by top officers associated to lower return in the crisis period. In the sixth column of table the coefficient on our measure is -65.30. One standard deviation (0.0009856) increase in net sell value associates to -6.44% drop in bank crisis performance.

1.4. Conclusion

Banking crises have been recurrent events and often induced by excessive risk taking. The 2007-2008 crisis was not different. In this paper, we are testing whether in the period prior to the initial fall in house prices bank insiders understood the risk they were taking.

We perform cross-sectional OLS regression analysis and find that higher sell in pre-crisis period by informed insiders (officers), more significantly top five officers, implies worse bank performance in the crisis. This result is robust to the inclusion of the bank characteristics that has been associated to bank crisis performance. We further find that the impact is stronger for large banks and for banks with higher exposure to the US real estate sector.

Our result points out that the bankers, at least to some extent, were aware of the risks they were taking. This evidence helps us to deepen our understanding of the causes of the recent financial crisis and accordingly revise public policy rules bearing regulations and supervision of financial institutions.

1.5. TABLES

Table 1.1: Summary statistics

Crisis period performance is the buy-and-hold return on bank stock from July 2007 to December 2008. Net Sales is the net value of sell transactions computed at bank level by pooling all insiders transactions in the period January 2005 to May 2006 (and divided with market capitalization as of December 2004). Net Sales Officers takes into account only officers' transactions and Net Sales Directors is computed with only independent directors' transactions. And finally Net Sales Top is the insider trading measure computed with only top five executives. Return is the buy-and-hold return from January 2004 to December 2004. All accounting variables are obtained from annual CRSP/Compustat Merged Database (CCM) and the values are as of 2004 fiscal year-end (in million $). Market Capitalization is equal to common shares outstanding (csho) times closing price at fiscal year end (prcc_f). Book-to-Market is the ratio of book value of equity to market capitalization. Leverage measure is the book value of assets minus book value of equity plus market value of equity divided by market value of equity. Tangible equity ratio (TCE ratio) is the ratio of common equity (ceqt) to total assets (at) in percentage. Asset Growth is calculated as the percentage change in total assets (at) from the fiscal year end 2003 to the end of 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market model from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. Deposits (ratio of total deposit to total asset) and loans (ratio of total loan to total asset) are obtained from Bankscope. All variables are winsorized at 1% in each tail.

	# of Obs.	Average	Median	Standard Deviation	Min	Max
Crisis performance	166	-0.34	-0.31	0.43	-1.00	0.72
Net Sales(%)	166	0.42	0.14	0.97	-0.44	7.96
Net Sales Officer(%)	166	0.26	0.09	0.45	-0.39	2.60
Net Sales Director(%)	166	0.11	0.00	0.35	-0.53	2.09
Net Sales Top(%)	166	0.15	0.01	0.38	-0.23	2.33
Return	166	0.18	0.18	0.17	-0.32	0.86
Total Assets	166	71749.74	6336.23	207242.92	2082.57	1157248.00
Market Capitalization	166	9728.93	1310.22	27174.55	281.47	190147.20
Book-to-market ratio	166	0.47	0.45	0.14	0.19	0.85
Leverage	166	6.21	5.70	2.40	3.50	16.10
TCE ratio	166	6.62	6.39	2.12	2.74	14.93
Asset Growth	166	17.99	13.29	20.07	-8.81	114.35
Deposits	155	0.69	0.72	0.18	0.01	0.91
Loans	155	0.60	0.64	0.18	0.00	0.88
Beta	166	0.90	0.81	0.40	0.10	1.96
Real Estate Beta	166	0.06	0.06	0.34	-0.91	1.09

Table 1.2: Bank's Performance during the Financial Crisis and Insider Trading

Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the net value of sell transactions computed at bank level by pooling all insiders transactions in the period January 2005 to May 2006 (and divided with market capitalization as of December 2004). Net Sales Officers takes into account only officers' transactions and Net Sales Directors is computed with only independent directors' transactions. And finally Net Sales Top is the insider trading measure computed with only top five executives. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Leverage is proxied as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. Interaction is the interaction term computed as Net Sales Top $\times$ Real Estate Beta. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

VARIABLES	(1) All Banks All Executives	(2) All Banks Officers vs Directors	(3) All Banks Top 5	(4) All Banks Top 5	(5) Large Banks Top 5	(6) Large Depository Top 5
Net Sales	-3.155					
	(2.368)					
Net Sales Officer		-9.679*				
		(5.555)				
Net Sales Director		2.220				
		(7.181)				
Net Sales Top			-14.13**	-10.96**	-23.44**	-27.43**
			(6.288)	(5.316)	(10.18)	(12.69)
log(market value)	-0.0533***	-0.0539***	-0.0558***	-0.0538***	-0.0486*	-0.0543*
	(0.0199)	(0.0199)	(0.0195)	(0.0200)	(0.0269)	(0.0300)
Book-to-market ratio	-0.0331	-0.0294	-0.0404	-0.00658	-0.261	-0.209
	(0.281)	(0.281)	(0.278)	(0.281)	(0.355)	(0.446)
Return	-0.162	-0.148	-0.132	-0.122	-0.0847	-0.107
	(0.225)	(0.233)	(0.226)	(0.231)	(0.251)	(0.269)
Beta	-0.124	-0.113	-0.111	-0.111	-0.0134	-0.0223
	(0.0762)	(0.0777)	(0.0771)	(0.0786)	(0.104)	(0.116)
Real Estate Beta	-0.0686	-0.0450	-0.0370	-0.0232	-0.0747	-0.145
	(0.0873)	(0.0879)	(0.0867)	(0.147)	(0.115)	(0.115)
Asset Growth	-0.00322*	-0.00322*	-0.00335*	-0.00341*	-0.00574***	-0.00579***
	(0.00184)	(0.00190)	(0.00183)	(0.00183)	(0.00187)	(0.00200)
Leverage	-0.0623***	-0.0619***	-0.0606***	-0.0616***	-0.0385***	-0.0492
	(0.0127)	(0.0126)	(0.0125)	(0.0124)	(0.0122)	(0.0317)
Interaction				-23.01**		
				(10.42)		
Observations	166	166	166	166	89	78
Adjusted R-squared	0.229	0.229	0.238	0.243	0.309	0.252

Table 1.3: Bank's Characteristics in 2006 and Insider Trading

Net Sales Top is the insider trading measure computed only taking into account top five officers. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization at 2004. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. In the first column dependent variable is the buy-and-hold return from June 2006 to June 2007. Leverage is proxied as the book value of assets minus book value of equity plus market value of equity divided by market value of equity as of 2006 fiscal year end. The one year growth rate of bank's assets is calculated from the end of fiscal year 2005 to the end of fiscal year 2006. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)
VARIABLES	Return	Leverage	Asset Growth
Net Sales Top	0.627	104.9	487.4
	(3.611)	(83.36)	(371.0)
log(market value)	0.0468***	0.586***	1.047
	(0.00845)	(0.203)	(0.665)
Book-to-market ratio	-0.00913	5.142*	6.630
	(0.127)	(2.640)	(8.586)
Return	-0.0874	5.223*	6.879
	(0.121)	(3.116)	(6.651)
Beta	-0.00329	-0.0525	1.855
	(0.0372)	(0.844)	(2.642)
Constant	-0.327***	-0.887	-5.330
	(0.0812)	(1.930)	(7.284)
Observations	166	166	166
R-squared	0.158	0.113	0.038

Table 1.4: Summary Statistics: Large Banks

Panel A presents summary statistics for large banks and Panel B shows large depository institutions. All accounting variables are obtained from annual CRSP/Compustat Merged Database (CCM) and the values are as of fiscal year 2004 year-end (in million $). Market Capitalization is equal to common shares outstanding (csho) times closing price at fiscal year end (prcc_f). Book-to-Market is the ratio of book value of equity to market capitalization. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market model from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculated as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail.

Panel A: Large Banks

	# of Obs.	Average	Median	Standard Deviation	Min	Max
Total Assets	89	130889.85	15648.81	270006.89	6024.79	1157248.00
Market Capitalization	89	17529.07	3324.77	35381.44	855.80	190147.20
Book-to-market ratio	89	0.46	0.46	0.13	0.19	0.84
Leverage	89	6.60	5.80	2.97	3.50	16.10
Short-term funding	89	0.17	0.13	0.15	0.00	0.63
TCE ratio	89	6.12	6.10	2.01	2.74	14.93
Asset Growth	89	17.43	14.45	17.10	-8.81	73.07
Beta	89	0.88	0.79	0.41	0.10	1.96
Real Estate Beta	89	0.10	0.09	0.34	-0.91	1.09
Net Sales(%)	89	0.24	0.08	0.39	-0.40	1.65
Net Sales Officer(%)	89	0.20	0.05	0.35	-0.39	1.65
Net Sales Director(%)	89	0.04	0.00	0.14	-0.15	1.08
Net Sales Top(%)	89	0.11	0.01	0.26	-0.15	1.65

Panel B: Large Depository Banks

	# of Obs.	Average	Median	Standard Deviation	Min	Max
Total Assets	78	87495.20	14240.94	228215.29	6024.79	1157248.00
Market Capitalization	78	15495.68	2773.33	36262.18	855.80	190147.20
Book-to-market ratio	78	0.45	0.45	0.12	0.19	0.76
Leverage	78	5.84	5.58	1.66	3.50	10.38
Short-term funding	78	0.14	0.13	0.11	0.00	0.63
TCE ratio	78	6.36	6.17	1.96	2.74	14.93
Asset Growth	78	17.04	12.49	17.80	-8.81	73.07
Beta	78	0.86	0.78	0.41	0.10	1.96
Real Estate Beta	78	0.07	0.05	0.32	-0.91	1.09
Net Sales(%)	78	0.23	0.08	0.39	-0.40	1.65
Net Sales Officer(%)	78	0.18	0.05	0.34	-0.39	1.65
Net Sales Director(%)	78	0.05	0.00	0.15	-0.15	1.08
Net Sales Top(%)	78	0.09	0.01	0.25	-0.15	1.65

Table 1.5: OLS Results: All Banks

Table 1.5 presents OLS results with all banks. Insider trading measure is computed in the period t_1 with pooling all insiders. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales	-3.273	-4.931*	-4.885*	-3.696	-4.717*	-3.155
	(2.643)	(2.779)	(2.763)	(2.387)	(2.691)	(2.368)
log(market value)		-0.0827***	-0.0812***	-0.0584***	-0.0596***	-0.0533***
		(0.0190)	(0.0196)	(0.0200)	(0.0206)	(0.0199)
Book-to-market ratio		-0.740***	-0.637**	-0.687***	-0.638**	-0.0331
		(0.251)	(0.251)	(0.225)	(0.248)	(0.281)
Return		-0.307	-0.253	-0.291	-0.229	-0.162
		(0.208)	(0.223)	(0.221)	(0.226)	(0.225)
Beta		-0.158*	-0.153*	-0.128	-0.156**	-0.124
		(0.0823)	(0.0821)	(0.0791)	(0.0784)	(0.0762)
Real Estate Beta		-0.113	-0.108	-0.0815	-0.0903	-0.0686
		(0.0926)	(0.0921)	(0.0926)	(0.0951)	(0.0873)
Asset Growth			-0.00224	-0.00113	-0.00177	-0.00322*
			(0.00199)	(0.00185)	(0.00194)	(0.00184)
TCE ratio				0.0503***		
				(0.0168)		
Short-term funding					-0.679***	
					(0.221)	
Leverage						-0.0623***
						(0.0127)
Constant	-0.324***	0.863***	0.829***	0.303	0.743***	0.687***
	(0.0361)	(0.207)	(0.210)	(0.280)	(0.209)	(0.209)
Observations	166	166	166	166	166	166
R-squared	0.005	0.181	0.191	0.241	0.224	0.267
Adjusted R-squared	-0.000605	0.150	0.155	0.203	0.184	0.229

Table 1.6: OLS Results: All Banks

Table 1.6 presents OLS results with all banks. Insider trading measure is computed in the period t_2 with pooling all insiders. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2005 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from June 2005 to May 2006. Bank's equity beta is obtained from a market model of monthly returns from June 2004 to May 2006, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from June 2004 to May 2006, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2004 to the end of fiscal year 2005. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales	-6.350	-10.68	-8.920	-6.774	-8.044	-8.343
	(12.63)	(11.48)	(11.55)	(12.09)	(11.77)	(11.48)
log(market value)		-0.0926***	-0.0918***	-0.0656***	-0.0709***	-0.0628***
		(0.0218)	(0.0221)	(0.0227)	(0.0245)	(0.0217)
Book-to-market ratio		-0.665***	-0.660***	-0.630***	-0.586**	-0.247
		(0.243)	(0.245)	(0.224)	(0.245)	(0.271)
Return		-0.146	-0.0283	-0.0802	-0.0278	-0.0510
		(0.215)	(0.233)	(0.233)	(0.224)	(0.251)
Beta		-0.0695	-0.0624	-0.0374	-0.0188	0.0264
		(0.0636)	(0.0674)	(0.0644)	(0.0723)	(0.0678)
Real Estate Beta		-0.125	-0.0701	-0.0257	-0.0195	0.0231
		(0.148)	(0.153)	(0.144)	(0.152)	(0.145)
Asset Growth			-0.00457	-0.00321	-0.00438	-0.00433
			(0.00366)	(0.00347)	(0.00366)	(0.00340)
TCE ratio				0.0496***		
				(0.0169)		
Short-term funding					-0.543*	
					(0.285)	
Leverage						-0.0467***
						(0.0130)
Constant	-0.328***	0.808***	0.825***	0.255	0.659**	0.640***
	(0.0382)	(0.229)	(0.233)	(0.309)	(0.254)	(0.234)
Observations	166	166	166	166	166	166
R-squared	0.001	0.148	0.162	0.214	0.180	0.232
Adjusted R-squared	-0.00488	0.116	0.125	0.174	0.139	0.192

Table 1.7: OLS Results: All Banks

Table 1.7 presents OLS results with all banks. Insider trading measure is computed in the period t_1 for officers and directors separately. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales Officer	-14.84**	-13.06**	-13.05**	-10.58*	-12.85**	-9.679*
	(5.782)	(5.851)	(5.804)	(5.824)	(6.001)	(5.555)
Net Sales Director	10.76	1.576	2.535	2.642	3.350	2.220
	(6.517)	(7.232)	(7.332)	(7.242)	(7.181)	(7.181)
log(market value)		-0.0829***	-0.0810***	-0.0586***	-0.0592***	-0.0539***
		(0.0191)	(0.0198)	(0.0201)	(0.0208)	(0.0199)
Book-to-market ratio		-0.733***	-0.628**	-0.678***	-0.628**	-0.0294
		(0.253)	(0.252)	(0.226)	(0.250)	(0.281)
Return		-0.291	-0.238	-0.277	-0.213	-0.148
		(0.216)	(0.232)	(0.229)	(0.237)	(0.233)
Beta		-0.144*	-0.139*	-0.116	-0.142*	-0.113
		(0.0840)	(0.0839)	(0.0804)	(0.0801)	(0.0777)
Real Estate Beta		-0.0830	-0.0769	-0.0558	-0.0588	-0.0450
		(0.0931)	(0.0927)	(0.0928)	(0.0946)	(0.0879)
Asset Growth			-0.00225	-0.00115	-0.00179	-0.00322*
			(0.00206)	(0.00191)	(0.00201)	(0.00190)
TCE ratio				0.0499***		
				(0.0169)		
Short-term funding					-0.681***	
					(0.223)	
Leverage						-0.0619***
						(0.0126)
Constant	-0.312***	0.854***	0.817***	0.297	0.727***	0.681***
	(0.0385)	(0.211)	(0.213)	(0.281)	(0.214)	(0.211)
Observations	166	166	166	166	166	166
R-squared	0.026	0.186	0.196	0.245	0.229	0.271
Adjusted R-squared	0.0144	0.150	0.155	0.202	0.185	0.229

Table 1.8: OLS Results: All Banks

Table 1.8 presents OLS results with all banks. Insider trading measure is computed in the period t_2 for officers and directors separately. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2005 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from June 2005 to May 2006. Bank's equity beta is obtained from a market model of monthly returns from June 2004 to May 2006, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from June 2004 to May 2006, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2004 to the end of fiscal year 2005. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales Officer	-16.74	-13.80	-8.870	-5.720	-9.108	-8.837
	(18.35)	(15.43)	(15.71)	(17.69)	(16.44)	(15.86)
Net Sales Director	6.707	-1.537	-2.692	-2.088	-2.138	-1.458
	(8.772)	(9.267)	(9.310)	(9.711)	(9.495)	(9.404)
log(market value)		-0.0923***	-0.0915***	-0.0652***	-0.0705***	-0.0625***
		(0.0219)	(0.0223)	(0.0228)	(0.0246)	(0.0219)
Book-to-market ratio		-0.656***	-0.657***	-0.628***	-0.580**	-0.242
		(0.246)	(0.249)	(0.226)	(0.250)	(0.274)
Return		-0.143	-0.0301	-0.0822	-0.0289	-0.0528
		(0.216)	(0.234)	(0.234)	(0.225)	(0.252)
Beta		-0.0691	-0.0622	-0.0371	-0.0182	0.0267
		(0.0639)	(0.0675)	(0.0645)	(0.0725)	(0.0680)
Real Estate Beta		-0.125	-0.0724	-0.0278	-0.0206	0.0209
		(0.149)	(0.153)	(0.144)	(0.153)	(0.145)
Asset Growth			-0.00452	-0.00320	-0.00431	-0.00427
			(0.00371)	(0.00351)	(0.00372)	(0.00346)
TCE ratio				0.0497***		
				(0.0170)		
Short-term funding					-0.548*	
					(0.285)	
Leverage						-0.0467***
						(0.0131)
Constant	-0.326***	0.800***	0.818***	0.248	0.652**	0.631***
	(0.0376)	(0.232)	(0.236)	(0.310)	(0.256)	(0.238)
Observations	166	166	166	166	166	166
R-squared	0.004	0.148	0.162	0.214	0.180	0.231
Adjusted R-squared	-0.00778	0.110	0.119	0.169	0.133	0.187

Table 1.9: OLS Results: All Banks

Table 1.9 presents OLS results with all banks. Insider trading measure is computed in the period t_1 with only top five officers. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales Top	-18.88**	-18.24***	-18.92***	-15.08**	-18.69***	-14.13**
	(7.488)	(6.728)	(6.572)	(6.532)	(6.649)	(6.288)
log(market value)		-0.0839***	-0.0826***	-0.0607***	-0.0612***	-0.0558***
		(0.0187)	(0.0194)	(0.0199)	(0.0203)	(0.0195)
Book-to-market ratio		-0.738***	-0.625**	-0.675***	-0.626**	-0.0404
		(0.248)	(0.249)	(0.224)	(0.247)	(0.278)
Return		-0.276	-0.214	-0.257	-0.189	-0.132
		(0.210)	(0.222)	(0.223)	(0.228)	(0.226)
Beta		-0.141*	-0.135	-0.114	-0.138*	-0.111
		(0.0825)	(0.0826)	(0.0798)	(0.0789)	(0.0771)
Real Estate Beta		-0.0723	-0.0649	-0.0481	-0.0477	-0.0370
		(0.0910)	(0.0904)	(0.0914)	(0.0932)	(0.0867)
Asset Growth			-0.00245	-0.00134	-0.00198	-0.00335*
			(0.00197)	(0.00185)	(0.00193)	(0.00183)
TCE ratio				0.0483***		
				(0.0167)		
Short-term funding					-0.680***	
					(0.220)	
Leverage						-0.0606***
						(0.0125)
Constant	-0.310***	0.855***	0.820***	0.318	0.735***	0.688***
	(0.0356)	(0.202)	(0.205)	(0.276)	(0.206)	(0.204)
Observations	166	166	166	166	166	166
R-squared	0.027	0.192	0.204	0.250	0.237	0.275
Adjusted R-squared	0.0215	0.162	0.169	0.212	0.198	0.238

Table 1.10: OLS Results: All Banks

Table 1.10 presents OLS results with all banks. Insider trading measure is computed in the period t_2 with only top five officers. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2005 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from June 2005 to May 2006. Bank's equity beta is obtained from a market model of monthly returns from June 2004 to May 2006, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from June 2004 to May 2006, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2004 to the end of fiscal year 2005. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales Top	-63.11**	-55.03**	-46.70*	-46.06	-45.61*	-37.22
	(30.52)	(24.39)	(26.84)	(31.37)	(27.43)	(28.42)
log(market value)		-0.0928***	-0.0921***	-0.0661***	-0.0714***	-0.0635***
		(0.0216)	(0.0220)	(0.0224)	(0.0244)	(0.0217)
Book-to-market ratio		-0.619**	-0.622**	-0.592***	-0.548**	-0.226
		(0.242)	(0.247)	(0.222)	(0.246)	(0.266)
Return		-0.132	-0.0312	-0.0814	-0.0300	-0.0539
		(0.212)	(0.230)	(0.230)	(0.222)	(0.248)
Beta		-0.0659	-0.0601	-0.0354	-0.0168	0.0263
		(0.0630)	(0.0663)	(0.0639)	(0.0714)	(0.0676)
Real Estate Beta		-0.108	-0.0627	-0.0165	-0.0118	0.0259
		(0.149)	(0.153)	(0.144)	(0.152)	(0.144)
Asset Growth			-0.00402	-0.00263	-0.00383	-0.00391
			(0.00370)	(0.00349)	(0.00371)	(0.00345)
TCE ratio				0.0499***		
				(0.0159)		
Short-term funding					-0.542*	
					(0.279)	
Leverage						-0.0456***
						(0.0128)
Constant	-0.313***	0.787***	0.805***	0.238	0.642**	0.625***
	(0.0358)	(0.225)	(0.229)	(0.294)	(0.249)	(0.232)
Observations	166	166	166	166	166	166
R-squared	0.020	0.160	0.170	0.223	0.189	0.236
Adjusted R-squared	0.0144	0.128	0.134	0.184	0.147	0.197

Table 1.11: OLS Results: Large Banks

Table 1.11 presents OLS results with only large banks. Insider trading measure is computed in the period t_1 with only top five officers. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales Top	-41.42***	-33.42***	-27.49**	-23.01**	-25.12**	-23.44**
	(9.041)	(10.63)	(10.52)	(11.06)	(11.13)	(10.18)
log(market value)		-0.0780***	-0.0652**	-0.0489	-0.0548*	-0.0486*
		(0.0288)	(0.0284)	(0.0302)	(0.0287)	(0.0269)
Book-to-market ratio		-0.841***	-0.714**	-0.719**	-0.737**	-0.261
		(0.313)	(0.299)	(0.294)	(0.313)	(0.355)
Return		-0.304	-0.140	-0.158	-0.114	-0.0847
		(0.275)	(0.246)	(0.257)	(0.253)	(0.251)
Beta		0.00529	-0.0241	-0.0131	-0.0155	-0.0134
		(0.106)	(0.105)	(0.109)	(0.104)	(0.104)
Real Estate Beta		-0.0849	-0.115	-0.108	-0.0766	-0.0747
		(0.111)	(0.115)	(0.119)	(0.124)	(0.115)
Asset Growth			-0.00594***	-0.00447**	-0.00465**	-0.00574***
			(0.00214)	(0.00223)	(0.00215)	(0.00187)
TCE ratio				0.0328		
				(0.0229)		
Short-term funding					-0.505*	
					(0.265)	
Leverage						-0.0385***
						(0.0122)
Constant	-0.391***	0.714**	0.643**	0.266	0.610**	0.516*
	(0.0451)	(0.273)	(0.286)	(0.400)	(0.280)	(0.276)
Observations	89	89	89	89	89	89
R-squared	0.076	0.266	0.324	0.342	0.352	0.372
Adjusted R-squared	0.0653	0.212	0.265	0.277	0.287	0.309

Table 1.12: OLS Results: Large Banks

Table 1.12 presents OLS results with only large banks. Insider trading measure is computed in the period t_2 with only top five officers. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2005 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from June 2005 to May 2006. Bank's equity beta is obtained from a market model of monthly returns from June 2004 to May 2006, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from June 2004 to May 2006, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2004 to the end of fiscal year 2005. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Net Sales Top	-111.2***	-74.79**	-67.57*	-75.59**	-63.99*	-60.61*
	(27.35)	(28.46)	(35.49)	(34.43)	(35.45)	(31.51)
log(market value)		-0.0779***	-0.0783***	-0.0392	-0.0528*	-0.0477*
		(0.0290)	(0.0291)	(0.0301)	(0.0289)	(0.0274)
Book-to-market ratio		-0.968***	-0.961***	-0.940***	-0.886***	-0.597*
		(0.322)	(0.321)	(0.278)	(0.316)	(0.340)
Return		0.118	0.145	0.123	0.163	0.0989
		(0.277)	(0.299)	(0.313)	(0.279)	(0.335)
Beta		0.0500	0.0505	0.0964	0.120	0.169*
		(0.0773)	(0.0795)	(0.0812)	(0.0806)	(0.0872)
Real Estate Beta		-0.198	-0.194	-0.113	-0.135	-0.150
		(0.178)	(0.183)	(0.171)	(0.178)	(0.177)
Asset Growth			-0.00206	0.000271	-0.000569	-0.000936
			(0.00489)	(0.00407)	(0.00482)	(0.00458)
TCE ratio				0.0592***		
				(0.0183)		
Short-term funding					-0.669**	
					(0.257)	
Leverage						-0.0399***
						(0.0116)
Constant	-0.394***	0.733**	0.748**	-0.00951	0.534*	0.506*
	(0.0440)	(0.279)	(0.287)	(0.366)	(0.284)	(0.293)
Observations	89	89	89	89	89	89
R-squared	0.074	0.302	0.305	0.401	0.349	0.386
Adjusted R-squared	0.0638	0.251	0.245	0.341	0.284	0.325

Table 1.13: OLS Results: Large Depository Banks

Table 1.13 presents OLS results with only large depository institutions. Insider trading measure is computed in the period t_1 with only top five officers. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2004 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from January 2004 to December 2004. Bank's equity beta is obtained from a market model of monthly returns from January 2003 to December 2004, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from January 2003 to December 2004, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2003 to the end of fiscal year 2004. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail.Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Net Sales Top	-44.45***	-37.75***	-29.89***	-27.36**	-30.10**	-27.43**
	(8.549)	(11.46)	(11.02)	(11.71)	(11.38)	(12.69)
log(market value)		-0.0610*	-0.0439	-0.0366	-0.0443	-0.0543*
		(0.0307)	(0.0303)	(0.0317)	(0.0301)	(0.0300)
Book-to-market ratio		-0.802**	-0.608*	-0.633*	-0.629*	-0.209
		(0.362)	(0.356)	(0.350)	(0.369)	(0.446)
Return		-0.342	-0.133	-0.151	-0.116	-0.107
		(0.297)	(0.260)	(0.271)	(0.271)	(0.269)
Beta		0.0271	-0.0248	-0.0141	-0.0234	-0.0223
		(0.112)	(0.113)	(0.118)	(0.114)	(0.116)
Real Estate Beta		-0.148	-0.170	-0.170	-0.150	-0.145
		(0.108)	(0.114)	(0.117)	(0.129)	(0.115)
Asset Growth			-0.00676***	-0.00557**	-0.00606**	-0.00579***
			(0.00215)	(0.00229)	(0.00247)	(0.00200)
TCE ratio				0.0227		
				(0.0230)		
Short-term funding					-0.259	
					(0.418)	
Leverage						-0.0492
						(0.0317)
Constant	-0.352***	0.563*	0.449	0.225	0.481	0.618*
	(0.0463)	(0.317)	(0.342)	(0.425)	(0.338)	(0.350)
Observations	78	78	78	78	78	78
R-squared	0.085	0.228	0.308	0.317	0.312	0.330
Adjusted R-squared	0.0731	0.163	0.239	0.238	0.232	0.252

Table 1.14: OLS Results: Large Depository Banks

Table 1.14 presents OLS results with only large depository institutions. Insider trading measure is computed in the period t_2 with only top five officers. Dependent variable is bank's crisis period performance measured with the bank's stock buy-and-hold return from July 2007 to December 2008. Net Sales is the insider trading measure. Market value is the market capitalization at 2005 fiscal year end obtained by closing price at fiscal year end (prcc_f) times the number of common shares outstanding (csho). Book-to-market is the ratio of book value of equity to market capitalization. Return is the buy-and-hold return from June 2005 to May 2006. Bank's equity beta is obtained from a market model of monthly returns from June 2004 to May 2006, where the market is represented by value-weighted CRSP index. Real Estate Beta is obtained from a market from June 2004 to May 2006, where the market is represented by value weighted CRSP index and Real estate market is represented by Fama French real estate industry portfolio. The one year growth rate of bank's assets is calculated from the end of fiscal year 2004 to the end of fiscal year 2005. Tangible common equity (TCE) ratio is the ratio of common equity (ceqt) to total assets (at). Short-term funding is the ratio of debt in current liabilities (dlc) to total liabilities (lc). Quasi market value of leverage is calculates as the book value of assets minus book value of equity plus market value of equity divided by market value of equity. All variables are winsorized at 1% in each tail. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Net Sales Top	-109.7***	-72.87***	-57.74*	-73.67**	-61.25*	-65.30**
	(25.84)	(25.38)	(32.35)	(34.61)	(33.37)	(31.80)
log(market value)		-0.0335	-0.0332	-0.00686	-0.0296	-0.0370
		(0.0324)	(0.0320)	(0.0335)	(0.0314)	(0.0330)
Book-to-market ratio		-0.909***	-0.882***	-0.830***	-0.806***	-0.523
		(0.330)	(0.328)	(0.282)	(0.304)	(0.404)
Return		0.358	0.447	0.424	0.422	0.359
		(0.344)	(0.383)	(0.396)	(0.386)	(0.442)
Beta		0.166**	0.172**	0.208**	0.185**	0.253***
		(0.0818)	(0.0860)	(0.0880)	(0.0870)	(0.0929)
Real Estate Beta		-0.249	-0.239	-0.138	-0.172	-0.129
		(0.196)	(0.204)	(0.200)	(0.218)	(0.241)
Asset Growth			-0.00476	-0.00244	-0.00374	-0.00262
			(0.00501)	(0.00420)	(0.00484)	(0.00502)
TCE ratio				0.0566***		
				(0.0186)		
Short-term funding					-0.422	
					(0.441)	
Leverage						-0.0432*
						(0.0254)
Constant	-0.352***	0.270	0.285	-0.362	0.252	0.355
	(0.0461)	(0.328)	(0.331)	(0.383)	(0.324)	(0.347)
Observations	78	78	78	78	78	78
R-squared	0.079	0.291	0.306	0.400	0.315	0.348
Adjusted R-squared	0.0667	0.231	0.236	0.330	0.236	0.272

Chapter 2

INSIDER TRADING DURING INDUSTRY-WIDE FINANCIAL DISTRESS

2.1. Introduction

Insider trading literature documents that insiders are contrarian investors (Seyhun (1992); Rozeff and Zaman (1998); Lakonishok and Lee (2001)). They tend to trade against the market in the sense that they sell their own firm's shares from their portfolio following the price increase and buy following the price decrease. This paper aims at testing contrarian strategy of insiders by focusing on financial sector insiders and analysing their trading decisions in their own portfolio during the crisis period.

The 2007-2008 financial crisis provides a natural experiment to test several hypothesis. If insiders are contrarian traders I expect to see that during the crisis period insiders increase their purchase decisions as the bank stock price experienced sever drops. On the other hand, crisis is a period in which there is a high uncertainty in the whole sector. Hence, even there were massive drops in share prices, insiders could behave differently from the normal times.

The paper raises mainly the following points. Given the huge drops in bank shares prices during the crisis period, it is natural to expect insider transactions on the buy side. If in crisis period insiders follow contrarian strategy as they do in 'normal times', it is expected

that they start buying their own bank shares. This can be interpreted in a way that, insiders believe in recovery and see the drops as an advantage to increase their shares while prices are low. On the other hand, if they did not follow contrarian strategy and were reluctant to buy the shares, this can be attributed to the industry-wide financial distress and high-level of uncertainty, even for the insiders.

This paper focuses on insider trading in U.S. financial institutions that were publicly listed in one of the main exchanges(NYSE, NASDAQ or AMEX) at least during the period of 2005 - 2008. I obtain the insiders' trades from the insider trading database Thomson Financial, which provides the detailed information on each trade (transaction date, number of shares, price..etc) and also the role rank of insiders in their firm. I analyze the insider trading by pooling all insiders (officers, directors, large shareholders...etc) together.

First and foremost, this paper aims at characterizing the insider trading in financial institutions during a period of industry-wide financial distress. This period is defined as July 2007 - December 2008 (Fahlenbrach and Stulz (2011);Fahlenbrach et al. (2012)). I employ both aggregate level and cross-sectional level analysis. At aggregate level, my aim is to understand if there is any change in insider trading in the crisis period. As all the financial institutions were subject to the common shock from sector, it is natural to expect a change even at aggregate level. Secondly, cross-sectional analysis aims at establishing the relationship between firm's insider trading during the crisis period and contrarian belief proxies such as stock return performance and market-to-book ratio (Rozeff and Zaman (1998)). To the extent that insiders have contrarian beliefs on their own firm stock price performance, purchase transactions should be inversely related to the recent price change and also market-to-book ratio.

In the second step of cross-sectional analysis, I go one step-further and disentangle the market-to-book ratio into three components: firm-specific, sector-specific and growth opportunities (Rhodes-Kropf et al. (2005)). The first component captures the misvaluation driven by firm-specific errors. The second one measures the error caused by the sector-wide changes. Finally, the remaining last component is attributed to the growth opportunities once the misvaluations implied by firm-specific and sector-wide errors are extracted. Insiders that are trading in an over-heated sector should be related not only to firm-specific misvaluation but also sector-wide changes. By disenatnagling the misvaluation into three sources I will be able to analyse the ratio of purchases driven by different misvaluation characteristics.

The findings of the paper can be summarized as follows: 1) In aggregate terms, purchase

transactions in financial sector increased substantially during the crisis period that is the first evidence of contrarian strategy. 2) Insiders increased the purchase of their own bank shares more in banks that experienced more severe drops. 3) Insiders purchased more in banks that has lower market-to-book ratio in crisis. 4) Insider purchases are driven by both firm-specific errors and sector-wide misvaluation errors. These findings point out that insiders traded in a contrarian manner during the crisis period.

This paper contributes to the literature in several ways. First, the paper tests the contrarian trading hypothesis with financial sector insiders using the measures that are proposed in the literature. Second, I go one step further and disentangle the market-to-book ratio and analyse the relationship between insider trading and each component. This analysis gives us more insight about the trading strategy of insiders. Misvaluation matters not only at firm-level but also sector-level. Finally, I provide evidence form the period in which there is an industry-wide financial distress and uncertainty. It is natural to expect that the motivations of insiders could be substantially different form normal times. To analyse the insider trading in that period also helps us to deepen our understanding of the experts' view on the crisis.

The remainder of the paper is organized as follows: Section 2 provides the details of the data, including the data filtering, sample selection and definition of variables, discuss the summary statistics and explains the empirical strategy. Section 3 presents and discusses the results. Section 4 concludes.

2.2. Data and Empirical Strategy

This section first explains the data sources, filtering steps and sample selection. Next, it discuss the summary statistics of the variables and describes the empirical strategy.

2.2.1. Data

The data used in this paper come from three sources. Price and shares outstanding data come from CRSP Monthly Stock Files. Fiscal year end accounting data is obtained from CRSP/Compustat Merged database. Finally, the corporate insider transactions data comes from Thomson Financial Insider Filing Database.

I begin my analysis with the list of financial firms that were publicly traded in one of the main exchanges (NYSE, NASDAQ or AMEX) during the period of from 2005 until at least end of 2008. The financial institutions are selected based on four-digit SIC codes provided in CRSP files. The sample includes three categories as: Banks (SIC codes 6000 - 6199), Brokers (SIC codes 6200 - 6299) and insurers (SIC codes 6300 - 6499) (Billio et al. (2010)). Final sample has 557 firms. Once I obtain the list of actively traded institutions I obtain the accounting data as of fiscal year 2007 from CRSP/Compustat merged file.

At final step, I obtain corporate insider transactions data from Thomson Financial Insider Filing Database. According the Securities and Exchange Act of 1934, the term corporate insiders refers to corporate officers, directors and large shareholders who own more than 10 percent of the firms' stock. If insiders buy or sell their firms' stock, they are mandated to file with the Securities and Exchanges Commission (SEC) within the first ten days of the next month after their transactions. Starting from August 29, 2002, insiders are required to report their trades within two business day.[1] The insider trading records Thomson database provides are the transactions of persons subject to the disclosure requirements of Section 16(a) of the Securities and Exchange Act of 1934 reported on SEC Forms 3, 4, 5 and 144.

The transactions on which this paper focus come from Form 4 which is filled out when insider's ownership position changes. The information provided in Form 4 includes: the name and address of corporate insider, issuer name and ticker or trading symbol of the security, relationship of insider to the issuer (officers, directors or other positions held by insider in issuers), whether it is an acquisition or disposition, the transaction code which describes the nature of the transaction, the transaction date and price. The transaction reported on Form 4 could be a purchase, sale, option grant, option exercise, gift or any other transaction that causes a change in ownership position.

Before merging transaction data with the sample, I filter the data to eliminate the reporting errors by following Lakonishok and Lee (2001).[2] CRSP daily file is used to be able to identify and eliminate non-meaningful records. Thomson database provides eight digit CUSIP number as an identifier for each security. I merge the trade information of each security on each date with CRSP daily file using CUSIP (this step enable us to obtain permno and permco). I exclude transactions whose trade price was not within 20% of CRSP closing price on that day. I also remove trades for which the number of shares traded exceeded 20% of the number of shares outstanding as reported in CRSP. Addition-

[1] See Agrawal and Nasser (2012) and Bainbridge (2012) for an overview of insider trading regulations.
[2] See, for example, Jeng et al. (2003) for data errors documented.

ally, transactions with less than 100 shares and also all the amended records (Amendment Indicator is A) and filings marked as inaccurate or incomplete by the database are eliminated (Cleanse code is "S" or "A"). From the overall common stock trades, transactions that have incomplete information such as no date, price or amount of transactions are also excluded. As a final step, I investigate the nature of the each transaction. Among the remaining transactions, I only take into account insiders' Open Market purchases and sales. All other types of transactions, such as exercises of options, shares acquired through a plan, and so forth, are excluded since it is expected that insiders' open market sales and purchases are more likely to represent actions as a result of insider information. I further eliminate option-driven sales and include only non-option relates open-market sell transactions.[3]

Finally, one of the main trader characteristics that Thomson database provides is the role rank (data item: *rolecode*) of insiders in their firm. This data item enables us to identify exactly the position of the insider in the bank i.e. officer, director, chairman of the board, large shareholder...etc.[4] In this paper, I include all the insiders together.

2.2.2. Empirical Strategy

This section presents two approaches that are employed. First, I explain the time-series approach to test for the changes in aggregate insider trading pattern in the crisis period. Second, the cross-sectional analysis will be presented to test the contrarian strategy of insiders.

A. Time-series Analysis

The first aim of this paper is to document the patterns in aggregate insider trading. In order to do this, I conduct a simple regression analysis using the time-series of aggregate insider trading. I estimate the following regression with 30 months observation:

$$PRAT_t = \beta_0 + \beta_1 Crisis_{2007M7-2008M12} + + Market\ Return_{t-1} + \epsilon_t \tag{2.1}$$

where t denotes each month from July 2005 to December 2008. LHS variable $PRAT_t$ is the monthly aggregate insider trading measure. $Crisis_{2007M7-2008M12}$ is a dummy

[3]Thomson provides a data field which gives information whether the sale transaction is related to an option exercise. I eliminate any sale transaction if it is related to option exercise (optionsell "A" or "P").

[4]See Yermack (2009) footnote10 for insiders title reporting practices.

variable which takes value of 1 in crisis months and zero otherwise. Crisis period is defined as July 2007 - December 2008 (Fahlenbrach and Stulz (2011), Fahlenbrach et al. (2012)). Finally, $Market\ Return_{t-1}$ is the previous month return on the CRSP value-weighted market index.

In the literature, academic studies define several measures for insider trading. The number of insiders who did a transaction in a given period, number of shares sold (purchased) in a period, the dollar value of sell (purchase), the number of transactions (or separately the number of acquisitions/dispositions) are the most common ones. I use purchase ratio that is computed as follows (Seyhun (1990)):

$$PRAT_t = NP_t/(NP_t + NS_t) \tag{2.2}$$

where t denotes month and NP_t (NS_t) denotes the total number of open-market purchase (sell) transactions by all the insiders of our sample firms in month t. As this ratio does not take into account the magnitude of the transaction, it is not sensitive to the extreme values.

Panel A of Table 2.1. presents the summary statistics of the monthly time-series of insider trading measures that is computed over the period of July 2005 - December 2008. Including both the two-year pre-crisis period (July 2005 -June 2007) as well as crisis period (July 2007 - December 2008), average $PRAT_t$ is 0.62 (standard deviation 0.12). Over the period under examination, the monthly proportion of insider purchases in the whole financial industry ranges from 0.44 to 0.79. The average number of sell transactions (NS) is 250.1 (standard deviation 85.7) while the average number of purchase transactions is 432.23 (standard deviation 176.80).

The main variable of interest in Equation 2.1. is the dummy variable, $Crisis_{2007M7-2008M12}$, which takes value of 1 in crisis months and zero otherwise. Previous month return on the CRSP value-weighted market index is included in the regression to control for the influence of market-wide events on insider trading. Controlling for this effect, the coefficient on dummy variable, $beta_1$, will show us whether aggregate insider trading is different in crisis period compared to two 2-year pre-crisis period. The result of this analysis will be discussed in Section 2.3.1.

B. Cross-sectional Analysis

The aim of the cross-sectional analysis is to analyse the link between firm-level insider

trading measure and contrarian belief proxies. To do this, I first compute insider trading measure for each firm in crisis period. Then in order to test contrarian hypotheses cross-sectionally, I am going to employ two methodologies: (1) Firm's stock return performance and market-to-book ratio are going to be used as the measures of contrarian beliefs (Rozeff and Zaman (1998)) and the relationship between firm's insider trading and these proxies will be analysed. (2) I decompose firm's market-to-book ratio into three components following Rhodes-Kropf et al. (2005). The idea is to disentangle the misvaluation into firm-specific, sector-specific and growth opportunities and then to establish a link between firm's insider trading and each of the market-to-book ratio components.

Firm level insider trading measure in the crisis period is computed as follows:

$$PRAT_{i,crisis} = NP_{i,crisis}/(NP_{i,crisis} + NS_{i,crisis}) \tag{2.3}$$

where i denotes firm and $NP_{i,crisis}$ ($NS_{i,crisis}$) denotes the total number of open-market purchase (sell) transactions by all the insiders of firm i during the crisis period (July 2005-December 2012). If insiders did not engage any open-market transaction during the crisis period, the firm is included with value of zero.

Panel B in Table 2.1. presents the summary statistics of the insider trading computed for the crisis period for each financial institution in our sample. Insider trading measure *PRAT* ranges from 0 to 1. On average, 65% of the total insider transactions corresponds to purchase. The average number of sell transactions is 6.98 (standard deviation 13.07) and average purchase transactions is 16.69 (standard deviation 22.22).

B.1. Crisis period stock performance and Market-to-Book ratio

This section explains the methodology employed in the first approach. In order to analyse the relationship between firm's insider trading in crisis period and contrarian belief measures i.e. firm's crisis period performance and firm's market-to-book ratio, I estimate the following cross-sectional regression:

$$\begin{aligned} PRAT_{i,crisis} = \beta_0 + \beta_1 RET\_MEDIUM_{i,crisis} + \beta_2 RET\_TOP_{i,crisis} \\ + \beta_3 MTB\_MEDIUM_{i,2007} + \beta_4 MTB\_TOP_{i,2007} + \epsilon_i \end{aligned} \tag{2.4}$$

where i denotes each firm and $PRAT_{i,crisis}$ is the firm i's insider trading measure computed in crisis period. I divide the financial institutions in the sample into three groups based on their crisis period stock performance. The indicator variables $RET\_MEDIUM_{i,crisis}$ and $RET\_TOP_{i,crisis}$ are equal to one if the the firm's stock performance is in the mid-

dle and top third of all sample firms, zero otherwise. Similarly, the sample divided into three based on the market-to-book ratio as of fiscal year 2007. The indicator variables $MTB\_MEDIUM_{i,crisis}$ and $MTB\_TOP_{i,crisis}$ are equal to one if the firm's market-to-book ratio ranks in the middle and top third of all sample firms and zero otherwise.

Crisis period firm's stock performance is measured with annualized buy-and-hold return from July 2007 to December 2008 (Fahlenbrach and Stulz (2011);Fahlenbrach et al. (2012)). Table 2.2. shows that on average financial institutions lost 34% during the crisis (standard deviation 29%). If insiders trade based on contrarian strategy in the crisis period then one would expect to see that purchase ratio will monotonically across the firms as firm's performance rank changes from high to low. I test for this by estimation equation 2.4. with only performance group indicators ($RET\_MEDIUM_{i,crisis}$ and $RET\_TOP_{i,crisis}$).

Market-to-book is the ratio of market value to book value of equity as of 2007 fiscal year-end. Market value of equity is obtained from CRSP monthly stock file as of June 2008 (shares outstanding (shrout) $\times$ price (prc)). Book value of equity is equal to common equity (compustat item 60). To the extent that insiders trade based on the deviation of market value from book value (misvaluation), I expect to observe relationship between insiders' purchase transactions and market-to-book ratio.

B.2. Market-to-Book Decomposition

Finally, in order to deepen our understanding of insider trading motivations during the period of industry-wide distress, I decompose market-to-book ratio into three components following Rhodes-Kropf et al. (2005). To test the relationship between insider trading and firm's valuation characteristics i.e. the three components of market-to-book ratio I estimate the following cross-sectional regression:

$$PRAT_{i,crisis} = \beta_0 + \beta_1 Misvaluation\_Firm_{i,2007} + \beta_2 Misvaluation\_Sector_{i,2007} + \beta_3 Growth\_Opportunity_{i,2007} + Controls_{i,2007} + \epsilon_i \tag{2.5}$$

where i denotes each firm. $PRAT_{i,crisis}$, that is the firm i's insider trading measure computed in crisis period (same as equation 2.4), regressed on the there components of firm's market-to-book ratio and control variables.

Initially market-to-book ratio can be written as a function of two components: market value-to-true value and true value-to-book value. In logarithms this can be written as

follows:

$$m - b = (m - v) + (v - b) \tag{2.6}$$

where m is market value of equity, b is book value and v is a measure of true value of firm. Further, (m-v) is disentangled into two components in such a way that one component capture the common component shared by all the firms in the same sector while the second one is firm-specific.[5] With this further separation, we end up with three components: firm-specific misvaluation, sector-level misvaluation and growth opportunity. Hence, for each firm i and fiscal year t Market-to-Book ratio can be written as :

$$m_{it} - b_{it} = Misvaluation\_Firm_{it} + Misvaluation\_Sector_{it} + Growth_{it} \tag{2.7}$$

Firm-specific misvaluation (*Misvaluation_Firm*) is defined as the difference between the market value and fundamental value of the firm. In order to estimate the fundamental value of the firm i the equation below is used (Model 3 in Rhodes-Kropf et al. (2005)):

$$m_{it} = \alpha_{0,jt} + \alpha_{1,jt} b_{it} + \alpha_{2,jt} ln(NI)^{+}_{it} + \alpha_{3,jt} I_{<0} ln(NI)^{+}_{it} + \alpha_{4,jt} Lev_{it} + \epsilon_{it} \tag{2.8}$$

m_{it} is the natural logarithm of the market value, b_{it} is the natural logarithm of the book value, $(NI)^{+}_{it}$ is the absolute value of net income, $I_{(<0)} ln(NI)^{+}_{it}$ is the negative income indicator interacted with log net income and Lev_{it} is the book leverage ratio.[6] The model assumes that market value is the function of book value, net income and leverage. I compute firm level mispricing by estimating the Equation (6) for fiscal year 2007 with all the financial institutions included in the sample. The residuals obtained from this cross-sectional regression is the firm specific misvaluation i.e. deviation of market value from fundamental value. .

The sector-wide misvaluation (*Misvaluation_Sector*), also defined as time series sector error, is the difference between fundamental value and long-run value. Fundamental value is the predicted value obtained from Equation (6) conditional on time t fundamentals. On the other hand, long-run value is the value obtained with time t-fundamentals but using long-run industry multiples. To obtain the long-run coefficients, I estimated Equation (6) for each year between 2003 to 2006 that can be defined as normal times and then take the

[5] See, Rhodes-Kropf and Viswanathan (2004) for the discussion of sector-wide and firm-specific misvaluation.

[6] Rhodes-Kropf et al. (2005) estimates this equation for each industry (j) and each year (t). Then the coefficients obtained are used with firm-level accounting variables. As I am only interested in 2007 and only with the financial sector, I directly estimate this equation to compute fundamental value in fiscal year 2007.

average of the coefficients.[7] Using these average coefficients with accounting variables as of 2007, I estimate long-run value for each firm. The deviation of fundamental value from the long-run value is attributed to the sector-wide changes.

Last component, growth opportunity ($Growth_{it}$) is the difference between long-run fundamental value that is computed using long-run coefficients and book value (b_{it}).

Table 2 presents the summary statistics of the characteristics of financial institutions. Market value of equity is common shares outstanding(shrout) $\times$ price(prc) as of June 2007. Market value of assets is market value of equity plus book value of assets (at) minus book equity (ceq) and minus deferred taxes (dftx). Book leverage is equal to 1 minus the ratio of book equity to book value.

Control variables

In all regressions, I include firm's crisis period performance that is measured with annualized buy-and-hold stock return from July 2007 to December 2008. On average the banks in our sample lost 34% during the crisis. Previous period price run-up is measured with 12 month buy-and-hold return from (from July 2006 to June 2007).[8] To control for risk, I include both the standard deviation of monthly stock return in crisis period and past one year period (July 2006-June 2007). The annualized volatility of monthly stock performance in crisis is 0.09 while it is 0.05 in the previous 12 month period. The volatility of stock return proxies for firms operating in more uncertain and unpredictable environments.

2.3. Results

This section first documents the results of aggregate level analysis. Then I present the cross-sectional results analysis between insider trading in the crisis period and valuation measures.

[7] For each year I include all the financial institutions with relevant SIC code.

[8] As a robustness check I also include 24 months buy-and-hold return (from July 2005 to June 2007)

2.3.1. Time-Series Analysis

Table 2.3. presents the monthly time-series regression results of insider trading measures on the previous month market return together with a dummy variable that takes value of 1 for months in the period of July 2007-December 2008. The dependent variable in column 1 is the total number of purchase transactions in month t. The coefficient on crisis dummy variable is positive and significant at 1% significance level. This shows us that the number of purchase transactions increase substantially in the crisis period compare to pre-crisis period that is represented with 12 months before the crisis started (July 2006 - June 2007). The second column shows the regression results of the number of sell transactions on the dummy variable. Negative and highly significant coefficient suggests that on average insiders engage significantly less sell transactions during the crisis period.

Through column three to five the dependent variable is the purchase ratio, $PRAT_t$, computed at aggregate level in each month t (equation 2.2.). I include one-month lag market return in column four and also contemporaneous market return in column five. In this case the adjusted R-square of the model is 0.639. In all cases, the coefficient on crisis period dummy variable is positive and statistically significant at 1% significance level.

This section characterizes the aggregate insider trading activity in financial sector during the recent crisis. The time-series regression results show that financial sector insiders increase the number of purchase transactions substantially during the crisis.

2.3.2. Cross-Sectional Analysis

This section aims at understanding the differences in insider trading behaviour across firms in times of industry-wide distress.

Crisis period stock performance and Market-to-Book ratio

I begin the cross-sectional analysis first analysing the relationship between firm's crisis period insider trading and contrarian belief proxies.

The first proxy for the contrarian belief is the firm's market-to-book ratio. The first column in Table 2.4. shows the results of regressing insider trading measure on firm's market-to-

book rank indicators. The intercept measures the average fraction of buy transactions in the low market-to-book stocks. The average value of PRAT in this group is 80.7%. The coefficients on the dummy variables for medium and top rank indicators are negative. The coefficient for the first group is 0.323% and statistically significant at 1% significance level. The decreasing coefficients implies that insider's purchase transactions are significantly decreasing as firm's market-to-book ratio changes from low to high. Adjusted R-square of the model is 0.138.

The second column of the same table presents the regression results of insider trading measure on the two performance group indicators. The model has adjusted R-square of 0.084. The intercept shows that on average the purchase ratio in the worst performers sample is 76.7%. All the coefficients are statistically significant at 1% significance level. The decreasing coefficients implies that purchase ratio is significantly higher in the worst performed financial institutions.

In the third column I include indicators of both performance and market-to-book ratio (equation 2.4.). Adjusted R-square of the model is 0.147. The intercept represents lowest market-to-book and lowest stock performance category. It shows that in this group on average insider purchase ratio is 82.3%. In general the patterns that we observe in column 1 and 2 remains same in column 3.

This section results points out that insider purchases inversely related to contemporaneous crisis period stock return performance (July 2007-December 2008) and also firm's market-to-book ranking.

Market-to-Book Decomposition

In order to disentangle the market-to-book ratio, first step is to estimate firm's fundamental value. Table 2.5. presents the cross-sectional regression results of firm's fundamental valaue for each year from 2003 to 2007 (equation 2.8). We observe that the adjusted R-square in all years are the above 90%. This shows the importance of the accounting variables and leverage for explaining the cross-sectional variation in market values. The coefficients can be directly comparable with the estimation results of Rhodes-Kropf et al. (2005) for financial sector. Both the sign and magnitude of each coefficient are very similar. The coefficient on net income for positive values is positive while it becomes negative for negative realizations. Not surprisingly, the coefficient on leverage is negative.

Firm-specific error is the residuals obtained from the regression presented in column 5.

The market value as of June 2008 June regressed on the accounting variables as of 2007 fiscal-year end. Hence the residuals represent the deviation of market-value from the fundamental value.

In order to compute the long-run fundamental value we estimate the same regression for each year from 2003 to 2006 with all the financial institutions that has accounting and market value data available in those years. Hence, the sample in those regressions are not restricted to the sample of this paper. Long-run coefficients are the average value of the coefficients over these four regressions that are presented through column 1 to 4 in table 2.5. Long-run fundamental value is obtained using these coefficients together with accounting and leverage data from fiscal-year 2007. Finally, growth component is computed using this long-run fundamental value.

Table 2.6. presents the regression results of the firm i's insider trading measure on market-to-book ratio components. The first column shows that cross-sectionally insider's purchase ratio is negatively correlated with market-to-book ratio. Through column 2 to 4 I present the regression results of insider trading measure on each of the market-to-book ratio components. We observe negative relationship between insiders' crisis period purchase ratio and each component. Column five includes all the components and also control for stock performance in the crisis period. The results are both statistically and economically significant. The coefficient on firm-specific misvaluation measure is -0.120 (with robust s.e. 0.0293) and statistically significant at 1% significance level. One standard deviation (0.61) movement in this variable leads 7.32% (-0.120 $times$ 0.61) decrease in purchase ratio. The sector-wide misvaluation measure coefficient is -0.719 (with robust s.e. 0.125). One standard deviation movement in this variable (0.12) associates to the 8.63% drop in insider's purchase transactions. The coefficient on the last component, growth, is -0.209 (with robust s.e. 0.0375) and one standard deviation movement (0.39) implies 8.15% decrease in purchase ratio. These results suggest that insiders trade based on the misvaluation and decomposition analysis shows that both firm specific and sector-wide misvaluation matters.

2.3.3. Robustness Checks

In order to show that the results are not sensitive to the choice of insider trading measure, I replicate the analysis with a different measure. The second insider trading measure, *SPRAT*, is similar to the first one, *PRAT*, but instead of using the number of transactions,

I use the number of shares purchased (sold) (Seyhun (1990); Piotroski and Roulstone (2005)).

The measure computed monthly defined as follows:

$$SPRAT_t = SP_t/(SP_t + SS_t) \tag{2.9}$$

where t denotes month and SP_t (SS_t) denotes the total number of shares purchased (sold) in open-market transactions by all the insiders of our sample firms in month t.

For the cross-sectional analysis, the firm's insider trading measure in crisis period is computed as follows: :

$$SPRAT_{i,crisis} = SP_{i,crisis}/(SP_{i,crisis} + SS_{i,crisis}) \tag{2.10}$$

where i denotes firm and $SP_{i,crisis}$ ($SS_{i,crisis}$) denotes the total number of shares purchased (sold) in open-market transactions by all the insiders of firm i during the crisis period.

Both time-series and cross-sectional analysis results remained unchanged with this alternative measure of insider trading. Table 2.7. presents the cross-sectional regression results.

Further, I conduct robustness checks with market values in different months to compute market-to-book ratio. Instead of using market value as of June 2008, I also replicate the analysis with market value as of January 2008 and March 2008. The results are the same.

2.4. Conclusion

This paper analyses financial sector insiders' trading in their own firm stock during the crisis period, July 2007- December 2008. To characterize the insider trading in this period I first analyse the patterns in aggregate insider trading in the financial sector. Time-series analysis results show that financial insiders significantly increase the purchase transactions i.e. they react to severe price drops by increasing their stake in bank shares in their portfolio. This result can be interpreted as the first evidence of contrarian trading strategy.

In the second step, firm-level cross-sectional analysis is performed. I analyze the rela-

tionship between firm's insider trading in the crisis period and contrarian belief proxies. For each firm I compute insider trading measure using the transactions held between July 2007 and December 2008 by all the insiders in the firm. The results suggest that insiders increased purchase transactions in firms that performed worse. Hence, purchase ratio is negatively related to the bank stock performance that is measure with annualized buy-and-hold return during the crisis period. Further, the results points that insider trading is also inversely related to the firm's market-to-book ratio. Univariate analysis shows that insider purchases increase monotonically as firm's market-to-book ratio as of 2007 fiscal year-end decreases. These results suggest that insiders trade based on the misvaluation and decomposition analysis shows that the portion of insider purchases is driven by both firm-specific and sector-specific misvaluation.

2.5. TABLES

Table 2.1: Summary Statistics: Insider Trading

This table presents summary statistics of insider trading measures. Panel A shows statistics of monthly times series from July 2005 to December 2008. $PRAT_t = NP_t/(NP_t + NS_t)$ where t denotes firm and NP_t (NS_t) denotes the total number of shares purchased (sold) in open-market transactions by all the insiders in month t. $SPRAT_t = SP_t/(SP_t + SS_t)$ where t denotes month and SP_t (SS_t) denotes the total number of shares purchased (sold) in open-market transactions by all the insiders of our sample firms in month t. Panel B shows the firm-level crisis period insider trading measures. The first measure at firm-level defined as $PRAT_i = NP_{i,crisis}/(NP_{i,crisis} + NS_{i,crisis})$ where ıdenotes each firm and $NP_{i,crisis}$ ($NS_{i,crisis}$) denotes the total number of open-market purchase (sell) transactions by all the insiders of firm i during the crisis period. The second measure is $SPRAT_i = SP_{i,crisis}/(SP_{i,crisis} + SS_{i,crisis})$ where i denotes each firm and $SP_{i,crisis}$ ($SS_{i,crisis}$) denotes the total number of shares purchased (sold) in open-market transactions by all the insiders of firm i during the crisis period. Crisis period is defined as July 2007 - December 2008.

	# of Obs.	Min	Max	Average	Standard deviation
Panel A:					
NS	30	116.00	461.00	250.10	85.70
NP	30	213.00	868.00	432.23	176.80
Total_Transaction	30	416.00	1150.00	682.33	198.65
PRAT	30	0.44	0.79	0.62	0.12
SS	30	1479109.52	32850063.62	8014503.77	8134531.13
SP	30	265148.95	1.02e+08	11270398.60	23376072.57
Total_Shares	30	3536615.25	1.05e+08	19284902.31	23181568.78
SPRAT	30	0.02	0.97	0.44	0.29
Panel B:					
NS	557	0.00	130.00	6.98	13.07
NP	557	0.00	188.00	16.69	22.22
Total_Transaction	557	0.00	223.00	23.68	25.08
PRAT	557	0.00	1.00	0.65	0.35
SS	557	0.00	20406669.00	158738.88	948270.94
SP	557	0.00	79030424.00	513385.34	5201501.00
Total_Shares	557	0.00	84631104.00	672124.21	5432525.11
SPRAT	557	0.00	1.00	0.58	0.39

Table 2.2: Summary Statistics: Characteristics of Financial Institutions

This table presents summary statistics of bank characteristics. Accounting variables are as of 2007 fiscal year. Misvaluation_Firm is the fundamental value of firm defined as the residuals(difference between market value and fundamental value) obtained from $m_{it} = \alpha_{0,jt} + \alpha_{1,jt} b_{it} + \alpha_{2,jt} ln(NI)^{+}_{it} + \alpha_{3,jt} I_{<0} ln(NI)^{+}_{it} + \alpha_{4,jt} Lev_{it} + \epsilon_{it}$ where m_{it} is market value of assets(log), b_{it} is the book value of assets(log)(item 6), $ln(NI)^{+}_{it}$ is the logarithm of absolute value of net income(item 172), $I_{<0} ln(NI)^{+}_{it}$ is an indicator for negative net income observations and Lev_{it} is the book leverage. Market value of assets (m_{it}) is CRSP market equity (common shares outstanding(shrout) $\times$ price(prc)) plus Compustat book assets (item 6) minus deferred taxes (item 74) minus book equity (item 60). Book leverage(Lev_{it}) is (1-book equity/book assets). Fundamental_Firm is the fundamental value of the firm that is the predicted y in the above equation. Growth is the difference between long-run fundamental value and book assets(item 6). Crisis period performance is the annualized buy-and-hold stock return from July 2007 to December 2008. Crisis period volatility is the annualized standard deviation of monthly returns over the crisis months. Pre-crisis return is the buy-and-hold return from July 2006 to June 2007 and pre-crisis volatility is the standard deviation of monthly returns in the same period.

	# of Obs.	Min	Max	Average	Standard deviation
Market-to-Book	557	0.24	5.96	1.26	0.99
Firm-specific	557	-3.09	2.79	0.00	0.61
Sector-specific	557	-0.70	0.19	-0.47	0.12
Growth	557	-1.31	1.46	0.49	0.39
Market Value of Equity	557	15.72	33539.01	2464.35	6592.92
Total Assets	557	114.13	558562.00	23732.20	88060.31
Common Equaity	557	19.89	27098.00	1956.56	5192.17
NI-et Income	557	-170.11	4012.00	236.16	727.64
Book Leverage	557	0.32	0.95	0.84	0.14
Crisis performance	557	-0.96	0.42	-0.34	0.29
Pre-crisis Return	557	-0.53	5.23	0.05	0.31
Pre-crisis volatility	557	0.01	0.29	0.05	0.03
Crisis volatility	557	0.01	0.35	0.09	0.04

Table 2.3: Aggregate Insider Trading

This table presents the monthly time-series regression results. In all column the dependent variable is the monthly insider trading measure that is computed at aggregate level for each month between July 2005 and December 2008 as $PRAT_t = NP_t/(NP_t + NS_t)$. NP_t (NS_t) denotes the total number of open-market purchase (sell) transactions by all the insiders in month t. Crisis period is defined as July 2007 - December 2008. Crisis is a dummy variable takes value of one in months from July 2007 to December 2008. Market return is monthly return of CRSP value-weighted market index obtained from CRSP monthly index file and lag corresponds to previous month. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES					
Crisis	210.9***	-85.11***	0.192***	0.190***	0.193***
	(47.26)	(30.27)	(0.0242)	(0.0311)	(0.0295)
Lag Market Return				-0.0461	-0.0855
				(0.227)	(0.308)
Market Return					0.116
					(0.387)
Constant	305.7***	301.2***	0.506***	0.507***	0.506***
	(23.04)	(26.31)	(0.0170)	(0.0176)	(0.0176)
Observations	30	30	30	30	30
Adjusted R-squared	0.330	0.218	0.662	0.650	0.639

Table 2.4: Insider Trading and Contrarian Strategy

This table presents the cross sectional regression results of insider trading measure over book-to-market and crisis period performance indicators. The dependent variable is the firm-level crisis-period insider trading measure computed as $PRAT_i = NP_{i,t}/(NP_{i,t} + NS_{i,t})$ where ıdenotes each firm and $NP_{i,crisis}$ ($NS_{i,crisis}$) denotes the total number of open-market purchase (sell) transactions by all the insiders of firm i during the crisis period. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)
VARIABLES			
Market-to-Book_Medium	-0.162***		-0.121***
	(0.0331)		(0.0379)
Market-to-Book_Top	-0.323***		-0.262***
	(0.0322)		(0.0430)
Return_Medium		-0.109***	-0.0380
		(0.0347)	(0.0371)
Return_Top		-0.254***	-0.111**
		(0.0333)	(0.0436)
Constant	0.807***	0.767***	0.823***
	(0.0202)	(0.0220)	(0.0211)
Observations	557	557	557
Adjusted R-squared	0.138	0.084	0.147

Table 2.5: Fundamental Value of Firm

This table presents the cross-sectional regression results of the following equation in each year from 2003 to 2007: $m_{it} = \alpha_{0,jt} + \alpha_{1,jt} b_{it} + \alpha_{2,jt} ln(NI)^{+}_{it} + \alpha_{3,jt} I_{<0} ln(NI)^{+}_{it} + \alpha_{4,jt} Lev_{it} + \epsilon_{it}$ where m_{it} is market value of assets(log), b_{it} is the book value of assets(log)(item 6), $ln(NI)^{+}_{it}$ is the logarithm of absolute value of net income(item 172), $I_{<0} ln(NI)^{+}_{it}$ is a negative net income indicator interacted with log net income and Lev_{it} is the book leverage. Market value of assets (m_{it}) is CRSP market equity (common shares outstanding(shrout) $\times$ price(prc)) plus Compustat book assets (item 6) minus deferred taxes (item 74) minus book equity (item 60). Book leverage(Lev_{it}) is (1-book equity/book assets). Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	2003	2004	2005	2006	2007
Total Asset(log)	0.616***	0.531***	0.549***	0.557***	0.630***
	(0.0228)	(0.0257)	(0.0278)	(0.0280)	(0.0550)
Net Income(log)	0.379***	0.435***	0.421***	0.418***	0.356***
	(0.0203)	(0.0227)	(0.0244)	(0.0238)	(0.0467)
I*Net Income(log)	-0.149***	-0.158***	-0.176***	-0.209***	-0.184***
	(0.0246)	(0.0368)	(0.0369)	(0.0326)	(0.0599)
Book Leverage	-2.352***	-1.970***	-2.459***	-2.920***	-3.512***
	(0.125)	(0.125)	(0.144)	(0.147)	(0.311)
Constant	2.185***	2.323***	2.666***	2.913***	2.634***
	(0.1000)	(0.103)	(0.0990)	(0.104)	(0.230)
Observations	866	829	824	808	557
Adjusted R-squared	0.937	0.931	0.936	0.935	0.901

Table 2.6: Insider Trading and Market-to-Book Components

This table presents the cross-sectional regression results of insider trading over stock performance and market-to-book components. In all regressions the dependent variable is insider trading measure: $PRAT_i = NP_{i,crisis}/(NP_{i,crisis} + NS_{i,crisis})$ where ıdenotes each firm and $NP_{i,crisis}$ ($NS_{i,crisis}$) denotes the total number of open-market purchase (sell) transactions by all the insiders of firm i during the crisis period. Crisis period is defined as July 2007 - December 2008. Crisis performance is the annualized buy-and-hold return from July 2007 to December 2008. Pre-crisis return is the buy-and-hold return from July 2006 to June 2007. Pre-crisis volatility is the standard deviation of monthly stock return from July 2006 to June 2007. Crisis volatility is the annualized standard deviation of monthly stock return from July 2007 to December 2008. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Firm-specific		-0.149***			-0.120***	-0.130***
		(0.0257)			(0.0293)	(0.0320)
Sector-specific			-0.547***		-0.719***	-0.694***
			(0.136)		(0.125)	(0.131)
Growth				-0.182***	-0.209***	-0.205***
				(0.0335)	(0.0375)	(0.0400)
Crisis performance					-0.188***	-0.281***
					(0.0625)	(0.0638)
Crisis volatility						-1.347***
						(0.394)
Pre-crisis return						-0.0706
						(0.0596)
Pre-crisis volatility						0.283
						(0.503)
Market-to-book	-0.128***					
	(0.0148)					
Observations	557	557	557	557	557	557
Adjusted R-squared	0.128	0.065	0.032	0.039	0.185	0.200

Table 2.7: Insider Trading and Market-to-Book Components

This table presents the cross-sectional regression results of insider trading over stock performance and market-to-book components. In all regressions the dependent variable is the insider trading measure: $SPRAT_i = SP_{i,crisis}/(SP_{i,crisis} + SS_{i,crisis})$ where i denotes each firm and $SP_{i,crisis}$ ($SS_{i,crisis}$) denotes the total number of shares purchased (sold) in open-market transactions by all the insiders of firm i during the crisis period. Crisis period is defined as July 2007 - December 2008. Crisis performance is the annualized buy-and-hold return from July 2007 to December 2008. Pre-crisis return is the buy-and-hold return from July 2006 to June 2007. Pre-crisis volatility is the standard deviation of monthly stock return from July 2006 to June 2007. Crisis volatility is the annualized standard deviation of monthly stock return from July 2007 to December 2008. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Firm-specific		-0.169***			-0.118***	-0.126***
		(0.0306)			(0.0339)	(0.0375)
Sector-specific			-0.438***		-0.617***	-0.567***
			(0.146)		(0.133)	(0.141)
Growth				-0.200***	-0.203***	-0.193***
				(0.0389)	(0.0421)	(0.0452)
Crisis performance					-0.283***	-0.383***
					(0.0679)	(0.0711)
Crisis volatility						-1.302***
						(0.482)
Pre-crisis return						-0.0602
						(0.0616)
Pre-crisis volatility						-0.108
						(0.518)
Market-to-book	-0.137***					
	(0.0170)					
Observations	557	557	557	557	557	557
Adjusted R-squared	0.118	0.068	0.016	0.038	0.178	0.190

Chapter 3

MORTGAGE BOOM AND BUST: LOAN-LEVEL EVIDENCE FROM SPAIN(WITH J.G. MONTALVO, J.G. VILLAR, J-L PEYDRÓ AND J.M. RAYA)

3.1. Introduction

In the last quarter of 2008 the economies of the United States and Western Europe were overwhelmed by a banking crisis, which was followed by a severe economic recession - that still lasts in Spain. This sequence of events was not unique: Banking crises are recurrent phenomena, often-triggering deep and long-lasting recessions (Reinhart and Rogoff (2009); Schularick and Taylor (2012)). A weakening in banks' balance-sheets may lead to a contraction in the supply of credit and to a slowdown in real activity (Bernanke (1983)). Moreover, highly leverage non-financial borrowers may face tightened lending conditions in crises due to a debt overhang problem (Myers (1977)). Importantly, banking crises are not random exogenous phenomena, but regularly come on the heels of periods of strong credit growth (Kindleberger (1978); Schularick and Taylor (2012); Gourinchas and Obstfeld (2012)). Thus, to understand banking crises, it is outmost importance to analyse credit conditions both in good and bad times.

As in other important banking crises in history, the boom and the bust in the housing market, and the associated credit cycle, seem the main drivers of the crisis that hit USA, Ireland, UK and Spain, among other countries, in 2007-8. It is therefore crucial to answer the following questions: Were the lending conditions and standards to housing loans too soft in the boom? Did all banks behave similarly or were there differences? Were pervasive bank incentives present in the boom? Did they contribute to the housing and credit bubble? If so, how did banks circumvent the regulatory constraints? Did the lending standards tighten in the crisis?

Spain offers an excellent setting to analyse these questions. Spain, a bank dominated economy, suffered one of the highest boom and bust in the housing and credit market over the last 10 years. Household mortgages were at the peak 65% of the GDP and loans to real estate developers and construction firms accounted for another 45% of the GDP. Therefore, the size of the loans' pool related directly with real estate activities (production and transactions) amounted to more than 100% of GDP.

Despite the importance of this concentration of banking risk on the real estate sector, there is scant evidence identifying the channels that explain the real estate credit boom. The main reason is the lack of statistical information on many issues related with the Spanish real estate.[1] We have access to a unique dataset on mortgage loans from 2005 to 2010 matched with borrower and lender identity for 30,262 mortgage loans. The loan-level dataset contains the loan price (spread), volume and market price and appraisal value of the house. Moreover, we know the identity of the lender and, therefore, we can classify the lender as a commercial bank, a savings bank (caja de ahorros) and a non-bank financial institution(financiera), and also exploit the variation across banks in the ex-post (revealed) risks that they took (whether banks were rescued or intervened). Finally, we know crucial characteristics of the borrower such as labour contract (temporal vs. long-term difficult-to-fire), income, education, age, sex, province, etc. In addition, we have been able to match the previous information with data on other indicators of prices from administrative records.

We first analyse - at the loan level - credit conditions (both LTVs and loan spreads) in both good (2005:Q1-2007:Q2) and bad (2007:Q3-2010:Q4) times. We find robust evidence that lending conditions and standards were softer in the boom than in the bust. For example, household income and labour contract/status matter more for LTV and loan pricing

[1]Note that even the Spanish house price indices are based on appraisals or administrative prices. None of them take market prices as their basic source. In fact, the dataset used in our paper is the first one that contains market prices of Spanish properties for a large sample of dwellings and also the first paper using loan-level data with loan volumes and prices.

in the bust than in the boom. Moreover, despite some adjustment in lending conditions in the good times depending on household risk, we uncover too soft lending standards (excessive bank pro-cyclically/risk-taking) in some loan margins in the boom. Controlling for other key borrower variables as income, workers with temporal contracts get the same LTVs (both statistically and economically speaking) as workers with long-term difficult-to-be-fired contracts. In the crisis, temporal workers instead obtain less LTVs and pay substantially more than permanent ones. Finally, controlling for borrowers' fundamentals and other characteristics, we find that banks that were rescued in the crisis with the Spanish TARP (called FROB) took excessive risk in the boom by increasing substantially LTVs.

How could banks overpass the tough regulation in terms of LTVs? Was the competition in Spain higher in pricing or in loan volumes? How did banks contribute to the real estate bubble, both in terms of real estate pricing and mortgage loan volumes? In the last part, we analyse the key mechanism that explains the build-up of the credit and housing bubble in the Spanish case.

The specific agency mechanism that inflated the bubble in the US was quite different from the forces at work in the Spanish case. In both cases, lax standards and excessive credit were the ultimate causes of the house price inflation.[2] However, in the case of the US, those lax standards for mortgage granting were the result of perverse incentives in the housing finance sector related with the securitization process, and the possibility of taking out of the banks' balance sheets the securitized mortgages.

We show evidence in this paper consistent with an alternative channel for Spain: appraisers were encouraged to introduce an upward bias in appraisal prices to satisfy their owners or most important clients. Theoretically, this mechanism has a potential obstacle: the appraiser's judgement. An appraiser is supposed to value homes as if they were purchased for cash, without any financial or other incentives to the buyer (Fannie Mae 2005, 2007).[3] However, appraisers' incentives in Spain were distorted as financial institutions own most of the appraisal firms (or are crucial clients for these firms). During the boom period, appraisers had the incentive to approve even an inflated transaction price in order to satisfy its client (financial institutions) by allowing the borrower to obtain a high mortgage volume by adjusting the actual loan to value of the mortgage when the borrower did not have

[2]For the US case, see Mian and Sufi (2009) and Keys et al. (2010). For the European (including Spain) versus the US case, see Maddaloni and Peydró (2011).

[3]LaCour-Little and Malpezzi (2003) find a positive association between the quality of appraisals and mortgage defaults. Lang and Nakamura (1993) already pointed that, in this case, the bank would require a larger down-payment.

enough resources for the down payment, thereby circumventing regulatory restrictions.[4] As the appraisal price was the price used by financial institutions to determine the loan to value ratio, this artificial increase in appraisal prices permit to draw larger mortgages. All in all, upward bias in appraisals prices has been one of the perverse incentives chain underlying the real-estate and credit boom and crisis.[5]

Our paper contributes to the literature in two ways. First, there are several papers analysing the lending conditions and standards in the Spanish market (Jiménez et al. (2012), Jiménez et al. (2013),Jiménez et al. (Forthcoming)), but these papers only analyse business loans and do not analyse loan prices. Second, there are papers analysing mortgage loans in other countries; in particular, Besley et al. (2012) analyse UK mortgages, but do not compare lending standards in boom versus bust (see Peydró (2012)) nor identify the key mechanism by which banks drive the housing and credit bubble, which is our second main contribution. We identify the specific mechanism that led to the creation of a large credit and housing bubble in Spain. Opposite to the US case, the Spanish banking regulation has a much larger regulatory perimeter for banks than the US, and therefore it does not foster the creation of shadow banking activities.[6] In addition, Spain was pioneer on the use of countercyclical buffers. Despite these regulatory constrains Spain could not avoid a credit and housing bubble. The mechanism did not rely on the lack of incentive for monitoring the quality of mortgages but the ability of financial institutions to influence the valuations of properties by the appraisal companies.

The paper proceeds as follows. Section 2 discusses the Spain's housing and credit boom and bust. Section 3 introduces the data and empirical strategy. Section 4 presents and discusses the results. Section 5 concludes.

3.2. The housing and credit markets in Spain

During the first decade of this century, Spain has experienced one of the most important housing booms among developed economies. This housing boom was one of the main engines for economic growth in Spain. In fact, during the period 2002-2006 the growth

[4]The Bank of Spain recommends not to grant credits over 80% of the value of the property and covered bonds, a key source of financing for banks, was easier if collateralized with mortgages with LTVs lower than 80%.

[5]See also García-Montalvo (2009).

[6]While in the US the business model during that period was "originate to distribute", in Spain the model was "originate to hold".

of the construction sector explained around 20% of GDP growth. During many years, the production of new dwellings in Spain was higher than the sum of the new dwellings in Germany, France and Italy. The boom was the highest in 2005-10. For example, in 2006 the official statistics on housing initiations reached 860.000 dwellings. This housing boom engendered a housing price bubble that starting to burst in 2008. Between 1998 and 2008, the housing prices in Spain tripled. The average number of conceded mortgages was of more than 1.1 million per year. These amounts are quite remarkable if we consider that in Spain the annual average number of households in that period was of 15.5 million.

Likewise, these amounts were also possible by a very strong competition in the mortgage origination business. Spanish Financial institutions offered the lowest mortgage rates of the Euro area. In fact during the period 2003-06 the average mortgage rate in the Euro area was 4.51 while the average in Spain was 3.71. The average Euro-area mortgage rate was 21% higher than the Spanish counterpart. Given this small loan spread in Spain, the competition took place through massive origination of mortgages (loan volumes). This competitive pressure implied that managers of financial institutions could only increase profits drastically by originating a large number of new mortgage.

The economies of different countries have been affected with different degrees of intensity according to their exposure to some of the main drivers of the financial crisis. The excessive dependence of the real estate industry, jointly with a loss of the credit standards, caused that economic and financial crisis hit Spain more severely than to other developed economies. In this context of economic recession in Spain, one of the most controversial issues is the Spanish Mortgage Law, which was approved in 1909, and with a small number of posterior modifications, still applies now to the Spanish mortgage market.

The Spanish mortgages are full-recourse loans in contrast with the limited recourse mortgages loans in the most significant states of the US. While in those states the guarantee is the same dwelling object of the loan, this is not so in Spain. In the event of a mortgage foreclosure, the lender seizes mortgagor's dwelling, which is sold at auction at a price generally quite bellow its market price. After that, borrowers still hold a debt consisting in the outstanding mortgage debt minus the auction prize of the dwelling plus the interests for late payment, which are generally quite high. Mortgage foreclosure usually takes two years; therefore, these interests consist in the accumulation of the monthly payment for two years priced at an interest rate of 15-20%. If mortgagors do not hold other real estate properties or businesses that can be included as guarantee in the mortgage contract, lenders will force borrowers to include another person, usually a relative, as a guarantor. The guarantor is responsible of the mortgage monthly payments in the event that bor-

rowers cannot meet these payments. If the guarantor has no earnings or income to take responsibility of these mortgage monthly payments, lenders can seize also guarantor's properties.

To what extent could banks lower credit standards? In terms of financial institutions, Basel Committee on Banking Supervision recommends certain standards and regulations for banks (also known as Basel I). This Agreement established the minimum amount of capital that institutions should have in relation to risk weighted assets (RWA), included a definition of capital, provided the system of weighting of exposures and fixed the minimum amount of capital at 8%. In 2004, the Committee came out with a revised framework known as Basel II. More recently, the committee has published another revised framework known as Basel III. In Basel II and III a more extensive calculation of RWA is developed. In this sense, RWA is a move away from having a static requirement for capital requirements. Comparing the amount of capital a bank has with the amount of its assets gives a measure of how able the bank is able to absorb losses. Instead, by adjusting the amount of each loan for an estimate of how risky it is, we can transform this percentage into a rough measure of the financial solvency of a bank. There are many difficulties involved in estimating these risks, which are exacerbated by the motivation banks have to distort it. The main use of risk weighted assets is to calculate tier 1 and tier 2 capital adequacy ratios.[7]

The regulation of the Bank of Spain establishes the weights assigned to each type of mortgage credit: low risk mortgages (those with a loan to value lower than 80%) has a weight of 35%, risk mortgages (those with a loan to value between 80% and 97%) has a weight of 100% and the riskier mortgages (those with a loan to value higher than 100%) has a weight of 150%. Note that one of the main ways that a financial institution can reduce its minimum amount of capital is to reduce its RWA. In this sense, financial institutions are encouraged to increase its percentage of mortgages with a loan to value lower than 80%, and over-appraising is an effective way of doing so.

[7]Tier 1 is the ratio of a bank's core equity capital to its total risk-weighted assets. Tier 2 includes revaluation reserves, general provisions and subordinated debt. Tier 2 capital is included in calculations of a bank's reserve requirements but is not considered as reliable as Tier 1 capital.

3.3. Data and Empirical Strategy

As we mentioned in the introduction the first objective of the paper is to test lending standards in boom and bust periods of the housing market in Spain. In order to do this we are going to focus our attention on the determinants of two variables: the loan to value ratio (LTV) and the loan price (spread). We estimate a kind of pseudo-reduced form equations for both variables in two periods. Period I corresponds to (2005Q1:2007Q2), what we call the pre-crisis period, and Period II (2007Q3:2010Q4) the crisis period.

We use a unique data set obtained from a housing market intermediary with franchisers in most of the Spanish provinces. This real estate company also possesses its own mortgage brokerage branch. We could access to the data corresponding to 30,262 mortgage loans originated between 2005 and 2010, 25,041 loans correspond to the pre crisis period (Period I) and the remaining 5,221 were issued in the crisis period (Period II).

It is important to remark that this company operates in a very specific segment of the housing market, and the flats they sell are medium-low and low profile. These circumstances make that mortgages and mortgagors in our sample are quite homogeneous in that regarding their socio-economic and dwelling characteristics.

In each observation, our loan-level dataset contains broadly the following information: the date of the issue, the characteristics of the loan (both volume and price), the appraisal value of the house and its province, the identity of the lender and finally borrower's several characteristics such as income, labor status, labor contract type, age, marital status, education level, nationality and number of holders.

In the first two columns of tables A.1 and A.2. (general sample) we present descriptive statistics of the variables used in the empirical analysis: the characteristics of the loan in Table A.1. and the socio-demographic characteristics of the borrower in Table A.2.

Our dependent variable in our first equation is LTV that is the ratio of loan to appraisal house value. The average LTV in period I is 82.52% (std. dev. 19.94%) and 78.37% (std. dev. 20.08%) in period II. In terms of the price of the loan we have two sources of information: Reference interest rate and spread. Lenders use as benchmark interest rates the Reference Interest for Mortgage Loans (hereafter RIML) and the Euribor. 84% of our sample loans were priced using Euribor as a reference rate. Spread that is defined as the difference between gross loan rate and reference rate is our dependent variable in the second equation. Average spread in period I is 0.86 (std. dev. 0.40) and period II it is

0.88 (std. dev. 0.46).

We include several borrower characteristics that enable us to infer the risk profile of the borrower in the equations to be estimated. The first variable is household's monthly income that is ranging from 417 Euro to 7030 Euro. Secondly, our dataset provides information on both borrower's labor status and labor contract type if he is occupied. Together with income we are going to focus on these two variables in order to infer the risk profile of the borrower. From labor status information we know whether borrower is working in private sector (or self-employed), in the public sector or not working and moreover for those who are occupied, the labor contract type information enables us to identify borrowers working with a permanent contract, or with a temporary contract. In both periods, our sample mainly consists of active workers (98% of borrowers in period I and 94% of borrowers in period II) and the share of the borrowers working with a temporary contract is 36% in period I and 25% in period II.

The loans in the sample period are originated by 86 lenders. As we know the identity of the lender we are able to classify each lender broadly in three groups: commercial banks (21), savings banks (51) or non-bank financial institutions (14). Moreover, as we want to exploit the different behaviors of rescued saving banks , we further split them into subgroups. We define the first group as individually rescued as the financial institutions that were individually rescued by the Spanish Central Bank (SCB).[8] And secondly, we have also distinguished banks which are owned by FROB (11 institutions). We observe that half of our sample loans, in both periods, are originated by saving banks and 30% of the loans are issued by institutions owned by FROB in the period I.

In terms of the characteristics of the house, apart from the house value we also have information on its province. We distinguish between coastal and interior provinces. In both periods, almost half of the houses purchased (11,186 out of 25,041 in period I and 2.463 out of 5,221 in period II) are located in coastal provinces.

Finally, the control variables in our both equations include other borrower characteristics (marital status, education, nationality, age and number of holders) and year and region dummies. Although our sample covers houses purchased in ten regions, the majority of our full sample (84%) is concentrated in four regions: Andalucia (36%), Comunidad de Madrid (25%), Catalunya (13%) and Comunidad Valencia (10%).

Also, as mentioned in the introduction, the second objective of the paper is to identify the

[8]Note that *Banco de Valencia* is included in individually rescued institutions.

mechanism that led to the housing bubble in Spain. In order to do this we are going to use a subsample of our general sample which also includes the transaction price. We will discuss the details of this subsample in the results subsection 4.2.

3.4. Results

We first provide the results on lending conditions and standards in the good and bad times, and then we analyse the particular mechanism by which banks in Spain influenced the housing and credit bubble.

3.4.1. Lending conditions and standards

In the first two columns of Table 1 we present the regression results of the loan to value equation for period I and period II respectively. When comparing the two sets of results we can point out that we can distinguish two types of variables in terms of its effect on the loan to value ratio: those with a significant change in its effect between these two periods and those with a similar effect in both the pre-crisis and the crisis period.

The most relevant results are those corresponding to the variables whose effect changes significantly between the pre-crisis and the crisis periods, pointing out that the standards and conditions for the housing loans in period I (boom) were too soft. For example, there was no compensating effect of the spread in that period (non significant coefficient) whereas the coefficient was positive and significant in the crisis period, i.e. higher differentials were compensating for higher loan to value ratios (see Besley et al. (2012) and Peydró (2012) for the UK analysis).

In particular, in the pre-crisis period there was no difference between having a temporary job or a permanent one. These very soft lending standards changed significantly in the crisis period. Those with a temporary job were receiving loans with a substantial smaller LTV ratio compared to those with a permanent contract.[9]

Moreover, in good times there is no difference between being a public or private sector

[9]Despite our dataset is unique for Spain (loan level data with loan prices and volumes), we do not have access to loan applications. However, the tightened lending standards that we find in crisis (as compared to the boom) would get strengthened with applications as riskier borrowers are more rejected in bad than in good times (see Jiménez et al. (2012)). Therefore, applications would reinforce our results.

employee, whereas in bad times people working in the private sector were receiving lower LTV with respect to people working in the public sector. All in all, in the bust period having a permanent contract and working in the public sector can be associated to less risky borrowers.

Additionally, it is worth to mention the different consideration in terms of the expected LTV of the fact that the property is a coastal province. In fact, in the pre-crisis period there was an extra 1.3 percentage point for those properties in terms of LTV, whereas in the crisis period the effect is just the opposite (negative) and significant at a 10% significance level.

In both boom and bust periods, the number of holders has a positive and significant effect on LTV. The coefficients on dummy variables for two and three holders show us that LTV is increasing with the number of holders. However, the positive effect on LTV is getting stronger in crisis period suggesting that lenders were differentiating a bit more in terms of this variable and higher LTV's are associated to these mortgages compared to soft-lending boom period.

The last interesting result in the LTV equation is that corresponding to the effect of the type of financial institution is giving the loan. The coefficient of the dummy for the non-bank financial companies shows that these institutions are giving higher LTV ratios than commercial banks in both periods (more than 5 percentage points). But the most striking result is that saving banks which were rescued during the crisis with the Spanish TARP (FROB) took excessive risk in the pre-crisis period by increasing LTV ratios. In the crisis period, these banks behave similar to the commercial banks and to the other rescued saving banks. The non-rescued saving banks were taken a less risky position, on average the LTV?s associated to the mortgages they were negotiating were approximately between 1 and 4 percentage points below the ones corresponding to commercial banks.

In the second group of variables we can include basically those which are related to individual (borrower) characteristics, excluding labor market variables. In that sense we find that education has no significant effect on the loan to value ratio, although the income variable, highly correlated with education, has a significant and expected positive effect similar in both periods - though effects were higher in the crisis period, but the difference between good and bad times for income was significantly higher in the loan spread rather in the LTVs.

Also Spanish borrowers in both periods have an associated LTV smaller than non Spanish

people. This result might be interpreted as a wealth effect. Compared to foreigners, Spanish borrowers are probably wealthier (in most cases they are owners of their actual house) and they need less amount of loan.

We also find similar effects in both periods for marital status and age. For this last variable although the linear term is not significant in the pre-crisis period, the dominating effect is the negative one corresponding to the coefficient of the quadratic term, i.e. the older the individual the smaller the LTV ratio. This is also a kind of wealth effect. Older people are usually wealthier.

When looking at the estimation results of the spread equation, we find basically the same type of results. Riskier people in terms of labor status (temporary contracts, either unemployed or out of the labor force, and private sector employees) have higher differentials than less risky people in both periods but this difference is increasing in the crisis period, i.e. the standards were softer in the pre-crisis period. Similarly, the LTV ratio was having no effect on the spread in the pre-crisis period whereas the effect was positive and significant in the crisis period. Finally, Spanish people had lower differentials than foreigners, being more relevant this difference in the crisis period. This result could be showing discrimination in the Spanish mortgage market (Diaz and Raya, 2012).

3.4.2. A key mechanism for excessive risk-taking

In order to know the determinants of overappraising, we merged three databases: the dataset from the housing market intermediary, the data from the "Registro de la Propiedad" (includes appraisal values and prices reflected in the official deed) and the information of the mortgage brokerage company. We use the information of the "Registro de la propiedad" to validate the accuracy of the matching of datasets. The combined dataset contain the observations (properties) for which we have information in all three datasets. We call this dataset the matched sample.

The matching sample covers those properties during the period 2005-2010, for which we have been able to obtain the actual market price, the appraisal value and the size of the mortgage, besides the characteristics of the borrower and those of the mortgage.

In Tables A.1. and A.2. we report the descriptive statistics of this matched sample, which finally contains 3,305 observations. The most important thing to highlight is the similarity of the descriptive values in both the general sample and the matched sample. Not only are

the mean values from the financial variables (spread, the percentage of mortgages with Euribor as the reference interest rate...) very similar in both samples, but also the mean values of the individual characteristics (percentage of Spanish buyers, family income, marital status, each category of the educational and labor status...). In this sense, the matched sample can be treated as a random subsample from the general one.

Our empirical strategy for the second part consists in estimating a pseudo-reduced form linear equation on the determinants of the upward bias in appraisal prices which can be defined as the ratio among the appraisal price and transaction price of the dwelling in terms of the same variables as in the previous models.

In Table 2 we present the estimation result of upward bias in appraisal price. Comments are based on the estimation using the pre-crisis subsample (second column of Table 2). The estimates provided reveal that most of the variables behave accordingly to our expectations. With respect to the individual characteristics we expect that upward bias in appraisal prices will be negatively correlated with income, age, university degree, permanent contract and the number of holders. All these cases are supposed to have less financial constrains. In those cases, it was more likely that appraisal prices get close to market prices than in the rest of the cases.

The education level can also be a potential source of bargaining skills. We expect more educated individuals to possess more bargaining skills than the less educated. However, we expect ”risk” is greater that the ”bargain” factor. Thus, to be a university graduate reduces the upward bias in 3.74 percentage points with respect to primary studies in the pre-crisis period. The former provides evidence of greater impact of the ”risk” factor with respect to the ”bargain” factor for this variable. Likewise, being older decreases the upward bias. Finally, a higher real income increases upward bias (from 0.015 points for every 1,000 Euro). A higher income could be capturing unobservable characteristics such as higher financial skills, higher future income or higher financial knowledge that makes lenders trust or, even, to provide incentives for over-appraising.

Being Spanish (knowledge of the bank, familiarity, reliability) can be an important factor when they bargain the conditions of their mortgages (especially for those that don’t speak Spanish). Spaniards asking for a credit need 3 percentage points of overappraisal less than immigrants. As expected, a higher spread is correlated with a higher ratio among appraisal and transaction prices. Thus, we have found evidence of higher interest rates in terms of compensation for the risk assumed with a loan with a higher overappraising (either for increase the total amount of mortgage or to reduce the loan to value to an

standard value). In particular, an increase of 1 percentage point in differential results in an increase of 2.0 percentage points in the ratio between appraisal and transaction prices.

In addition, when Euribor is the benchmark interest rate, the ratio between appraisal and transaction prices decreases in 5.3 percentage points. This result brings evidence that lenders tends to use RIML for riskier mortgages. By construction, the RIML is not only higher but also less volatile and react less sharply to changes in the market interest rates than the Euribor. This circumstance makes that the RIML is more advantageous for lenders, especially for riskier borrowers. As a result, we use this variable to capture unobserved riskier characteristics of the borrower. In this sense we expect negative sign for the Euribor variable.

Finally, financial institutions have had different behavior towards risk during the pre-crisis period. In this specification we found evidence for a higher upward bias (of 5.7 percentage points) in individually rescued institutions and a lower upward bias for non-bank financial companies (10.8 percentage points), FROB owned institutions (7.5 percentage points) and the rest of the saving banks (9.3 percentage points) with respect to commercial banks. As pointed out previously, from this result we cannot infer that banks behave riskier than savings and loans and non-bank financial companies. From the models estimated in section 4.1 for the pre-crisis period we have shown that non bank financial companies and FROB owned institutions set riskier mortgages in the sense of higher loan to value (with respect to commercial banks). That is, according to results of both models we can classify financial institutions in three groups: 1) LTV relatively higher and lower overappraisal (non bank financial companies and FROB owned institutions). 2) A higher over-appraising behavior (banks and rescued institutions). 3) LTV and over-appraisal relatively lower (the rest of saving banks).

3.5. Conclusion

We analyse the cycle in lending conditions and standards using a unique dataset on mortgage loans in Spain. The loan-level dataset contain lending conditions (such as price, volume and LTV), matched with borrower characteristics (such as income, labor status, education) and the lender identity, over the last credit boom and bust. We find that lending standards are softer in the boom than in the bust. Moreover, despite some adjustment in lending conditions in the good times depending on borrower risk, we uncover too soft lending standards in some loan margins in the boom. Finally, we analyse the mechanism

by which banks could increase the supply of mortgage loans despite of regulatory restrictions. Our evidence is consistent with banks encouraging appraisers to introduce an upward bias in appraisal prices, to meet LTV regulatory thresholds, thus building-up the credit and the real estate bubble.

All in all, the results suggest that the credit and housing bubble were partly driven by bank agency problems (Freixas and Rochet (2008)) and not simply by behavioural motives (Gennaioli et al. (2012)). This has crucial implications for public policy. Our results are therefore consistent with the new prudential policy measures on limiting the ex-ante banks' incentives to take on excessive risk-taking.

3.6. TABLES

Table 3.1: Characteristics of the Loan*

	General sample		Matched sample	
	Period I	Period II	Whole sample	Period I
Amount of the Loan (Euro)[1]	189,957	168,202	171,211	174,13
	(-82697.96)	(-76403.72)	(-70513.57)	(-70064.54)
Appraisal value (Euro)[1]	231,054	216,366	195,214	196,318
	(-86567.24)	(-84753.42)	(-69813.47)	(-68276.03)
Loan to Value (%)	82.52	78.37	87.56	88.56
	(-19.94)	(-20.08)	(-18.64)	(-18.3)
Spread (%)	0.86	0.88	0.85	0.84
	(-0.4)	(-0.46)	(-0.43)	(-0.43)
Appraisal to transaction price (%)			128.93	128.18
			(-22.25)	(-21.84)
Transaction price (Euro)[1]			156,005	157,782
			(-60,073)	(-59,877)
Reference Interest Rate				
RIML (ref)	17.02	12.47	15.16	16.73
Euribor	82.98	87.53	84.84	83.27
Financial Institution				
Commercial bank	39.19	30.67	39.61	40.25
Saving Bank	50.35	48.82	51.62	51.71
Individually rescued[2]	9.35	7.41	8.56	8.87
FROB owned	29.98	18.27	30.65	32.92
Rest	11.02	23.14	12.41	9.92
Non-bank financial institutions	10.45	20.51	8.77	8.03
Years				
2005	29.14		52.95	61.36
2006	50.03		31.29	36.26
2007	20.83	59.07	4.57	2.38
2008		8.98	2.51	
2009		16.13	4.6	
2010		15.82	4.08	
Number of Observations	25,041	5,221	3,305	2,852

*We present mean and standard deviation (in brackets) for quantitative variables and the distribution in percentage for qualitative variables. [1]Variables are in real terms. [2]*Banco de Valencia* is included in this

group.

Table 3.2: Characteristics of the Borrower*

	General sample		Matched sample	
	Period I	Period II	Whole sample	Period I
Labor status				
Public sector employee	88.47	15.36	86.63	88.57
Private sector employee or self-employed	9.21	78.17	10.32	9.29
Non-occupied	2.32	6.47	3.06	2.14
Type of contract				
Permanent	61.43	69.05	62.17	59.82
Temporary	36.26	24.48	34.77	38.04
Marital status				
Married	36.02	32.64	31.04	32.5
Separate	5.41	7.41		
Single	57.69	58.72	68.96	67.5
Widow	0.89	1.23		
Education				
Primary	57.59	46.03	54.52	57.47
Secondary	31.56	39.8	33.4	31.45
University degree	10.84	14.17	12.07	11.08
Nationality				
Other	32.97	17.89	32.62	36.19
Spanish	67.03	82.11	67.38	63.81
Number of holders				
One	28.25	39.13	31.71	28.51
Two	60.14	53.46	57	59.29
Three	11.61	7.41	11.01	12.03
Province				
Interior	55.33	52.83	57.7	57.26
Coastal	44.67	47.17	42.93	42.74
Region				
Andalucia	34.7	40.62	31.95	30.47
Aragon	4.1	5.94	8.77	9.68
Castilla-La-Mancha	5.55	4.75	3.24	3.26
Castilla Leon	3.53	2.39	3	3.23
Cataluna	12.45	13.89	13.16	13.78
Comunidad De Madrid	25.48	22.47	27.62	26.51

Comunidad Valencia	10.68	5.88	8.47	9.4
Extremadura	0.83	1.09	-	-
Galicia	1.15	0.46	1.09	1.26
Pais Vasco	1.52	2.51	2.69	2.42
Income (thousand Euro)[1]	1.601	1.627	1.563	1.557
	(0.72)	(0.69)	(0.65)	(0.65)
Age	33.78	35.8	33.77	33.43
	(9.31)	(9.97)	(9.18)	(8.98)
Number of Observations	25,041	5,221	3,305	2,852

*We present mean and standard deviation (in brackets) for quantitative variables and the distribution in percentage for qualitative variables. [1]Variables are in real terms.

Table 3.3: Estimation results of the lending standards

	LTV (%)		SPREAD	
	Period I	Period II	Period I	Period II
Spread	0.343	4.131***		
	(-0.517)	(-0.71)		
LTV (%)			0.0000774	0.00160***
			(-0.000117)	(-0.00028)
Labor status				
(ref: Public sector employee)				
Private sector employee	-0.643	-2.183***	0.0228***	0.0630***
	(-0.43)	(-0.759)	(-0.00613)	(-0.0143)
non-occupied	-6.788***	-5.021***	0.0467***	0.0965***
	(-1.288)	(-1.391)	(-0.0148)	(-0.0254)
Type of contract				
(ref: permanent)				
Temporary	-0.0144	-2.884***	0.0374***	0.0883***
	(-0.246)	(-0.61)	(-0.00386)	(-0.0131)
Marital status				
(ref: Married)				
Separate	1.579**	0.198	0.0111	-0.00961
	(-0.639)	(-1.323)	(-0.0078)	(-0.0213)
Single	4.442***	3.794***	0.0106**	0.00423
	(-0.284)	(-0.66)	(-0.00453)	(-0.0143)
Widow	1.262	-2.654	0.0453**	-0.0417
	(-1.824)	(-2.857)	(-0.0215)	(-0.0479)
Education				
(ref: Primary)				
Secondary	0.41	0.811	-0.0444***	-0.0618***
	(-0.284)	(-0.624)	(-0.00404)	(-0.0121)
University degree	0.246	1.271	-0.139***	-0.191***
	(-0.425)	(-0.922)	(-0.00632)	(-0.0158)
Nationality				
(ref:Other)				
Spanish	-6.832***	-6.110***	-0.191***	-0.241***

	(-0.292)	(-0.69)	(-0.00467)	(-0.0169)
Number of holders				
(ref: One)				
Two	5.168***	5.661***	0.00364	-0.0231*
	(-0.291)	(-0.608)	(-0.00436)	(-0.0123)
Three	7.172***	9.492***	0.0718***	0.0651***
	(-0.439)	(-1.079)	(-0.00697)	(-0.0241)
Province				
(ref: interior)				
Coastal	1.308***	-1.526*	-0.0429***	-0.0870***
	(-0.407)	(-0.824)	(-0.00577)	(-0.0164)
Income	1.517***	1.737***	-0.0142***	-0.0324***
	(-0.174)	(-0.432)	(-0.00265)	(-0.0079)
Age	0.129	0.506***	0.000941	-0.00457
	(-0.101)	(-0.196)	(-0.00131)	(-0.0039)
Age^2	-0.00602***	-0.0118***	-7.15E-06	0.0000812*
	(-0.00137)	(-0.00253)	(-0.0000171)	(-0.0000487)
Reference Interest Rate				
(ref: RIML)				
Euribor	-0.155	-0.996	0.731***	0.717***
	(-0.552)	(-1.357)	(-0.00543)	(-0.0221)
Financial Institutions				
(ref: commercial)				
Non-bank financial institution	5.222***	5.880***	0.211***	0.111***
	(-0.498)	(-1.007)	(-0.00804)	(-0.0214)
Individually rescued	-0.256	0.0293	-0.0205***	-0.109***
	(-0.404)	(-1.011)	(-0.00532)	(-0.0204)
Owned by FROB	4.326***	-0.383	0.0731***	-0.101***
	(-0.291)	(-0.706)	(-0.00427)	(-0.0145)
Saving Bank	-1.291***	-3.803***	0.0465***	-0.180***
	(-0.448)	(-0.688)	(-0.00677)	(-0.014)
Year Dummies	YES	YES	YES	YES

Region Dummies	YES	YES	YES	YES
Observations	25,041	5,221	25,041	5,221
R-squared	0.153	0.155	0.513	0.383

Constant is included but its coefficient left unreported. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 3.4: Estimation results for the appraisal to transaction data

	AT Ratio (%)	
	Whole	Period I
Spread	4.034***	2.016*
	(-1.091)	(-1.219)
Labor status (ref: Public sector employee)		
Private sector employee or self-employed	-0.815	-0.625
	(-1.256)	(-1.347)
Non-occupied	-4.059	-6.428*
	(-2.856)	(-3.495)
Type of contract (ref: permanent)		
Temporary	0.79	1.059
	(-0.77)	(-0.794)
Marital status (ref: Married)		
Single, separated, widow	-0.773	-0.196
	(-0.907)	(-0.929)
Education (ref: Primary)		
Secondary	-3.221***	-3.693***
	(-0.843)	(-0.876)
University degree	-4.114***	-3.742***
	(-1.199)	(-1.297)
Nationality (ref:Other)		
Spanish	-2.157**	-3.038***
	(-0.899)	(-0.94)
Number of holders (ref: One)		
Two	0.055	-0.783
	(-0.866)	(-0.929)
Three	-0.504	-0.84
	(-1.274)	(-1.313)
Province (ref: interior)		
Coastal	0.789	2.025
	(-1.517)	(-1.646)

Income	1.515***	1.452**
	(-0.577)	(-0.622)
Age	-0.449*	-0.679**
	(-0.238)	(-0.294)
Age^2	0.003	0.006
	(-0.003)	(-0.004)
Reference Interest Rate (ref: RIML)		
Euribor	-7.118***	-5.310***
	(-1.436)	(-0.94)
Financial Institutions (ref: commercial)		
Non-bank financial institution	-10.823***	-10.819***
	(-1.535)	(-1.609)
Individually rescued	4.020**	5.669***
	(-1.591)	(-1.713)
Owned by FROB	-7.372***	-7.460***
	(-0.898)	(-0.971)
Saving Bank	-6.623***	-9.278***
	(-1.288)	(-1.453)
Year Dummies	YES	YES
Region Dummies	YES	YES
Observations	3,305	2,852
R-squared	0.181	0.201

Constant is included but its coefficient left unreported. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

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