Do short sellers exploit risky business models of banks? Evidence from two banking crises

Chih-Yung Lin*
Department of Information Management and Finance
National Chiao-Tung University

Dien Giau Bui**
Institute of Banking and Money,
Nanjing Audit University

Tse-Chun Lin***
Faculty of Business and Economics
University of Hong Kong

We want to thank David Lucca, Rüdiger Fahlenbrach, Gerard Hoberg, Hong Ru, and seminar participants at Chinese University of Hong Kong, University of Hong Kong, Monash University, National Taiwan University, National Chengchi University, and Deakin University for their helpful comments. Tse-Chun Lin gratefully acknowledges research support from the Faculty of Business and Economics at the University of Hong Kong and the Research Grant Council of the Hong Kong SAR government. Chih-Yung Lin appreciates the financial support from Taiwan Ministry of Science and Technology (MOST108-2636-H-009-001). Any remaining errors are ours.

* E-mail: d95723009@ntu.edu.tw
** Corresponding author. E-mail: d05723007@ntu.edu.tw
*** E-mail: tsechunlin@hku.hk

Do short sellers exploit risky business models of banks? Evidence from two banking crises

Abstract

We find that changes in short interest predict banks' stock returns during two recent banking crises. Furthermore, before the 2007-2008 crisis, short interest increased more for banks with worse performance during the Long-Term Capital Management crisis of 1998. We also find that changes in short interest predicted banks' loan quality and default risk during the 2007-2008 crisis. The results are stronger for banks with higher levels of risk-taking. Overall, our findings indicate that short sellers were informed about the persistent risky business models of banks and shorted those banks before the 2007-2008 crisis.

JEL classification: G01, G14, G20, G32

Keywords: Short selling; short interest; financial crisis; predictability; persistent risky business models

1. Introduction

The recent financial crisis from 2007 to 2008 (the 2007-2008 crisis) pulled economies around the world into severe recessions with continuing repercussions. The public criticized economists because they were not able to predict the crises and might even have contributed to them.[1] The Federal Reserve Bank (FED) and the Treasury also failed to detect the financial bubbles.[2] Scholars have tried but have failed to find concrete evidence that the corporate insiders and bankers were aware of the imminent financial crises. For example, Fahlenbrach and Stulz (2011) find that CEOs did not foresee the upcoming crisis even though they were supposed to have more private information. Cheng, Raina, and Xiong (2014) find that mid-level managers in securitized finance did not anticipate the housing bubble in 2004-2006. In this paper, rather than focusing on corporate insiders or bankers, we test whether short sellers were aware of the imminent financial crises as they are typically portrayed to have more private information.

Another heated debate is whether banks change their risk-taking after the crisis. For example, Fahlenbrach, Prilmeier, and Stulz (2012) use banks' performance in the Long-Term Capital Management (LTCM) crisis and the 2007-2008 crisis to test two competing hypotheses: the learning hypothesis versus the risk culture hypothesis. They propose that if a bank learns from past experience, then the correlation between banks' stock returns in the two crises should be negative. However, if the risk culture or risky business model were to persist, then a bank with poor performance in the LTCM crisis

[1] See the study of Colander, Goldberg, Haas, Juselius, Kirman, Lux, and Sloth (2009) for details.

[2] In 2011, the Financial Crisis Inquiry Commission, in a 576-page report, criticized the former FED chairman Alan Greenspan for advocating financial deregulation and promoting excessive derivative products that turned out to be "toxic assets." The commission also noted that the Bush administration and Treasury Secretaries Henry M. Paulson Jr. and Ben S. Bernanke (Greenspan's successor) neglected the 2007-2008 crisis and even "added to the uncertainty and panic in the financial markets" by allowing Lehman Brothers to collapse in September 2008. That full report is available at https://fcic-static.law.stanford.edu/cdn_media/fcic-reports/fcic_final_report_full.pdf.

would continue to underperform in the 2007-2008 crisis. Extending the argument of Fahlenbrach, Prilmeier, and Stulz (2012), we use the behavior of short sellers to shed light on whether persistent risky models predict the performance of banks in a future crisis.[3] We propose that short sellers were informed about the persistent risky business models of banks and shorted the underperforming banks in the LTCM crisis before the 2007-2008 crisis.

Our empirical tests rely on the two recent major banking crises: the 1998 LTCM crisis and the 2007-2008 crisis. In 1998, the Russian Default led to the collapse of the hedge fund managed by LTCM that had US$5 billion in capital and US$125 billion in debt. The Federal Reserve Bank of New York induced 14 large banks to provide US$3.6 billion to rescue the LTCM.[4] Alan Greenspan said that "I've watching the US markets for fifty years and I never seen anything like this." Later on, the Federal Reserve System (FED) lowered the interest rate three times in rapid succession between September 29 and November 17, 1998.[5] Similarly, the 2007-2008 crisis is considered as the second largest crisis in history after the Great Depression of the 1930s. Financial institutions like Lehman Brothers, Bear Stearns, Merrill Lynch, Fannie Mae, Freddie Mac, Citigroup, and AIG were rescued or went bankrupt. American families' wealth fell by a total of US$11 trillion in 2008, which is equal to the combined output of Germany, Japan, and the UK.

We collect the short interest data from the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and NASDAQ. The sample comprises 676 banks from the 1998 LTCM crisis and 731 banks from the 2007-2008 crisis. We follow

[3] Throughout the paper, the term "banks" is broadly defined including commercial banks, non-depository credit institutions, insurance carriers, security and commodity brokers, dealers, exchanges and services, real estate operators, holding and other investment offices etc. (SIC codes between 6000 and 6999 include). We find similar results using subsamples based on finer industry classifications.

[4] Kindleberger, Charles P., and Robert Z. Aliber (2005). *Manias, Panics and Crashes*. Palgrave Macmillan.

[5] Greenspan, Alan (2008). *The age of turbulence: Adventures in a new world*. Penguin.

Karpoff and Lou (2010) who show that abnormal short interest starts increasing 19 months before the financial misrepresentation of firms is publicly revealed and use the level of short interest two years before the crisis periods as the benchmark to calculate the change in short interest.

Our results show that the change in short interest in the pre-crisis period is negatively correlated to the banks' stock returns during the 2007-2008 crisis. The result is robust to using characteristic-adjusted stock returns (Daniel, Grinblatt, Titman, and Wermers, 1997) or using the one-year change in short interest. These results provide verifying and complementary evidence to the short selling literature that short sellers are also informed about the performance of financial firms.

For our main hypothesis, we find that short sellers established larger short positions on the banks that performed poorly during the LTCM crisis before the 2007-2008 crisis. This result complements the findings in Fahlenbrach, Prilmeier, and Stulz (2012) who show that past crisis performance can predict bank performance in the next crisis. In particular, this result not only provides a validity check for their claim on the existence of the persistent risky business models of banks but also indicates that short sellers are able to target those with overly risky business models before the next crisis. Moreover, these findings also indicate that short sellers profited from being able to better process public information on banks before the 2007-2008 crisis.

We conduct several tests and robustness checks to corroborate our main results. First, we repeat our analysis for nonfinancial firms to mitigate the concern that our previous finding is just a re-documentation of the return predictability in short selling shown in the literature. We find that the magnitude of the return predictability of short selling is much larger for the banking industry than for nonfinancial industries. Furthermore, we do not find that short sellers target nonfinancial firms with risky

business models. Thus, the role of persistent risky business models is significant only for banks and not for nonfinancial firms when short sellers search for potential targets.[6]

Second, we randomly choose pseudo-events for each bank in our sample and each firm in the nonfinancial sample to test whether the return predictability of short selling that we find is much weaker during non-crisis periods. We conduct this exercise to alleviate the concern that we again only re-document a previous result. Our results show that the predictability of short selling during the 2007-2008 crisis is more than four times stronger than in the pseudo-event periods. This result highlights that the stronger predictability of short interest on banks' stock returns during crisis periods comes at least partially from their information concerning excessively risky business models.

Third, the banks' persistent risky business models and short sellers' predictability are stronger among highly leveraged and large banks. Fourth, the results hold after excluding banks with the same CEOs in the two crises, which mitigates the concern that the persistence of CEOs' managerial style is the only driver of our results. Fifth, we find that banks with lower loan quality and higher default risk in the LTCM crisis have higher short interest before the 2007-2008 crisis. Sixth, we use the costs of borrowing stocks (equity lending fees) and two abnormal short interests as alternative measures for informed short selling (Drechsler and Drechsler, 2016) and find similar results. Lastly, we also find supportive evidence from different industry subsamples after controlling for industry-related factors.

Our paper is closely related to Hasan, Massoud, Saunders, and Song (2015) and Desai, Rajgopal, and Yu (2016) who find that short sellers seem to target banks with more subprime assets and worse financial statements before the crisis, respectively.

[6] We recognize that the return volatility of financial firms during the financial crisis is higher, compared with that of nonfinancial firms or that during other times. However, the high variance in bank returns should only generate larger noises in the estimation, not necessarily a larger regression coefficient, unless the covariance in bank crisis-period returns and pre-crisis change in short interest increases.

However, our paper differs from theirs in several ways. First, we test whether short selling can predict banks' crisis returns by providing direct evidence on whether these trades are informed. Second, we demonstrate that short sellers are able to identify the banks' risk-taking or risk culture and target those with excessive risks before the two crises. Last, our findings indicate that short sellers could learn from public information regarding banks' past stock performances and profit from it before the next financial crisis.

Our paper contributes to the literature in three ways. First, we shed light on the debate about whether any market participants were aware of the imminent financial crises. Different from the previous studies, we find that some short sellers are informed and establish short positions before the 2007-2008 crisis, particularly among banks that performed rather poorly in the LTCM crisis period. This is an intriguing and novel finding as the result indicates that short sellers may know more than corporate managers (and perhaps regulators). This finding expands the literature as the existing studies mainly show that short sellers at best know the negative information withheld by managers.

Second, our research also adds to the informed literature on short selling. We complement this line of research by showing that the return predictability of short interest can be as long as up to 24 months before the crisis period. In addition, this study also contributes to the literature on the source of information for short sellers. We find that short sellers use not only private but also public information to choose their target firms.

Third, our paper adds to the literature on corporate culture by focusing on the risk culture or risky business model of banks. Besides the aforementioned Fahlenbrach, Prilmeier, and Stulz (2012), Ellul and Yerramilli (2013) find that banks with aggressive

business models are associated with weaker risk management. Ho, Huang, Lin, and Yen (2016) find that a bank's risk culture reflects the character of its CEO. However, we acknowledge that it might still be challenging to directly and accurately gauge the risk culture, which itself deserves more attention from researchers. Hence, our main contribution is not about proposing a measure for corporate risk culture or persistent risky business models but by providing evidence that short sellers target banks with poor stock performance in the previous crisis, which is an indicator of overly persistent risk-taking that Fahlenbrach, Prilmeier, and Stulz (2012) had proposed.[7]

2. Hypothesis development

The literature shows that short sellers are more likely to be informed than other investors (Diamond and Verrecchia, 1987).[8] Among others, Senchack and Starks (1993), Asquith, Pathak, and Ritter (2005), Nagel (2005), and Boehmer, Jones, and Zhang (2008) all show that an increase in short interest negatively predicts future stock returns. Their findings indicate that short sellers possess private information and reveal it to the market via their trading. Another stream of studies explores what types of information short sellers have that enable their trading to predict stock returns. Karpoff and Lou (2010) find that short interest goes up significantly 19 months prior to the initial public disclosure of a firm's misrepresentation. They argue that short sellers can

[7] In this regard, our paper is related to the literature of bank crisis performance. Recent evidence indicates that poorly-performed banks includes those with CEOs who had better incentives in terms of the dollar value of their stakes (Fahlenbrach and Stulz, 2011); banks with more shareholder-friendly boards and more fragile financing (Beltratti and Stulz, 2012); banks with lower-quality regulatory capital such as Tier 1 ratios (Berger and Bouwman, 2013); banks with worse risk management mechanism (Ellul and Yerramilli, 2013); banks with more highly rated tranches of securitization (Erel, Nadauld, and Stulz, 2014).

[8] Short sellers are shown to be informed regarding financial misrepresentation (e.g., Desai, Krishnamurthy, and Venkataraman, 2006), Karpoff and Lou, 2010), analyst-related information (e.g., Christophe, Ferri, and Hsieh, 2010 and Drake, Rees, and Swanson, 2011), negative earnings surprises (Christophe, Ferri, and Angel, 2004), negative future stock returns (e.g., Asquith, Pathak, and Ritter, 2005, Pownall and Simko, 2005, Bris, Goetzmann, and Zhu, 2007, Chang, Cheng, and Yu, 2007, Cohen, Diether, and Malloy, 2007, Boehmer, Jones, and Zhang, 2008, and Engelberg, Reed, and Ringgenberg, 2012, 2018, Daniel, Klos, and Rottke, 2017).

use not only publicly available information (i.e., fundamental accounting) but also other private information. Christophe, Ferri, and Hsieh (2010) find that short interest predicts recommendation changes via tipping analysts. Further, Kecskés, Mansi, and Zhang (2012) show that short interest also predicts bond spreads. However, Engelberg, Reed, and Ringgenberg (2012) argue that the information advantage of short sellers mainly comes from their premium ability to process publicly available information.

These studies indicate that short sellers are informed about various aspects of firms. We thus conjecture that short sellers also pay attention to some banks that might suffer more before an imminent financial crisis. The reasoning is that econometricians are able to observe a lead-lag correlation between the change in short interest and banks' stock returns during crisis periods.

Recently, several studies have examined whether corporate culture affects a bank's performance.[9] For example, Fahlenbrach, Prilmeier, and Stulz (2012) find that a bank with poor performance in the LTCM crisis continued to perform relatively poorly in the 2007-2008 crisis, which supports the risk culture hypothesis. Ellul and Yerramilli (2013) study a sample of 74 US bank holding companies and find that banks with an aggressive risk culture are associated with weaker risk management. Cheng, Hong, and Scheinkman (2015) examine the relation between executive compensation and several risk measures in banks. They find that more excessive compensation is associated with more risk-taking. Ho, Huang, Lin, and Yen (2016) find that aggressive banks tend to hire overconfident managers who are willing to take greater risks.

If banks' risk culture or risky business model was persistent, as suggested by Fahlenbrach, Prilmeier, and Stulz (2012), the poorly performing banks in the LTCM crisis would continue to underperform in the 2007-2008 crisis. Thus, sensing an asset

[9] Recent studies in corporate finance have shown that corporate risk culture affects corporate polices (e.g., Guiso, Sapienza, and Zingales, 2015a, 2015b and Pan, Siegel, and Wang, 2017).

bubble in the banking industry, a good strategy for short sellers might be to establish short positions on the banks that severely underperformed in the LTCM crisis. As a result, we expect a negative correlation between the banks' stock returns during the LTCM crisis period and the change in short interest before the 2007-2008 crisis.

Based on the above arguments, we thus propose our main hypothesis:

Main Hypothesis: *Short sellers tend to target the banks that had high-risk exposures in the LTCM crisis when they anticipate an imminent financial crisis.*

3. Data

In this section, we provide information on our data sources and summary statistics for the variables of interests.

3.1. Sample

Our sample comprises all of the financial institutions with SIC codes between 6000 and 6999. Figure 1 shows the sample distribution across two-digit SIC codes, and Appendix C lists the names of all the financial institutions in this study. Following Fahlenbrach, Prilmeier, and Stulz (2012), the recent 2007-2008 crisis refers to the period from July 2007 to December 2008, while the 1998 LTCM crisis refers to the period from August 1998 to December 1998. The pre-crisis period we use to analyze short selling refers to the 24-month period prior to the trigger events. The trigger events occurred in August 1998 for the LTCM and July 2007 for the 2007-2008 crisis.

We collect the short selling data from two main sources. First, we use the short interest to measure the trading of short sellers. Short interest is the open short position in the NYSE, AMEX, or NASDAQ. Second, we collect the stock borrowing cost data of short selling from the Markit Data Explorer (DXL). Recent studies such as Beneish, Lee, and Nichols (2015), Drechsler and Drechsler (2016), Engelberg, Reed, and

Ringgenberg (2012), and Chang, Lin, and Ma (2016) also use this database to gauge the market condition of short selling.[10] Then, we match the short selling data with the stock return data and the accounting data from Compustat. In total, the sample comprises 731 banks during the LTCM crisis and 676 banks during the 2007-2008 crisis.

We use the change in short interest as the primary independent variable. We scale the short interest by the percentage of the total shares outstanding as in Asquith, Pathak, and Ritter (2005). They argue that using outstanding stocks rather than the trading volume to scale the short interest is more appropriate for testing whether short selling discloses private information. Based on Karpoff and Lou (2010), we use the change in the short interest 24 months before the crisis period as the benchmark measure (e.g, $\Delta SI = SI_t - SI_{t-1}$ in which SI_{t-1} is 24 months prior to the trigger event). We denote our primary independent variable as ΔSI for the 2007-2008 crisis.

The stock borrowing cost is the Daily Cost of Borrow Score (DCBS) in the DXL. The DCBS is a cost index that ranges from one (cheapest) to ten (most expensive) that the DXL assigns to every stock. Similar to the change in the short interest, the change in the stock borrowing costs is calculated as $\Delta Cost = DCBS_t - DCBS_{t-1}$ in which $DCBS_{t-1}$ is the DCBS 24 months prior to the trigger events.

The dependent variables that capture the banks' crisis performance are *RE08* (the annualized buy-and-hold returns from July 1, 2007, through December 31, 2008), *RE98* (the annualized buy-and-hold returns from August 3, 1998, until the day in 1998 on which the bank's stock attains its lowest price), *RE98 rebound* (buy-and-hold returns since the date with the lowest price until six months later), *EDF98* (the percentile ranking of a firm's default risk based on its distance to default in year 1998),

[10] The DXL consists of data from more than 100 institutional lenders that cover more than 90% of the US markets' capitalization (Beneish, Lee, and Nichols, 2015).

Δ*NPL/Loan98* (change in the ratio of nonperforming loans to total gross loans between crisis year 1998 and year 1997), Δ*NPL/Equity98* (change in ratio of nonperforming loans to total equity between crisis year 1998 and year 1997), and *ROE98* (Net income over book equity in year 1998).[11]

Following Fahlenbrach, Prilmeier, and Stulz (2012), we include key bank characteristics such as *PastReturn* (the previous one-year buy-and-hold returns), *LnAssets* (log of total assets), *BM* (book value of common equity divided by market value of common equity), *Leverage* (ratio of assets to book value of equity), *TCE* ratio (tangible common equity ratio: tangible common equity divided by tangible assets and multiplied by 100) in the regressions.[12]

Moreover, a bank's risk may affect its stock return and short interest. Thus, we further control for systematic risk (*Beta*, banks' equity beta from a market model of daily returns in excess of three-month T-bills using the previous two years of data in which the market is represented by the value-weighted CRSP index) and idiosyncratic risk (*IDIORISK*, standard deviations of the residuals obtained from a market model of daily returns in excess of three-month T-bills using the previous two years of data). Lastly, we also control for the left-tail exposure of a bank by adding *MES* (marginal expected shortfall measured using the 5% worst days for the value-weighted CRSP market return during the previous two years, as in Acharya, Pedersen, Philippon, and Richardson, 2017).

3.2. Descriptive statistics

Table 1 presents the summary statistics for the mean, standard deviation, and quartiles. The table shows that the banks' stock returns are quite negative during the financial crises. The annualized buy-and-hold return for the period from July 2007 to

[11] The *EDF* is constructed from Bharath and Shumway (2008).
[12] The results are similar if we use a log of market capitalization as a proxy for bank size.

December 2008 (*RE08*) is –46.6%. In the LTCM crisis, the annualized buy-and-hold return (*RE98*) is –27.5% on average.

In particular, there is a considerable increase in the short interest. One and two-years prior to the 2007-2008 crisis, the changes in short interest (ΔSI_{12m} and ΔSI) are about 0.7% and 1.7% on average. Likewise, there is an increase of 13.5% in the stock borrowing cost two years prior to the 2007-2008 crisis ($\Delta COST$).

[Insert Table 1]

Next, we independently sort banks into 3×3 terciles based on the pre-crisis short interest change in the two crises, where G1 is the lowest and G3 is the highest short interest. Panel A of Table 2 shows that the observations concentrate more on the two groups G1–G1 or G3–G3 and account for 36.26% and 37.71% of the total observations in row G1 and G3, respectively. The group G2–G2 also constitutes 36.26% of the total observations in row G2. These results show a persistent trend in short interest variation across the two crises.

Panel B shows that the average *RE08* is the lowest in the group G3–G3 that has the highest increase in short interest in both pre-crisis periods. By contrast, in the group G1–G1 that received the lowest change in short interest before the two crises, banks tend to perform less negatively. This result indicates a negative correlation between a change in short interest and crisis performance.

[Insert Table 2]

4. Empirical results

4.1. Short selling and stock returns in the 2007-2008 crisis

Following the study of Fahlenbrach, Prilmeier, and Stulz (2012), we use the following ordinary least-squares (OLS) to investigate whether a change in short interest can predict a bank's stock returns during a crisis:

$$RE08_{i,\text{crisis}} = \alpha + \beta\ \Delta SI_{i,pre-crisis} + \gamma Z_{i,2006} + \varepsilon_i \quad (1)$$

in which $RE08_{i,crisis}$ represents stock returns for bank *i* in the 2007-2008 crisis; $\Delta SI_{i,pre-crisis}$ is the change in the short interest for bank *i* in the pre-crisis period; and ***Z*** is a vector of control variables for bank *i* in 2006, which is the last full fiscal year prior to the crisis. The definitions of these control variables are presented in Appendix A. In all regressions, we report the *t*-values based on the standard errors adjusted for heteroskedasticity (White, 1980; Petersen, 2009).

We expect that short sellers anticipated the 2007-2008 crisis and established large short positions for some banks in the pre-crisis period. The banks that are heavily shorted should perform worse during the crisis. We thus expect the signs of coefficients β in Equation (1) to be negative.

We control for a number of important bank characteristics: *RE98*, *RE98 rebound*, *PastReturn*, *LnAssets*, *BV*, *Beta*, *Leverage*, *TCE*, *MES*, and *IDIORISK*, the same as those in Fahlenbrach, Prilmeier, and Stulz (2012). Table 3 presents the regression results. Across all specifications, the coefficients for Δ*SI* are significantly negative even after we control for the risk culture effect (*RE98*, Fahlenbrach, Prilmeier, and Stulz, 2012). For example, in Model (1), the coefficient for Δ*SI* is –0.5501 and statistically significant. A one-standard-deviation increase in the Δ*SI* is associated with a 1.43% (0.026×0.5501) lower stock return during the 2007-2008 crisis. After controlling for more bank characteristics in Models (2) to (4), the economic magnitude of the coefficients becomes even larger. For example, in Model (3), the stock returns decrease

by 2.11% (0.026×0.8122) during the crisis for a one-standard-deviation increase in the pre-crisis change in short interest.[13]

Furthermore, this 2.11% is approximately 40% of the risk culture effect (*RE98*) in which we find that a one-standard-deviation lower return during the LTCM crisis is associated with a 5.18% (0.155×0.3342) lower return during the 2007-2008 crisis. Thus, the predictability of short interest for the banks' stock returns during the 2007-2008 crisis is both statistically significant and economically meaningful.

[Insert Table 3]

In sum, Table 3 provides evidence that there was a negative correlation between the change in short interest prior to the 2007-2008 crisis and the banks' stock performance during the 2007-2008 crisis. That is, short sellers were informed that some banks were going to be in trouble, and they tried to profit from it.

4.2. Short selling and banks' risky business models

To test our main hypothesis, we perform the following regression:

$$\Delta SI_{i,\,pre-\text{crisis}} = \alpha + \beta\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i \qquad (2)$$

in which $\Delta SI_{i,\,pre-\text{crisis}}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis, while $RE98_{i,crisis}$ is the stock returns of bank *i* during the LTCM crisis; and $\boldsymbol{Z}$ is a vector of control variables in the year 2004, which is the last fiscal year before the pre-crisis period.

Our main hypothesis states that short sellers targeted the banks that severely underperformed during the LTCM crisis before the 2007-2008 crisis. These banks are

[13] We find similar results when we use 125 (5×5×5) or 27 (3×3×3) characteristic-adjusted returns in Equation (1) based on Daniel, Grinblatt, Titman, and Wermers (1997). The results are available upon request.

the obvious targets of short sellers as long as the culture of taking excessive risks does not change. We thus expect a negative sign for coefficient β in Equation (2).

Table 4 presents the results. Across all four specifications, we find a negative correlation between *RE98* and ΔSI. For example, in Model (4), the coefficient for *RE98* is –0.0252 and statistically significant, which supports our main hypothesis. These results also provide a validity check to the risk culture hypothesis in Fahlenbrach, Prilmeier, and Stulz (2012).

[Insert Table 4]

Another extension, albeit not our main focus, is to test whether some banks learn from the previous crisis such that they perform better in the next crisis, and which factors may potentially affect the probability of such learning. We define learning banks as those that are in the highest tercile of $\triangle SI_{LTCM}$ in the LTCM crisis but then are in the lowest tercile of $\triangle SI$ in the 2007-2008 crisis. There are 48 learning banks in our sample as indicated by group G3–G1 in Panel A of Table 2. We then use bank variables in 2004 to examine whether any characteristic can explain the likelihood of becoming a learning bank by using a logit regression model. The results are in Appendix B. We find that banks with high BM and idiosyncratic risk are more likely to learn from the LTCM crisis.

4.3 Verification of our main results and simulation

In this subsection, we provide further evidence that verifies our main results. First, we repeat the analysis for the nonfinancial firms. Second, we compare the predictability of short interest on stock returns during the crisis period with those in the pseudo-event periods (non-crisis periods). These two exercises help to rule out the concern that we just re-document the stock return predictability of short sales shown in the literature. In addition, two exercises help to examine whether or not short sellers search for their

targets by identifying their use of the persistent risky business model in two different samples.

4.3.1. Nonfinancial firms

In this subsection, we repeat our analysis for the nonfinancial sample. We collect all firms with available short interest data before the 2007-2008 crisis. Then, we merge the short selling data with stock returns and accounting data. The sample comprises 2,498 nonfinancial firms during the LTCM crisis and 2,326 nonfinancial firms during the 2007-2008 crisis.

First, we perform a regression as specified in Equation (1) and present the results in Table 5. In all specifications, we find that the negative relation between *RE08* and ΔSI becomes statistically insignificant after we control for the *RE98*. Thus, this result confirms that the predictability of short selling is much stronger for banks than for nonfinancial industries.

[Insert Table 5]

Next, we test our main hypothesis using the nonfinancial sample. We collect firms with available data for *RE98* and merge these data with short selling and accounting data. We then repeat the regressions in Equation (2) and present the results in Table 6.

Table 6 shows that the estimated coefficients for *RE98* are positive and become statistically insignificant. These findings show that short sellers focus uniquely on banks' risky business models before an imminent crisis. Therefore, the role of a persistent risky business model is significant only for the banks and not for the nonfinancial firms when short sellers search for targets.

[Insert Table 6]

4.3.2. Simulation in pseudo-events

Next, we rely on simulations to show that our results are much stronger for the crisis periods than any other periods based on the approach in Chan, Ge, and Lin (2015). For the first result, we randomly choose a month in the non-crisis period from 1990 to 2014 and treat it as the actual trigger event of the 2007-2008 crisis. We then regress the annualized buy-and-hold stock returns of 18 months of pseudo-events (from month *t* to month *t+17*, which matches the duration of 2007-2008 crisis) on the change in short interest in the 24 months before the pseudo-events (from month *t–24* to month *t–1*). We control for the same bank characteristics as in Table 3. We repeat the process 1,000 times and report the average coefficient for the change in short interest (ΔSI) and its associated *p*-value. We compute the *p*-value as the fraction of the number of times that the coefficient of the simulated sample is much larger (in absolute value) than that of the actual sample (in Table 3).

For the main hypothesis, we randomly choose a month in the non-crisis period from 1990 to 2014 and treat it as July 2005 (the beginning of the pre-crisis period in the 2007-2008 crisis) to conduct the simulation. We then regress the change in short interest for the 24 months of the pre-crisis period (from month *t* to month *t*+23) on the annualized buy-and-hold stock returns of the 5-month pseudo-LTCM crisis (from month *t*–78 to month *t*–83), and control for the bank characteristics as in Table 4. We repeat the process 1,000 times and report the average coefficient for the LTCM crisis returns and its associated *p*-value, which is the fraction of the number of times that the simulated coefficient is larger (in absolute value) than the coefficient of the actual sample (in Table 4).

We present the results of these simulation exercises in Panels A and B of Table 7 for the main results in Tables 3 and 4, respectively. For easier comparison, we also report the coefficients for the actual sample in the first row of the tables.

In Panel A, the negative sign of the average coefficient from 1,000 simulations of for the first result indicates that short sellers are in general informed about future banks' stock returns, which is consistent with the short selling literature. However, the coefficients for the actual bank sample are around four to six times larger in magnitude than those in the simulations. In addition, the small *p*-values indicate that there are very few simulations in which the short sellers have stronger predictability for banks' stock returns in the non-crisis periods.

Panel B of Table 7 shows that the simulated coefficients are close to zero. The small *p*-values indicate that there are very few simulations in which the magnitude of the simulated coefficients is greater than the actual sample. Like the results in subsection 4.3.1, these findings indicate that the predictability of short interest for banks' stock returns is much stronger in the 2007-2008 crisis and supports our argument that short sellers have incremental information regarding banks' stock performance in the crisis. This incremental information is likely to be rooted in the persistent risky business models of the banks as stated in our main hypothesis.

[Insert Table 7]

Next, we repeat the simulations for nonfinancial firms. In the first simulation, we are interested in whether the predictability of short selling on the stock returns of nonfinancial industries was also stronger during the 2007-2008 crisis. We present the results in Panel A of Table 8. We find that the average simulated coefficients are close to the coefficients in the actual sample. Unlike the financial stocks, the nonfinancial firms do not generate a huge difference in return predictability between actual and

pseudo-events. Meanwhile, in Panel B, we do not find significant results that short sellers target the nonfinancial firms due to their poor past performance in non-crisis periods.

[Insert Table 8]

In sum, the results in Tables 5 to 8 provide evidence that short sellers have prior knowledge of the poor performance of certain banks in a forthcoming crisis. Compared with other periods, the stock return predictability of short selling is much higher during a crisis. Furthermore, short sellers target banks that performed particularly poorly in the previous crisis, which is consistent with the idea of a persistent risky business model. These patterns are not found in the nonfinancial firms, which eases the concern that we are simply repackaging the findings in the short selling literature by using a bank sample in crisis periods.

5. Additional supporting evidence

5.1. Cross-sectional results

In this section, we conduct a cross-sectional subsample analysis to provide more evidence on the main hypothesis. Specifically, we perform regressions in Equations (1) and (2) for subsamples of banks' leverage and size (in market capitalization). The rationale is that their size may affect banks' risk-taking, and leverage is the observed outcome of this behavior.

Table 9 shows that the predictability of short selling on returns is stronger among highly leveraged and large banks. In Models (1) and (3), the point estimates of $\triangle SI$ are negative and significant, but their statistical significance disappears in Models (2) and (4). For our main hypothesis, *RE98*'s coefficients are only significant for large and highly leveraged banks.

[Insert Table 9]

Another interesting cross-sectional subsample is whether a bank has the same CEO in the two crises or not as his or her managerial style may be an important factor in the bank's risk-taking. Using the IRRC database, we track if a CEO serves for a bank both in the LTCM and the 2007-2008 crisis. In our sample, we find only 29 CEOs that serve in both crises. Thus, the observations are too few to perform a meaningful analysis for the subsample of banks having the same CEO. Instead, to assure that our results are not driven by this same CEO effect, we exclude those 29 banks and rerun the regressions in Models (9) and (10) of Table 9. Our results remain the same and indicate that a bank's risk culture goes beyond CEOs and has an influence on its performance in the two crises.[14]

5.2. Short selling and bank performance measures: loan quality and default risk

Ho, Huang, Lin, and Yen (2016) find that overconfident banks with higher levels of risk-taking before the 2007-2008 crisis suffered more in terms of more nonperforming loans (*NPL*) and a higher expected default frequency (*EDF*) during the crisis. Thus, in this subsection, we further examine whether the pre-crisis change in short interest also predicts these two performance measures of banks during the 2007-2008 crisis as additional evidence for our first result. We also use these measures to test our main hypothesis that the poor performance in the LTCM crisis makes a bank a more obvious target for short sellers before the 2007-2008 crisis. Specifically, we perform the following regressions:

[14] In unreported results, we run our main regressions for a full sample, but further controlled for CEO- and governance-related variables including *SameCEO* (a dummy that equals one if a bank has the same CEO in 1998 and 2005), *Holder67* (a dummy that equals one if the CEO, since the first year, postpones to exercise 67%-in-the-money options at least twice during his or her tenure period), *Duality* (a dummy that equals one if the CEO is also the chairman), *Board Size* (a number of board members), *Institutional Ownership* (the sum of institutional investors' share ownership), and *CEO Experience* and *Board Experience* (a number of years serving on a board by the CEO and (mean) by all board directors). Our main conclusions remain after we control for these variables and mitigate the concern that CEO attributes and bank governance quality may drive our main findings.

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\ \Delta NPL / Loan98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i \quad (3)$$

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\ \Delta NPL / Equity98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i \quad (4)$$

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\ EDF98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i \quad (5)$$

in which $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis; Δ*NPL/Loan98* is the change in the ratio of nonperforming loans to total gross loans between the crisis year of 1998 and the pre-crisis year of 1997; Δ*NPL/Equity98* is the change in the ratio of nonperforming loans to total equity between the crisis year of 1998 and the pre-crisis year of 1997; and *EDF98* is the percentile ranking of a firm's default risk based on its distance to default in the crisis year of 1998. We expect the signs of the coefficients β in Equations (3) to (5) to be positive.

Table 10 presents the results. First, the coefficients for Δ*NPL/Loan98*, Δ*NPL/Equity98*, and *EDF98* are all significantly positive. Thus, these results show that the poor performance in the LTCM crisis makes a bank a more obvious target for short sellers before the 2007-2008 crisis. In addition, these results also confirm that short sellers tended to short target banks with higher levels of risk-taking in the LTCM crisis.

[Insert Table 10]

5.3. Alternative measures of short interest

5.3.1 Borrowing costs of short selling

In this subsection, we use the borrowing cost as an alternative measure for informed short selling. We perform the following regression to examine whether our main results hold when replacing changes in short interest with changes in borrowing costs:

$$\Delta COST_{i,\,pre-\text{crisis}} = \alpha + \beta\ RE98_{i,crisis} + \gamma Z_{i,t-1} + \varepsilon_i \qquad (6)$$

in which $\Delta COST_{i,\,pre-crisis}$ is the change in borrowing costs for bank *i* in the pre-crisis period, and $RE98_{i,crisis}$ is the stock returns of bank *i* during the LTCM crisis. We expect the sign of the coefficient β in Equation (6) to be negative.

Table 11 presents the regression results. The coefficients for $\Delta COST$ are significantly negative in all models, which is consistent with our main findings. For example, in Model (4), the coefficient for *RE98* is –0.6584 and statistically significant, which supports the finding that lower returns in the LTCM crisis leads to higher borrowing costs before the 2007-2008 crisis.

[Insert Table 11]

5.3.2 Abnormal short interests

In this subsection, we construct several alternative measures of abnormal short interests and test whether our findings are robust to these measures.

Following Dechow, Hutton, Meulbroek, and Sloan (2001), Asquith, Pathak, and Ritter (2005), and Karpoff and Lou (2010), we construct the first measure of abnormal short interest *ABSI(1)* that adjusts for size (market value of equity), book-to-market ratio (BM), and momentum (the prior year return of the stock). For each month, each stock is assigned to one of 27 portfolios that are constructed by sorting stocks based on size, BM, and momentum. We run a first-stage regression as follows:

$$\begin{aligned} SI_{it} = {} & \beta_1 LowSize_{it} + \beta_2 MedSize_{it} + \beta_3 LowBM_{it} + \beta_4 MedBM_{it} \\ & + \beta_5 LowMom_{it} + \beta_6 MedMom_{it} + \sum_{k=1}^{K} \phi_k Ind_{ikt} + u_{it} \end{aligned} \qquad (7)$$

in which SI_{it} is the number of shares shorted divided by the shares outstanding. The first six explanatory variables are used to jointly define 27 portfolios based on size, BM, and momentum. For example, if bank *i* is assigned to the portfolio with the lowest market

value in month *t*, then $LowSize_{it}$ equals one and $MedSize_{it}$ equals zero. Ind_{ikt} are industry dummies based on the first two-digit SIC code. If bank *i* belongs to industry *k*, then Ind_{ikt} equals one and zero otherwise. After running the regression, abnormal short interest is defined as the difference between the raw short interest and the fitted short interest:

$$ABSI(j)_{it} = SI_{it} - \hat{SI}(j)_{it}, j = 1,2 \tag{8}$$

in which SI_{it} is the raw short interest, and $\hat{SI}(j)_{it}$ is the fitted short interest from the above regression.

With the same process, we construct our second abnormal short interest measure, *ABSI(2)*, from 243 size-, BM-, and momentum-based portfolios with share turnover (i.e., share trading volume over number of shares outstanding) and institutional ownership (i.e., the number of shares owned by institutional investors divided by the number of shares outstanding) as additional controls.

Accordingly, we have two measures of abnormal short interest: *ABSI(1)* and *ABSI(2)*. Then, we define changes in abnormal short interest in the 24-month period before the 2007-2008 crisis: $\Delta ABSI(j)_i = ABSI(j)_{i,t} - ABSI(j)_{i,t-1}$.

We then use these two measures as our main explanatory variables to re-perform our main analysis as follows:

$$\Delta ABSI(j)_{i,pre-crisis} = \alpha + \beta\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i\ ,\ j = 1,2 \tag{9}$$

Table 12 presents the regression results. Consistently, we find a negative correlation between change in abnormal short interest and the LTCM crisis returns that support our hypothesis that short sellers tend to target the banks that had high-risk exposures in the LTCM crisis when they anticipate a financial crisis.

[Insert Table 12]

5.4. Robustness checks

This subsection provides a number of robustness checks for our main hypothesis. First, we check the sensitivity of the main result by adopting the alternative time period (ΔSI_{12m}). Second, to mitigate the concern that short sellers could simply identify poor stocks based on current risks instead of a persistently risky business model, we re-perform the main test in Table 3 and control for the contemporaneous leverage. We use four measures of the contemporaneous leverage: *Leverage05* (leverage level on December 31, 2005), *Leverage06* (leverage level on December 31, 2006), $Leverage_{Jun07}$ (leverage level on June 30, 2007), and $\Delta Leverage_{05\text{-}07}$ (change in leverage from June 2005 through June 2007). Third, to control for short-sale strategies, we add lagged and contemporaneous buy-order imbalances ($OIMB^{+}$) and market uncertainty (*Uncertainty*) to the regressions (Diether, Lee, and Werner, 2009). Specifically, short sellers may voluntarily provide liquidity when there is buying pressure or short-term volatility in the market. In addition, we also control for trading turnover (*Turnover*) and liquidity (*Liquidity*).[15]

The regression results are presented in Table 13. Model (1) shows that short interest increases significantly in the next pre-crisis period if these banks suffered poor stock returns in a previous crisis. The coefficient for *RE98* is significantly negative. Second, after controlling the contemporaneous leverage, the negative relation between *RE98* and ΔSI remains significant. Model (5) shows that the persistent risky business

[15] Lagged (contemporaneous) measures are the average of the corresponding measures in 2004 (the pre-crisis period). These measures are buy-order imbalance, uncertainty, turnover, and liquidity. First, the buy-order imbalance is the daily buys minus sells scaled by daily volume. Buys and sells are identified based on Lee and Ready's (1991) algorithm and New York Stock Exchange Trades and Quotes (TAQ) database. Following Diether, Lee, and Werner (2009), we construct $OIMB^{+}$ as the buy-order imbalance if it is positive and zero otherwise. Second, *Uncertainty* is the difference in the daily high and low price scaled by the high price. Third, *Turnover* is the daily trading volume divided by the total outstanding shares. Finally, *Liquidity* is the standardized turnover-adjusted number of zero daily trading volumes over the prior 12 months (Liu, 2006).

model tends to induce short selling after controlling for short-sale strategies. Together, these results show that our findings are not driven by a particular definition of a crisis period, measurement of short selling, the potential impact of the contemporaneous leverage, or other well-documented short-sale strategies.

[Insert Table 13]

Next, some industry-specific factors may influence our findings. For example, total deposits are an important source of liabilities, but unique to commercial banks. To mitigate this potential concern, we follow Fahlenbrach et al. (2012) and re-perform our analysis using different subsamples: only depository banks (with SIC codes begin with 60), both depository and non-depository institutions (with SIC codes between 6000 and 6300), and all institutions in our sample (with SIC codes between 6000 and 6999). We also control for industry-specific factors by including asset growth, acquisition percentage, and liquidity beta into the regression. For depository banks, we additionally control whether the bank has a S&P credit rating in the Compustat database, a numeric-translated rating score (one for AAA, two for AA+, and so forth), deposit ratio, a fraction of total assets held for sale or invested in securities, and the ratio of noninterest income. Table 14 reports the results.

In Models (1) and (4), we find significant coefficients of $\triangle SI$ for *RE08* in the 2007-2008 crisis and for *RE98* before the crisis among depository institutions. For depository, saving banks, and non-depository institutions, we also find similar results in Models (2) and (5). Lastly, we rerun regressions for all institutions with SIC codes from 6000 to 6999 and further control for industry-related factors. Models (3) and (6) provide consistent results with our main findings and show that $\triangle SI$ and *RE98* are

significant in those regressions, respectively. In sum, we find that our results hold for different subsamples and after controlling for industry-specific covariates.[16]

[Insert Table 14]

6. Conclusion

Since the 2007-2008 crisis, researchers have debated whether any market participants were aware of the imminent financial crisis. Our study sheds light on this debate by focusing on whether changes in short interest before a crisis predict banks' stock returns during the crisis. We explore whether short sellers target the banks with worse performance in the previous LTCM crisis that indicates that banks excessive risk culture could serve as a red flag to the short sellers.

Our results show that a negative correlation exists between changes in short interest before the 2007-2008 crisis and return performance during the 2007-2008 crisis. We further find that before the 2007-2008 crisis, short selling was concentrated on the banks that performed relatively poorly in the LTCM crisis. This finding not only provides a validity check for the finding in Fahlenbrach, Prilmeier, and Stulz, (2012), who argue that a persistent risky business model exists among banks but also indicates that this model of taking overly high risks made these banks the targets of short sellers before the 2007-2008 crisis.

Collectively, our results provide convincing evidence that short selling predicts the performance of banks during crisis periods and that short sellers seem to be able to identify banks with a persistent culture of highly risky business models. These results

[16] Another interesting point is to explore banks' merger and acquisitions (M&A) activities in the 2007-2008 crisis. We collect all complete M&A deals with at least one million dollar value from SDC Platinum database between 2007 and 2008. Following Chan et al. (2015), we keep deals classified as "merger" or "acquisition of a majority interest" and target firms with SIC code from 6000 to 6999. We merge this data to our main sample. In total, we have 33 M&A deals with corresponding return data in the 2007-2008 crisis. We then exclude these targets and re-run our regressions and find similar support to our hypothesis. Those results are available upon request.

also show that short interest could be a potential indicator of bank performance in a tumultuous period, such as a financial crisis. Our results thus offer potential policy advice to both policy-makers and regulators who might pay attention to the market for equity lending of banks for better monitoring bank stability.

References

Acharya, V. V., Pedersen, L. H., Philippon, T., & Richardson, M. (2017). Measuring Systemic Risk. *Review of Financial Studies*, 30, 2–47.

Asquith, P., Pathak, P. A., & Ritter, J. R. (2005). Short interest, institutional ownership, and stock returns. *Journal of Financial Economics*, 78, 243–276.

Beltratti, A., & Stulz, R. M. (2012). The credit crisis around the globe: Why did some banks perform better? *Journal of Financial Economics*, 105, 1–17.

Beneish, M. D., Lee, C. M. C., & Nichols, D. C. (2015). In short supply: Short-sellers and stock returns. *Journal of Accounting and Economics*, 60, 33–57.

Berger, A. N., & Bouwman, C. H. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 109, 146–176.

Bharath, S. T., & Shumway, T. (2008). Forecasting default with the Merton distance to default model. *Review of Financial Studies*, 21, 1339–1369.

Boehmer, E., Jones, C. M., & Zhang, X. (2008). Which Shorts Are Informed? *The Journal of Finance*, 63, 491–527.

Bris, A., Goetzmann, W., & Zhu, N. (2007). Efficiency and the bear: Short sales and markets around the world. *Journal of Finance*, 62, 1029–1079.

Chan, K., Ge, L., & Lin, T.-C. (2015). Informational Content of Options Trading on Acquirer Announcement Return. *Journal of Financial and Quantitative Analysis*, 50, 1057–1082.

Chang, E. C., Cheng, J. W., & Yu, Y. (2007). Short-Sales Constraints and Price Discovery: Evidence from the Hong Kong Market. *Journal of Finance*, 62, 2097–2121.

Chang, E. C., Lin, T. C., & Ma, X. (2016). Does short-selling threat discipline managers in M&A decisions? *Unpublished Working Paper. University of Hong Kong*.

Cheng, I. H., Hong, H., & Scheinkman, J. A. (2015). Yesterday's Heroes: Compensation and Risk at Financial Firms. *The Journal of Finance*, 70, 839–879.

Christophe, S. E., Ferri, M. G., & Angel, J. J. (2004). Short-Selling Prior to Earnings Announcements. *Journal of Finance*, 59, 1845–1876.

Christophe, S. E., Ferri, M. G., & Hsieh, J. (2010). Informed trading before analyst downgrades: Evidence from short sellers. *Journal of Financial Economics*, 95, 85–106.

Cheng, I.-H., Raina, S., & Xiong, W. (2014). Wall Street and the Housing Bubble. *American Economic Review*, 104(9), 2797–2829.

Cohen, L., Diether, K. B., & Malloy C. J. (2007). Supply and demand shifts in the shorting market. *The Journal of Finance*, 62, 2061−2096.

Colander, D., Goldberg, M., Haas, A., Juselius, K., Kirman, A., Lux, T., & Sloth, B. (2009). The financial crisis and the systemic failure of the economics profession. *Critical Review*, 21, 249–267.

Daniel, K., Grinblatt, M., Titman, S., & Wermers, R. (1997). Measuring Mutual Fund Performance with Characteristic-Based Benchmarks. *The Journal of Finance*, 52(3), 1035–1058.

Daniel, K., Klos, A., & Rottke, S. (2017). Overpriced Winners. *Unpublished Working Paper, Columbia University*.

Dechow, P. M., Hutton, A. P., Meulbroek, L., & Sloan, R. G. (2001). Short-sellers, fundamental analysis, and stock returns. *Journal of Financial Economics*, 61, 77–106.

Desai, H., Krishnamurthy, S., & Venkataraman, K. (2006). Do short-sellers target firms with poor earnings quality? Evidence from earnings restatements. *Review of Accounting Studies*, 11, 71–90.

Desai, H., Rajgopal, S., & Yu, J. (2016). Were information intermediaries sensitive to the financial statement-based leading indicators of bank distress prior to the financial crisis? *Contemporary Accounting Research*, 33, 576–606.

Diamond, D. W., & Verrecchia, R. E. (1987). Constraints on short-selling and asset price adjustment to private information. *Journal of Financial Economics*, 18, 277–311.

Diether, K. B., Lee, K. H., Werner, I. M. (2009). It's SHO time! Short-sale price tests and market quality. *Journal of Finance*, 64, 37–73.

Drake, M. S., Rees, L., & Swanson, E. P. (2011) Should Investors Follow the Prophets or the Bears? Evidence on the Use of Public Information by Analysts and Short Sellers. *The Accounting Rev*iew, 86, 101–130.

Drechsler, I., & Drechsler, Q. (2016), The Shorting Premium and Asset Pricing Anomalies, *Unpublished Working Paper. New York University.*

Ellul, A., & Yerramilli, V. (2013). Stronger risk controls, lower risk: Evidence from US bank holding companies. *The Journal of Finance*, 68, 1757–1803.

Engelberg, J. E., Reed, A. V., & Ringgenberg, M. C. (2012). How are shorts informed?: Short sellers, news, and information processing. *Journal of Financial Economics*, 105, 260–278.

Engelberg, J. E., Reed, A. V., & Ringgenberg, M. C. (2018). Short-Selling Risk. *Journal of Finance*, 73, 755–786.

Erel, I., Nadauld, T., & Stulz, R. M. (2014). Why Did Holdings of Highly Rated Securitization Tranches Differ So Much across Banks? *Review of Financial Studies*, 27, 404–453.

Fahlenbrach, R., Prilmeier, R., & Stulz, R. M. (2012). This Time Is the Same: Using Bank Performance in 1998 to Explain Bank Performance during the Recent Financial Crisis. *The Journal of Finance*, 67, 2139–2185.

Fahlenbrach, R., & Stulz, R. M. (2011). Bank CEO incentives and the credit crisis. *Journal of Financial Economics*, 99, 11–26.

Greenspan, A. (2008). *The age of turbulence: Adventures in a new world*. Penguin.

Guiso, L., Sapienza, P., & Zingales, L. (2015a). Corporate Culture, Societal Culture, and Institutions. *American Economic Review*, 105, 336–339.

Guiso, L., Sapienza, P., & Zingales, L. (2015b). The Value of Corporate Culture. *Journal of Financial Economics*, 117, 60–76.

Hanley, K.W., & Hoberg, G. (2016). Dynamic interpretation of emerging systemic risks. *Unpublished Working Paper. University of Southern California*.

Hasan, I., Massoud, N., Saunders, A., & Song, K. (2015). Which financial stocks did short sellers target in the subprime crisis? *Journal of Banking & Finance*, 54, 87–103.

Ho, P. H., Huang, C. W., Lin, C. Y., & Yen, J. F. (2016). CEO overconfidence and financial crisis: Evidence from bank lending and leverage. *Journal of Financial Economics*, 120, 194–209.

Karpoff, J. M., & Lou, X. (2010). Short Sellers and Financial Misconduct. *The Journal of Finance*, 65, 1879–1913.

Kecskés, A., Mansi, S. A., & Zhang, A. J. (2012). Are short sellers informed? Evidence from the bond market. *The Accounting Review*, 88, 611–639.

Kindleberger, C.P., & Aliber, R.Z. (2005). *Manias, Panics and Crashes*. Palgrave Macmillan.

Lee, C.M.C., & Ready, M.J. (1991). Inferring Trade Direction from Intraday Data. *The Journal of Finance*, 46, 733–746.

Liu, W., (2006). A liquidity-augmented capital asset pricing model. *Journal of Financial Economics*, 82, 631–671.

Nagel, S. (2005). Short sales, institutional investors and the cross-section of stock returns. *Journal of Financial Economics*, 78, 277–309.

Pan, Y., Siegel, S., & Wang, T. (2017). Corporate Risk Culture. *Journal of Financial and Quantitative Analysis*, 52, 2327–2367.

Pástor, L., & Stambaugh, R.F., (2003). Liquidity Risk and Expected Stock Returns. *Journal of Political Economy*, 111, 642–685.

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies*, 22, 435–480.

Pownall, G., & Simko, P. J. (2005). The information intermediary role of short sellers. *The Accounting Review*, 80, 941–966.

Senchack, A. J., & Starks, L. T. (1993). Short-Sale Restrictions and Market Reaction to Short-Interest Announcements. *The Journal of Financial and Quantitative Analysis*, 28, 177–194.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, 48, 817–838.

Yermack, D., (1996). Higher market valuation of companies with a small board of directors. *Journal of Financial Economics*, 40, 185–211.

Table 1. Summary statistics

The table presents the summary statistics for all of the variables used in this study. The 2007-2008 crisis is from July 1, 2007, through December 31, 2008, for *RE08*. The *RE98* is from August 3, 1998, until the day in 1998 on which the bank's stock attains its lowest price during the LTCM crisis. The ΔSI and $\Delta COST$ are changes in the short interest and the stock borrowing cost from June 2005 through June 2007, respectively. ΔSI_{12m} is a similar measure of short interest from August 1996 through July 1998. The other variables are bank characteristics in the year 2006 and 2004. The variable definitions are in Appendix A.

	(1) Mean	(2) SD	(3) Min	(4) p25	(5) p50	(6) p75	(7) Max
Panel A: Financial crisis variables							
ΔSI	0.017	0.044	–0.221	–0.000	0.005	0.037	0.372
ΔSI_{12m}	0.007	0.044	–0.358	–0.000	0.001	0.016	0.270
$\Delta COST$	0.135	0.396	–0.375	0.000	0.000	0.143	1.381
RE08	–0.466	0.310	–0.951	–0.733	–0.470	–0.216	0.069
Panel B: LTCM crisis variables							
RE98	–0.275	0.155	–0.701	–0.354	–0.248	–0.167	–0.008
RE98 rebound	0.263	0.433	–0.154	0.014	0.139	0.313	2.000
$\Delta LTCMSI$	0.006	0.012	–0.009	–0.000	0.002	0.008	0.035
$\Delta NPL/Loan98$	–0.001	0.004	–0.011	–0.002	–0.000	0.001	0.006
$\Delta NPL/Equity98$	–0.007	0.026	–0.084	–0.016	–0.003	0.008	0.038
EDF98	0.065	0.139	0.000	0.000	0.002	0.037	0.543
ROE98	0.035	0.019	0.007	0.023	0.032	0.043	0.094
Panel C: Control variables							
LnAssets06	7.936	2.327	2.809	6.520	7.624	9.196	13.469
BM06	0.602	0.266	0.101	0.425	0.573	0.749	1.253
PastReturn06	0.116	0.209	–0.293	–0.023	0.114	0.268	0.479
Leverage06	8.245	5.946	1.077	2.708	7.932	12.140	22.172
Beta06	0.662	0.409	–0.012	0.290	0.679	0.956	1.346
IDIORISK06	1.640	0.609	0.601	1.161	1.487	1.971	3.043
MES06	–0.011	0.006	–0.022	–0.015	–0.012	–0.006	0.000
TCE06	19.644	19.768	–1.009	6.311	9.700	29.038	75.257
LnAssets04	7.402	2.257	2.286	6.217	7.186	8.546	13.192
BM04	0.572	0.267	0.097	0.401	0.525	0.706	1.284
PastReturn04	0.118	0.227	–0.324	–0.018	0.100	0.260	0.603
Leverage04	8.492	5.581	1.063	2.858	9.192	12.205	22.193
Beta04	0.445	0.350	–0.041	0.139	0.380	0.695	1.201
IDIORISK04	2.172	1.019	0.818	1.471	1.891	2.482	4.955
MES04	–0.012	0.010	–0.032	–0.019	–0.010	–0.003	0.002
TCE04	19.273	20.819	–4.574	6.396	8.935	26.863	76.839
Leverage05	8.622	5.628	1.100	2.893	9.356	12.607	21.923
$Leverage_{Jun07}$	8.562	5.639	1.077	2.902	9.228	12.373	22.172
$\Delta Leverage_{05\text{-}07}$	0.182	1.592	–3.184	–0.542	0.023	0.778	5.168
$OIMB^{+}_{04}$	0.190	0.088	0.064	0.118	0.172	0.253	0.375
$OIMB^{+}_{0507}$	0.160	0.094	0.047	0.086	0.128	0.220	0.487
$Uncertainty_{04}$	0.023	0.008	0.007	0.017	0.021	0.027	0.039
$Uncertainty_{0507}$	0.020	0.007	0.005	0.015	0.019	0.024	0.035
$Turnover_{04}$	0.003	0.003	0.000	0.001	0.002	0.004	0.015
$Turnover_{0507}$	0.003	0.004	0.000	0.001	0.002	0.004	0.035
$Liquidity_{04}$	17.427	31.961	0.000	0.000	0.000	18.190	111.942
$Liquidity_{0507}$	17.680	31.024	0.000	0.000	0.000	23.397	104.030
Asset growth	0.112	0.112	–0.037	0.028	0.091	0.173	0.364
Acquisition	0.001	0.006	–0.013	0.000	0.000	0.002	0.013
Liquidity beta	0.060	0.201	–0.466	–0.024	0.044	0.180	0.573

Rated	0.198	0.399	0.000	0.000	0.000	0.000	1.000
Rating	18.893	6.359	4.000	22.000	22.000	22.000	22.000
Deposit	0.790	0.141	0.331	0.724	0.822	0.890	0.991
Investment securities	0.183	0.118	0.006	0.105	0.162	0.236	0.598
Asset for sale	0.007	0.020	0.000	0.000	0.000	0.003	0.130
Noninterest income	0.254	0.161	0.023	0.140	0.219	0.318	0.781

Table 2. Double sorting of pre-crisis short interest

This table presents the frequency and the average *RE08* for 3×3 groups formed by the LTCM and the 2007-2008 pre-crisis change in short interest. We sorted the pre-crisis change into terciles in which G1 and G3 are groups that had the lowest and highest changes in short interest, respectively. In the table, ΔSI is the change in the total number of stocks that are borrowed divided by the stocks outstanding from June 2005 through June 2007, while ΔSI_{LTCM} is a similar measure for August 1996 through July 1998. Panel A shows the frequency and row percentage of observations (in parentheses), while Panel B presents the average of *RE08* for each group.

Panel A: Frequency				
			ΔSI	
		G1	G2	G3
ΔSI_{LTCM}	G1	62 (36.26%)	48 (28.07%)	61 (35.67%)
	G2	61 (35.67%)	62 (36.26%)	48 (28.07%)
	G3	48 (27.43%)	61 (34.86%)	66 (37.71%)
Panel B: Average RE98				
			ΔSI	
		G1	G2	G3
ΔSI_{LTCM}	G1	–0.34	–0.39	–0.43
	G2	–0.36	–0.44	–0.40
	G3	–0.42	–0.45	–0.45

Table 3. Short selling and financial crisis returns

This table presents the results from an OLS for the short selling and financial crisis returns. The 2007-2008 crisis period is from July 1, 2007, through December 31, 2008.

$$RE08_{i,\text{crisis}} = \alpha + \beta\ \Delta SI_{i,\,pre-crisis} + \gamma Z_{i,2006} + \varepsilon_i$$

in which $RE08_{i,crisis}$ represents stock returns for bank *i* in the 2007-2008 crisis; $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the crisis; and $\boldsymbol{Z}$ is a vector of control variables for bank *i* in the year 2006. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	RE08	*RE08*	*RE08*	*RE08*
ΔSI	–0.5501*	–0.5957**	–0.8122***	–0.6967**
	(–1.86)	(–2.01)	(–2.66)	(–2.16)
RE98	0.3663***	0.3434***	0.3342***	0.3500***
	(4.08)	(3.79)	(3.68)	(3.77)
RE98 rebound	–0.0283*	–0.0257	–0.0244	–0.0239
	(–1.75)	(–1.58)	(–1.50)	(–1.46)
LnAssets	–0.0354***	–0.0442***	–0.0332***	–0.0470***
	(–4.93)	(–5.13)	(–4.14)	(–5.00)
BM	0.0319	0.0536	0.0515	0.0587
	(0.69)	(1.13)	(1.08)	(1.21)
PastReturn	0.0158	0.0366	0.0355	0.0453
	(0.45)	(0.99)	(0.95)	(1.20)
Leverage	–0.0005		–0.0006	–0.0013
	(–0.39)		(–0.44)	(–0.90)
Beta	0.2304***	0.2468***		0.1149*
	(6.34)	(6.68)		(1.67)
IDIORISK		–0.0335	–0.0279	–0.0362*
		(–1.64)	(–1.38)	(–1.75)
MES			–14.6780***	–9.2918**
			(–6.55)	(–2.26)
TCE				–0.0013**
				(–2.00)
Constant	–0.2271***	–0.1400*	–0.2213***	–0.0891
	(–3.89)	(–1.76)	(–2.81)	(–0.97)
Obs.	676	676	676	661
Adj-R^2	0.0836	0.0871	0.0857	0.0919

Table 4. LTCM crisis returns and short selling in pre-crisis period

This table presents the results for an OLS for the 1998 LTCM crisis return and short selling in the pre-crisis period.

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\, RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis; $RE98_{i,crisis}$ is the stock returns for bank *i* in the LTCM crisis; and ***Z*** is a vector of control variables for bank *i* in the year 2004. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) ΔSI	(2) ΔSI	(3) ΔSI	(4) ΔSI
RE98	–0.0223*	–0.0239**	–0.0250**	–0.0252**
	(–1.90)	(–1.99)	(–2.05)	(–2.10)
RE98 rebound	–0.0020	–0.0019	–0.0019	–0.0021
	(–0.92)	(–0.85)	(–0.89)	(–0.92)
LnAssets	0.0006	–0.0002	–0.0001	0.0006
	(0.53)	(–0.17)	(–0.05)	(0.46)
BM	–0.0075	–0.0058	–0.0063	–0.0090
	(–1.23)	(–0.95)	(–1.03)	(–1.44)
PastReturn	0.0040	0.0051	0.0047	0.0032
	(0.70)	(0.89)	(0.81)	(0.56)
Leverage	–0.0002		–0.0001	–0.0001
	(–0.66)		(–0.50)	(–0.33)
Beta	–0.0003	0.0020		–0.0023
	(–0.06)	(0.35)		(–0.22)
IDIORISK		–0.0014	–0.0013	–0.0006
		(–0.88)	(–0.85)	(–0.36)
MES			–0.0685	–0.0935
			(–0.35)	(–0.28)
TCE				0.0001
				(0.85)
Constant	0.0154**	0.0198**	0.0201**	0.0145
	(1.98)	(2.13)	(2.19)	(1.39)
Obs.	731	731	727	701
Adj-R^2	0.0086	0.0090	0.0098	0.0120

Table 5. Short selling and financial crisis returns: Nonfinancial firms

This table presents the results for an OLS for short selling and the 2007-2008 crisis returns for nonfinancial firms. The crisis period is from July 1, 2007, through December 31, 2008.

$$RE08_{i,\text{crisis}} = \alpha + \beta\ \Delta SI_{i,\,pre-crisis} + \gamma Z_{i,2006} + \varepsilon_i$$

in which $RE08_{i,crisis}$ represent stock returns for firm *i* in the 2007-2008 crisis; $\Delta SI_{i,pre-crisis}$ is the change in short interest for firm *i* in the pre-crisis period of the crisis; and ***Z*** is a vector of control variables for firm *i* in the year 2006. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	RE08	*RE08*	*RE08*	*RE08*
ΔSI	–0.0347	–0.0402	–0.0422	–0.0374
	(–0.56)	(–0.65)	(–0.68)	(–0.60)
RE98	0.2871***	0.2584***	0.2588***	0.2511***
	(3.72)	(3.30)	(3.28)	(3.11)
RE98 rebound	–0.0007	–0.0004	–0.0006	–0.0005
	(–0.18)	(–0.11)	(–0.17)	(–0.14)
LnAssets	0.0106	0.0026	0.0004	0.0038
	(1.64)	(0.34)	(0.06)	(0.47)
BM	–0.0462**	–0.0514***	–0.0498***	–0.0666***
	(–2.49)	(–2.75)	(–2.67)	(–2.97)
PastReturn	–0.0060	–0.0030	–0.0022	–0.0045
	(–0.33)	(–0.17)	(–0.12)	(–0.25)
Leverage	0.0000		0.0001	0.0000
	(0.09)		(0.12)	(0.10)
Beta	–0.0501*	–0.0451*		–0.0464
	(–1.92)	(–1.72)		(–1.26)
IDIORISK		–0.0175**	–0.0175**	–0.0161*
		(–1.98)	(–1.97)	(–1.78)
MES			1.8997	0.0895
			(1.22)	(0.04)
TCE				0.0003
				(1.24)
Constant	–0.3731***	–0.2856***	–0.2834***	–0.3004***
	(–6.64)	(–4.00)	(–3.95)	(–4.03)
Obs.	2,326	2,326	2,326	2,270
Adj-R^2	0.0108	0.0124	0.0114	0.0108

Table 6. LTCM crisis returns and short selling in pre-crisis period: Nonfinancial firms

This table presents the results for an OLS for the LTCM crisis return and short selling in pre-crisis period for nonfinancial firms.

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\, RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $\Delta SI_{i,pre-crisis}$ is the change in short interest for firm *i* in the pre-crisis period of the 2007-2008 crisis; $RE98_{i,crisis}$ is the stock returns for firm *i* in the LTCM crisis; and ***Z*** is a vector of control variables for firm *i* in the year 2004. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) ΔSI	(2) ΔSI	(3) ΔSI	(4) ΔSI
RE98	0.0251	0.0280	0.0260	0.0297
	(1.02)	(1.11)	(1.02)	(1.13)
RE98 rebound	0.0001	–0.0001	–0.0001	–0.0001
	(0.01)	(–0.02)	(–0.04)	(–0.08)
LnAssets	–0.0022	–0.0016	–0.0019	–0.0022
	(–1.09)	(–0.68)	(–0.79)	(–0.85)
BM	0.0018	0.0020	0.0020	0.0028
	(0.19)	(0.21)	(0.21)	(0.28)
PastReturn	–0.0101**	–0.0105***	–0.0112***	–0.0112***
	(–2.56)	(–2.59)	(–2.70)	(–2.65)
Leverage	0.0001		0.0001	0.0001
	(0.21)		(0.20)	(0.21)
Beta	0.0119	0.0110		0.0081
	(1.60)	(1.44)		(0.59)
IDIORISK		0.0011	0.0005	0.0005
		(0.46)	(0.20)	(0.19)
MES			–0.4484	–0.2070
			(–1.40)	(–0.38)
TCE				–0.0001
				(–0.34)
Constant	0.0282	0.0222	0.0254	0.0270
	(1.57)	(0.99)	(1.12)	(1.14)
Obs.	2,498	2,498	2,476	2,419
Adj-R^2	0.0017	0.0018	0.0016	0.0010

Table 7. Pseudo-events test in bank sample

Panel A shows the coefficients of change in short interest in regressions of the 2007-2008 crisis returns based on simulation. For comparison, the coefficients in the first row are our original sample of the 2007-2008 crisis (i.e., Table 3). The second row presents the coefficients from the simulation. For each bank in our sample, we randomly choose a non-crisis month as its pseudo-event month. We regress the annualized buy-and-hold stock returns of 18-month pseudo-events (from month *t* to month *t*+17) on the change in short interest for the 24 months before the pseudo-events (from month *t–24* to month *t–1*), and control for the pre-year bank characteristics as those in Table 3. We repeat the process 1,000 times and report the average coefficient of the change in short interest (ΔSI) and its associated *p*-value in parentheses. The *p*-value is the fraction of the number of times that the simulated coefficient is larger (in absolute value) than the coefficient for the actual sample (in Table 3).

Panel B shows the coefficients for the LTCM crisis returns in regressions of change in pre-crisis short interest based on simulation. For comparison, the coefficients in the first row are our original sample of the 2007-2008 crisis (i.e., Table 4). The second row presents the coefficients from the simulation. For each bank in our sample, we randomly choose a non-crisis month as its pseudo-event month for July 2005 (the beginning of pre-crisis period in the 2007-2008 crisis). We regress the change in short interest for the 24 months before the pre-crisis period (from month *t* to month *t+23*) on the annualized buy-and-hold stock returns for the 5-month pseudo-LTCM crisis (from month *t–78* to month *t–83*) and control for the pre-year bank characteristics as those in Table 4. We repeat the process 1,000 times and report the average coefficient of the LTCM crisis returns and its associated *p*-value in parentheses. The *p*-value is the fraction of the number of times that the simulated coefficient is larger (in absolute value) than the coefficient for the actual sample (in Table 4).

Panel A: Simulation for short selling and stock returns in financial crisis				
	Model 1	**Model 2**	**Model 3**	**Model 4**
Original sample on actual crisis period	–0.5501	–0.5957	–0.8122	–0.6967
Bank sample on non-crisis period (pseudo-events)	–0.1696 (0.090)	–0.1480 (0.090)	–0.1485 (0.080)	–0.1273 (0.086)
Panel B: Simulation for main hypothesis				
	Model 1	**Model 2**	**Model 3**	**Model 4**
Original sample on actual crisis periods	–0.0223	–0.0239	–0.0250	–0.0252
Bank sample on non-crisis period (pseudo-events)	0.0006 (0.045)	0.0003 (0.041)	–0.0001 (0.041)	0.0000 (0.037)

Table 8. Pseudo-events test in nonfinancial firms

Panel A shows the coefficients of change in short interest in regressions of the 2007-2008 crisis returns based on simulation. For comparison, the coefficients in the first row are our original sample of the 2007-2008 crisis (i.e., Table 5). The second row presents the coefficients from the simulation. For each nonfinancial firm in our sample, we randomly choose a non-crisis month as its pseudo-event month. We regress the annualized buy-and-hold stock returns of 18-month pseudo-events (from month *t* to month *t*+17) on the change in short interest for the 24 months before the pseudo-events (from month *t–24* to month *t–1*), and control for the pre-year firm characteristics as those in Table 5. We repeat the process 1,000 times and report the average coefficient of the change in short interest (ΔSI) and its associated *p*-value in parentheses. The *p*-value is the fraction of the number of times that the simulated coefficient is larger (in absolute value) than the coefficient for the actual sample (in Table 5).

Panel B shows the coefficients of LTCM crisis returns in regressions of change in pre-crisis short interest based on simulation. For comparison, the coefficients in the first row are our nonfinancial sample of the 2007-2008 crisis (i.e., Table 6). The second row presents the coefficients from simulation. For each nonfinancial firm, we randomly choose a non-crisis month as its pseudo-event month of July 2005 (the beginning of pre-crisis period in the 2007-2008 crisis). We regress the change in short interest of for the 24 months before the pre-crisis period (from month *t* to month *t*+23) on the annualized buy-and-hold stock returns of for the 5-month pseudo-LTCM crisis (from month *t*–78 to month *t*–83), and control for the pre-year firm characteristics as those in Table 6. We repeat the process for 1,000 times and report the average coefficient of the LTCM crisis returns and its associated *p*-value in parentheses. The *p*-value is the fraction of the number of times that the simulated coefficient is larger (in absolute value) than the coefficient of for the actual sample (in Table 6).

Panel A: Simulation for short selling and stock returns in financial crisis				
	Model 1	**Model 2**	**Model 3**	**Model 4**
Nonfinancial on actual crisis period	–0.0347	–0.0402	–0.0422	–0.0374
Nonfinancial firms on non-crisis periods (pseudo-events)	–0.0362 (0.269)	–0.0367 (0.241)	–0.0461 (0.218)	–0.0464 (0.252)
Panel B: Simulation for main hypothesis				
	Model 1	**Model 2**	**Model 3**	**Model 4**
Nonfinancial on actual crisis period	0.0251	0.0280	0.0260	0.0297
Nonfinancial firms on non-crisis period (pseudo-events)	–0.0019 (0.610)	–0.0018 (0.610)	–0.0006 (0.676)	–0.0007 (0.676)

Table 9. Cross-sectional analysis

This table presents the results from an OLS for subsamples of the banks' leverage and size after excluding banks with the same CEO in the two crises. The models (1)-(4) and (9) present the regression results for the LTCM crisis return and pre-crisis change in short selling in the 2007-2008 crisis and the models (5)-(8) and (10) present the regression results for the LTCM crisis return and pre-crisis change in short selling in the 2007-2008 crisis.

$$RE08_{i,\text{crisis}} = \alpha + \beta\ \Delta SI_{i,pre-crisis} + \gamma Z_{i,2006} + \varepsilon_i$$

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta_1\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $RE08_{i,crisis}$ represents the stock returns for bank *i* in the 2007-2008 crisis; $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis; $RE98_{i,crisis}$ is the stock returns for bank *i* in the LTCM crisis; and $\boldsymbol{Z}_{i,t}$ is a vector of control variables for bank *i* in year *t*. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Subsamples	(1) *High Leverage*	(2) *Low Leverage*	(3) *Large*	(4) *Small*	(5) *High Leverage*	(6) *Low Leverage*	(7) *Large*	(8) *Small*	(9) *Only different CEOs*	(10) *Only different CEOs*
	RE08	*RE08*	*RE08*	*RE08*	*△SI*	*△SI*	*△SI*	*△SI*	*RE08*	*△SI*
△SI	–1.1287**	–0.5938	–0.8111**	–0.2040					–0.7768**	
	(–2.33)	(–1.30)	(–2.06)	(–0.32)					(–2.35)	
RE98	0.2920**	0.3625**	0.5317***	0.1138	–0.0175***	–0.0174	–0.0421**	–0.0246*	0.3377***	–0.0259**
	(2.25)	(2.59)	(3.86)	(0.90)	(–2.82)	(–0.43)	(–2.53)	(–1.67)	(3.51)	(–2.09)
RE98 rebound	–0.0579*	–0.0078	0.0024	–0.0961***	–0.0007	0.0036	–0.0033	0.0033	–0.0247	–0.0025
	(–1.82)	(–0.39)	(0.12)	(–2.64)	(–0.47)	(0.56)	(–1.16)	(0.94)	(–1.48)	(–1.04)
LnAssets	–0.0536***	–0.0374**	–0.0545***	–0.0700**	0.0005	–0.0023	–0.0120***	0.0131***	–0.0413***	–0.0004
	(–3.69)	(–2.11)	(–3.23)	(–2.07)	(0.67)	(–0.47)	(–5.76)	(4.10)	(–3.90)	(–0.27)
BM	–0.0831	–0.0266	–0.0664	–0.0305	–0.0030	0.0035	0.0079	–0.0037	–0.0278	–0.0092
	(–1.03)	(–0.41)	(–0.84)	(–0.47)	(–0.66)	(0.19)	(0.84)	(–0.53)	(–0.56)	(–1.47)
PastReturn	–0.0270	0.0459	–0.1114	0.0773*	0.0103**	0.0298*	–0.0140	0.0065	0.0509	0.0047
	(–0.27)	(1.05)	(–1.35)	(1.80)	(2.40)	(1.89)	(–1.43)	(1.08)	(1.31)	(0.78)
Leverage	–0.0006	0.0013	–0.0029	–0.0005	–0.0001	0.0004	0.0005	–0.0002	–0.0016	–0.0000
	(–0.32)	(0.08)	(–0.94)	(–0.28)	(–0.79)	(0.12)	(1.58)	(–0.47)	(–1.10)	(–0.13)
Beta	0.2136**	0.0016	–0.0441	0.3622***	–0.0028	–0.1111***	0.0118	–0.0295**	0.1003	0.0059
	(2.12)	(0.02)	(–0.47)	(3.41)	(–0.48)	(–3.40)	(0.80)	(–2.06)	(1.41)	(0.55)

TCE	–0.0004	–0.0008	–0.0000	0.0001	–0.0001	0.0002	0.0000	0.0001	–0.0000	0.0001
	(–0.04)	(–0.95)	(–0.04)	(0.08)	(–0.23)	(0.86)	(0.07)	(1.04)	(–0.03)	(0.76)
MES	–7.4971	–11.3884*	–12.9063*	3.0007	0.1779	–3.3584***	0.2889	–0.8084**	–10.0654**	–0.0130
	(–1.31)	(–1.81)	(–1.90)	(0.49)	(0.95)	(–3.15)	(0.56)	(–2.16)	(–2.36)	(–0.04)
IDIORISK	–0.0188	–0.0311	0.0114	–0.0315	0.0024**	0.0114**	–0.0133***	0.0039**	–0.0251	–0.0014
	(–0.50)	(–1.16)	(0.27)	(–1.27)	(2.16)	(2.30)	(–3.37)	(2.44)	(–1.20)	(–0.84)
Constant	–0.1372	–0.0961	0.0821	–0.1158	–0.0022	–0.0093	0.1208***	–0.0626***	–0.1701*	0.0202*
	(–0.80)	(–0.55)	(0.46)	(–0.59)	(–0.24)	(–0.21)	(6.65)	(–3.29)	(–1.78)	(1.75)
Obs.	385	276	348	313	398	300	417	284	632	670
Adj. R^2	0.1060	0.0326	0.1199	0.0845	0.0517	0.0576	0.1057	0.1045	0.0782	0.0010

Table 10. Short selling, loan quality, and default risk

This table presents the results from an OLS for short selling, loan quality, and default risk. The LTCM crisis is from August 1998 to December 1998.

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\ \Delta NPL/Loan98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\ \Delta NPL/Equity98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta\ EDF98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis; Δ*NPL/Loan98* is the change in ratio of nonperforming loans to total gross loans between the crisis year 1998 and the pre-crisis year 1997; Δ*NPL/Equity98* is the change in ratio of nonperforming loans to total equity between crisis year 1998 and the pre-crisis year 1997; *EDF98* is the percentile ranking of a firm's default risk based on its distance to default in year 1998; and ***Z*** is a vector of control variables for bank *i* in the year 2004. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Δ*SI*	(2) Δ*SI*	(3) Δ*SI*
Δ*NPL/Loan 98*	0.0376**		
	(2.22)		
Δ*NPL/Equity 98*		0.0075**	
		(2.25)	
EDF 98			0.0405**
			(2.30)
LnAssets	0.0083	–0.0029	–0.0009
	(1.37)	(–1.23)	(–0.42)
BM	–0.0101	–0.0308*	–0.0252**
	(–0.50)	(–1.83)	(–1.98)
PastReturn	0.0188	0.0237	0.0031
	(1.13)	(1.42)	(0.31)
Leverage	–0.0007	–0.0001	0.0003
	(–0.36)	(–0.03)	(0.49)
Beta	0.0061	0.0376	–0.0252
	(0.18)	(1.46)	(–1.48)
IDIORISK	0.0004	0.0004	0.0002*
	(0.37)	(0.36)	(1.66)
MES	–0.0752	0.2385	–0.9806
	(–0.07)	(0.25)	(–1.59)
TCE	–0.0006	–0.0029	–0.0002
	(–0.19)	(–1.54)	(–0.08)
Constant	–0.0325	0.0511	0.0332*
	(–0.46)	(1.22)	(1.97)
Obs.	214	264	360
Adj-R²	0.0679	0.0596	0.0122

Table 11. Stock borrowing costs and financial crisis returns

This table presents the results from an OLS for stock borrowing costs and the 2007-2008 crisis returns. The pre-crisis period is from July 1, 2005, through June 30, 2007, while the LTCM crisis is from August 1998 to December 1998.

$$\Delta COST_{i,\,pre-crisis} = \alpha + \beta\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $\Delta COST_{i,pre-crisis}$ is the change in stock borrowing costs for bank *i* in the pre-crisis period of the 2007-2008 crisis; $RE98_{i,crisis}$ is the stock returns of bank *i* during the LTCM crisis; and ***Z*** is a vector of control variables for bank *i* in the year 2004. The variable definitions are in the Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) $\Delta COST$	(2) $\Delta COST$	(3) $\Delta COST$	(4) $\Delta COST$
RE98	–0.7682***	–0.6154**	–0.6441***	–0.6584***
	(–3.26)	(–2.53)	(–2.65)	(–2.62)
RE98 rebound	0.0358	0.0323	0.0209	0.0397
	(0.85)	(0.77)	(0.52)	(0.85)
LnAssets	–0.0074	0.0274	0.0320	0.0390
	(–0.33)	(1.18)	(1.28)	(1.42)
BM	–0.3218**	–0.4167***	–0.3991***	–0.4365***
	(–2.51)	(–3.18)	(–3.06)	(–3.06)
PastReturn	0.1728	0.1476	0.1606	0.1546
	(1.29)	(1.10)	(1.20)	(1.11)
Leverage	0.0040		0.0005	–0.0009
	(0.76)		(0.10)	(–0.17)
Beta	–0.2309**	–0.3252***		0.0489
	(–2.01)	(–2.81)		(0.24)
IDIORISK		0.0897**	0.0822**	0.1009**
		(2.42)	(2.26)	(2.55)
MES			13.9418***	17.6891**
			(3.38)	(2.45)
TCE				–0.0003
				(–0.17)
Constant	0.2974*	0.0165	–0.0048	–0.0358
	(1.74)	(0.08)	(–0.02)	(–0.15)
Obs.	506	506	505	483
Adj-R^2	0.0414	0.0514	0.0585	0.0633

Table 12. Abnormal short interest and LTCM crisis return

This table presents the results from an OLS for the 1998 LTCM crisis return and abnormal short selling in the pre-crisis period. The pre-crisis period is from July 1, 2005, through June 30, 2007, while the LTCM crisis is from August 1998 to December 1998. For Models (1) and (2), the empirical models are as follows.

$$\Delta ABSI(j)_{i,\,pre-crisis} = \alpha + \beta\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i\ ,\ j = 1, 2$$

in which $\Delta ABSI(j)_{i,\,pre-crisis}$ is the change in abnormal short interest for bank *i* in the pre-crisis period; $RE98_{i,crisis}$ is the stock returns of bank *i* during the LTCM crisis; and ***Z*** is a vector of control variables for bank *i* in the year 2004. To construct *ABSI(1)*, we regress short interest (as percentage of the number of shares outstanding) on explanatory variables (size, book-to-market, momentum, and industry dummies). To construct *ABSI(2)*, besides size, book-to-market, momentum, and industry dummies, we add share turnover and institutional ownership as explanatory variables in the short interest regression. Following Karpoff and Lou (2010), the abnormal short interest is calculated by subtracting raw short interest from the fitted short interest of the short interest regression. Industry is defined as the two-digit SIC code, share turnover is the trading volume divided by the number of shares outstanding, and institutional ownership is the number of shares owned by institutional investors divided by the number of shares outstanding. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Δ*ABSI(1)*	(2) Δ*ABSI(2)*
RE98	–0.0315*	–0.0261*
	(–1.94)	(–1.70)
RE98 rebound	–0.0019	0.0015
	(–0.76)	(0.48)
LnAssets	0.0007	–0.0023
	(0.60)	(–1.45)
BM	–0.0095	0.0027
	(–1.36)	(0.34)
PastReturn	–0.0130**	–0.0187**
	(–1.99)	(–2.56)
Leverage	–0.0002	0.0002
	(–0.41)	(0.47)
Beta	0.0136	0.0021
	(0.98)	(0.16)
IDIORISK	–0.0000	–0.0001
	(–0.17)	(–1.29)
MES	0.6209	0.0572
	(1.33)	(0.13)
TCE	–0.0019	–0.0003
	(–1.03)	(–0.16)
Constant	0.0013	0.0134
	(0.11)	(0.99)
Obs.	666	556
Adj-R²	0.0073	0.0115

Table 13. Robustness check (I): Alternative △SI, Contemporaneous Leverage, and short-sale strategies

This table presents the robustness checks for our main hypothesis. The first model presents the results from an OLS for the LTCM crisis return and short selling in the pre-crisis period by using different time period definitions. The last three models present the OLS results for the LTCM crisis return and short selling in pre-crisis period after controlling for the contemporaneous leverage.

$$\Delta SI_{i,\,pre-\text{crisis}} = \alpha + \beta\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

$$\Delta SI_{i,\,pre-\text{crisis}} = \alpha + \beta_1\ RE98_{i,crisis} + \beta_2 Leverage_{i,\text{t}} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis; $RE98_{i,crisis}$ is the stock returns for bank *i* in the LTCM crisis; $Leverage_{i,\text{t}}$ is measures of contemporaneous leverage (i.e., *Leverage05*, *Leverage06*, and $Leverage_{Jun07}$ are the leverages on December 31, 2005, December 31, 2006, and June 30, 2007, respectively; $\Delta\text{Leverage}_{05\text{-}07}$ is the change in leverage from June 2005 through June 2007); $OIMB^{+}$ is buy-order imbalance if it is positive and zero otherwise; *Uncertainty* is a difference in the daily high and low price scaled by high price; *Turnover* is the daily trading volume divided by the total outstanding shares; *Liquidity* is the standardized turnover-adjusted number of zero daily trading volumes over the prior 12 months (Liu, 2006); and ***Z*** is a vector of control variables for bank *i* in the year 2004. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) ΔSI_{12m}	(2) ΔSI	(3) ΔSI	(4) ΔSI	(5) ΔSI
RE98	–0.0095*	–0.0240**	–0.0263**	–0.0320***	–0.0276**
	(–1.68)	(–1.99)	(–2.18)	(–2.60)	(–2.11)
Leverage05		0.0005	0.0011	0.0010	
		(0.78)	(1.40)	(1.16)	
Leverage06		–0.0002	–0.0001	–0.0012	
		(–0.70)	(–0.22)	(–0.89)	
$Leverage_{Jun07}$			–0.0007		
			(–1.27)		
$\Delta Leverage_{05\text{-}07}$				0.0001	
				(0.13)	
RE98 rebound	–0.0009	–0.0024	–0.0030	–0.0058**	–0.0001
	(–0.82)	(–1.03)	(–1.28)	(–2.36)	(–0.04)
LnAssets	0.0003	0.0003	0.0003	–0.0003	–0.0018
	(0.58)	(0.27)	(0.23)	(–0.22)	(–0.95)
BM	–0.0050*	–0.0090	–0.0093	–0.0046	0.0057
	(–1.71)	(–1.42)	(–1.45)	(–0.71)	(0.71)
PastReturn	0.0010	0.0036	0.0046	0.0029	–0.0038
	(0.38)	(0.62)	(0.78)	(0.48)	(–0.51)
Leverage	–0.0001	–0.0003	–0.0003	0.0003	0.0003
	(–1.03)	(–0.51)	(–0.46)	(0.30)	(0.57)
Beta	–0.0059	–0.0018	–0.0002	0.0214**	0.0040
	(–1.24)	(–0.17)	(–0.02)	(2.03)	(0.37)
IDIORISK	0.0000	0.0001	0.0001	–0.0000	–0.0080***
	(0.20)	(0.97)	(0.99)	(–0.12)	(–3.21)
MES	–0.1379	–0.0972	–0.0956	0.5573*	0.7195**
	(–0.88)	(–0.29)	(–0.29)	(1.67)	(2.14)
TCE	0.0003	–0.0007	–0.0007	–0.0039**	0.0000
	(0.37)	(–0.43)	(–0.42)	(–2.30)	(0.39)
$OIMB^{+}_{04}$					–0.0675*
					(–1.79)
$OIMB^{+}_{0507}$					–0.0839**

					(–2.00)
Uncertainty$_{04}$					0.1444
					(0.35)
Uncertainty$_{0507}$					1.2829***
					(2.94)
Turnover$_{04}$					–5.7291***
					(–6.19)
Turnover$_{0507}$					3.5469***
					(7.24)
Liquidity$_{04}$					0.0000
					(0.09)
Liquidity$_{0507}$					–0.0002
					(–1.17)
Constant	0.0070	0.0151	0.0145	0.0218**	0.0440**
	(1.46)	(1.44)	(1.37)	(2.06)	(2.17)
Obs.	759	700	690	625	406
Adj-R^2	0.0109	0.0133	0.0181	0.0302	0.3352

Table 14. Robustness check (II): Controlling for various industry characteristics

This table presents the OLS results after controlling for various industry characteristics. The first three models present the regression results for the LTCM crisis return and short selling in pre-crisis period and the last three models present the regression results for the LTCM crisis return and short selling in the pre-crisis period.

$$RE08_{i,\text{crisis}} = \alpha + \beta\ \Delta SI_{i,pre-crisis} + \gamma Z_{i,2006} + \varepsilon_i$$

$$\Delta SI_{i,pre-\text{crisis}} = \alpha + \beta_1\ RE98_{i,crisis} + \gamma Z_{i,2004} + \varepsilon_i$$

in which $RE08_{i,crisis}$ represents the stock returns for bank *i* in the 2007-2008 crisis; $\Delta SI_{i,pre-crisis}$ is the change in short interest for bank *i* in the pre-crisis period of the 2007-2008 crisis; $RE98_{i,crisis}$ is the stock returns for bank *i* in the LTCM crisis; and $\boldsymbol{Z}_{i,t}$ is a vector of control variables for bank *i* in year *t*. In addition to control variables as in Tables 2 and 3, we further add some industry-related factors. *Asset Growth* is the growth rate of total assets; *Acquisition* is the sum of the transaction values of all acquisitions undertaken by the bank divided by total assets; *Liquidity Beta* is the sensitivity of excess return to the market-wide liquidity innovations in Pástor and Stambaugh (2003) after controlling for the market's excess return and using past three-year data; *Rated* is a dummy that equals one if the bank has an S&P rating in Compustat; *Rating* is the bank's rating translated to a numeric measure, such as one for AAA, two for AA+, and so forth; *Deposit* is the total customer deposits divided by total liabilities; *Investment Securities* is a fraction of total assets held in investment securities; *Asset for sale* is a fraction of total assets held for sale; *Noninterest income* is a ratio of noninterest income to the sum of noninterest income and net interest income. The variable definitions for other variables are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Depository	Depository and non-depository	All financial industry	Depository	Depository and non-depository	All financial industry
SIC codes	6000-6099	6000-6300	6000-6999	6000-6099	6000-6300	6000-6999
	RE08	*RE08*	*RE08*	*⊿SI*	*⊿SI*	*⊿SI*
⊿SI	–1.2017**	–0.9659**	–0.7229**			
	(–2.05)	(–2.27)	(–2.24)			
RE98	0.0408	0.3076**	0.3464***	–0.0141*	–0.0129*	–0.0245**
	(0.28)	(2.56)	(3.73)	(–1.90)	(–1.79)	(–2.04)
RE98 rebound	–0.0835	–0.0157	–0.0234	0.0001	–0.0012	–0.0019
	(–0.90)	(–0.84)	(–1.43)	(0.02)	(–0.35)	(–0.81)
LnAssets	0.0286	–0.0396***	–0.0382***	0.0014	0.0011	–0.0006
	(0.84)	(–2.84)	(–3.69)	(0.87)	(0.88)	(–0.43)
BM	–0.0368	–0.0073	–0.0413	0.0016	–0.0012	–0.0088
	(–0.30)	(–0.09)	(–0.85)	(0.20)	(–0.17)	(–1.44)
PastReturn	–0.0930	–0.0518	0.0420	0.0105**	0.0102**	0.0020
	(–0.83)	(–0.77)	(1.10)	(2.13)	(2.11)	(0.34)

Leverage	0.0049	–0.0063*	–0.0020	0.0005	0.0004	–0.0001
	(0.43)	(–1.70)	(–1.39)	(0.90)	(0.72)	(–0.19)
Beta	0.0498	0.0860	0.0804	–0.0054	–0.0061	0.0020
	(0.42)	(0.93)	(1.17)	(–0.69)	(–0.82)	(0.19)
TCE	0.0074	–0.0007	–0.0002	0.0000	0.0000	0.0001
	(0.59)	(–0.44)	(–0.30)	(0.09)	(0.03)	(0.81)
MES	–12.3652*	–13.1014**	–10.0031**	0.1245	0.1226	–0.0308
	(–1.91)	(–2.41)	(–2.43)	(0.56)	(0.57)	(–0.09)
IDIORISK	0.0709*	–0.0172	–0.0180	0.0019	0.0018	–0.0012
	(1.71)	(–0.62)	(–0.87)	(1.34)	(1.31)	(–0.75)
Asset Growth	–0.3529**	–0.4453***	–0.4410***	0.0072	0.0063	0.0170
	(–2.32)	(–3.01)	(–3.00)	(1.21)	(1.10)	(1.26)
Acquisition	0.6024	1.2269	1.3540	0.0121	0.0130	0.0404
	(0.44)	(0.86)	(0.95)	(0.22)	(0.24)	(0.28)
Liquidity Beta	0.0318	0.0514	0.0400	0.0020	0.0022	0.0096
	(0.34)	(0.63)	(0.67)	(0.48)	(0.52)	(1.55)
Rated	0.2055			–0.0022		
	(0.53)			(–0.13)		
Rating	0.0227			–0.0002		
	(0.78)			(–0.12)		
Deposit	0.2127			0.0087		
	(1.00)			(0.83)		
Investment Securities	0.9762***			0.0019		
	(5.44)			(0.25)		
Asset for sale	–1.8110**			–0.0295		
	(–2.07)			(–0.93)		
Noninterest Income	0.3266*			–0.0032		
	(1.84)			(–0.37)		
Constant	–1.7726*	–0.1386	–0.1332	–0.0204	–0.0110	0.0199*
	(–1.91)	(–1.12)	(–1.43)	(–0.48)	(–0.75)	(1.78)
Obs.	320	399	661	341	423	698
Adj. R^2	0.2262	0.1298	0.0934	0.0125	0.1621	0.0705

Appendix A. Variable definitions

Variable	Definition	Data Source
Panel A: Short selling variables		
ΔSI	Change in the total number of stocks that are borrowed divided by the stocks outstanding from June 2005 through June 2007.	Compustat
ΔSI_{12m}	Change in the total number of stocks that are borrowed divided by the stocks outstanding from June 2006 through June 2007.	Compustat
$\Delta COST$	Change in stock borrowing costs (Daily Cost of Borrow Score—a relative measure of borrowing costs, constructed by DXL. It ranges from 1- cheap to borrow- to 10- expensive to borrow) from June 2005 through June 2007.	DXL
Panel B: Crisis performance variables		
RE08	The annualized buy-and-hold returns from July 1, 2007, through December 31, 2008.	CRSP
RE98	Following Fahlenbrach et al. (2012), *RE98* is the annualized buy-and-hold returns from August 3, 1998, until the day in 1998 when the bank's stock attains its lowest price. If the lowest price occurs more than once, then the return is calculated using the first date on which it occurs.	Compustat Security
RE98 rebound	Buy-and-hold returns since the date with the lowest price (from August 3, 1998, until the end of 1998) until six months later.	Compustat Security
Δ*NPL/Loan98 and* Δ*NPL/Equity98*	Change in ratio of nonperforming loans (NPL) to total gross loans (or equity) between crisis year 1998 and pre-crisis year 1997. Nonperforming loans are defined as loans with interest payments and principal more than 90 days overdue.	Compustat Bank
EDF98	Expected default frequency (EDF) in year 1998. The EDF is the percentile ranking of a firm's default risk based on its distance to default (constructed from Bharath and Shumway, 2008).	Compustat and CRSP
Panel C: Control variables		
PastReturn	The previous one-year buy-and-hold returns.	CRSP
LnAssets	Log of total assets (US billion).	Compustat
BM	Book value of common equity divided by the market value of common equity.	Compustat and CRSP
Leverage	The ratio of assets to book value of equity.	Compustat
TCE ratio	Tangible common equity ratio: tangible common equity divided by tangible assets and multiplied by 100.	Compustat
Beta	Bank's equity beta from a market model of daily returns in excess of three-month T-bills using the previous two-year data, where the market is represented by the value-weighted CRSP index.	CRSP
Idiosyncratic volatility (IDIORISK)	The standard deviation of the residuals obtained from a market model of daily returns in excess of three-month T-bills using the previous two-year data, where the market is represented by the value-weighted CRSP index.	CRSP
MES (%)	Marginal expected shortfall as defined in Acharya, Pedersen, Philippon, and Richardson (2017), measured using the 5% worst days for the value-weighted CRSP market return during the previous two-year data.	CRSP
$\Delta Leverage_{05\text{-}07}$	Change in leverage from June 2005 through June 2007	Compustat
$OIMB^{+}$	Following Diether, Lee, and Werner (2009), we construct OIMB+ as buy-order imbalance if it is positive and zero otherwise. Buy-order imbalance is the daily buys minus sells scaled by the daily volume. Buys and sells are identified based on Lee and Ready (1991)'s algorithm.	NYSE Trades and Quotes (TAQ)

Uncertainty	The difference in the daily high and low price scaled by the high price (Diether, Lee, and Werner, 2009)	CRSP
Turnover	The daily trading volume divided by the total outstanding shares	CRSP
Liquidity	Liquidity measure is the standardized turnover-adjusted number of zero daily trading volumes over the prior 12 months (Liu, 2006)	CRSP
Asset growth	The growth rate of total assets.	Compustat
Acquisition	Sum of the transaction values of all acquisitions undertaken by the bank divided by total assets	
Liquidity beta	The sensitivity of bank excess returns to the market-wide liquidity innovations of Pástor and Stambaugh (2003) after controlling for the market's excess return and using the past three-year data	Compustat Security, Pástor and Stambaugh (2003)
Rated	A dummy that equals one if the bank has an S&P rating in Compustat	Compustat
Rating	The bank's rating translated to a numeric measure, such as one for AAA, two for AA+, and so forth	Compustat
Deposit	Total customer deposits divided by total liabilities	Compustat
Investment securities	The fraction of total assets held in investment securities	Compustat
Asset for sale	The fraction of total assets held for sale	Compustat
Noninterest income	The ratio of noninterest income to the sum of noninterest income and net interest income	Compustat

Appendix B. Which factors affect the probability to be a learning bank

This table presents the logit regression results to determine the probability that a bank is a learning bank. We define a learning bank as a bank in the highest tercile of $\triangle SI_{96\text{-}98}$ but then in the lowest tercile of $\triangle SI_{05\text{-}07}$. We then run a logit regression as follows:

$$\Pr(Learning\ Bank_i = 1 \mid Z) = \Lambda(\alpha + \gamma Z_{i,2004} + \varepsilon_i)$$

in which $Learning\ Bank_i$ equals one if bank *i* is in the highest tercile of $\triangle SI_{96\text{-}98}$ but then is in the lowest tercile of $\triangle SI_{05\text{-}07}$; ; $\Lambda(z)$ is the standard logistic distribution density; and ***Z*** is a vector of control variables for bank *i* in the year 2004. The variable definitions are in Appendix A. The *t*-statistics are in parentheses and are based on standard errors adjusted for heteroskedasticity (White, 1980). The superscripts *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) LearningBank = 1
Size	0.2892
	(1.58)
BM	2.0332**
	(2.32)
PastReturn	–0.0101
	(–0.01)
Leverage	–0.0016
	(–0.03)
Beta	0.5952
	(0.61)
TCE	–0.0163
	(–0.50)
MES	50.5635
	(0.88)
IDIORISK	1.0298***
	(3.50)
Constant	–7.3415***
	(–3.15)
Obs.	203
Pseudo R^2	0.1928

Appendix C. Sample Banks

This appendix lists all sample banks based on depository, non-depository, and other institutions. The names are in the field "comnam" of the Compustat database at the end of fiscal year 2006.

Panel A. Depository and non-depository institutions (SIC code: 6000-6099):

1ST CONSTITUTION BANCORP
1ST INDEPENDENCE FINL GROUP
1ST SOURCE CORP
ABIGAIL ADAMS NATL BANCORP
ABN-AMRO HOLDINGS NV
AIB GROUP PLC
ALABAMA NATL BANCORPORATION
AMCORE FINANCIAL INC
AMERIANA BANCORP
AMERICAN NATL BANKSHARES
AMERICAN RIVER BANKSHARES
AMERICANWEST BANCORP
AMERIS BANCORP
AMERISERV FINANCIAL INC/PA
ANNAPOLIS BANCORP INC
ANZ-AUSTRALIA & NEW ZEALD BK
ARROW FINANCIAL CORP
ASSOCIATED BANC-CORP
ASTORIA FINANCIAL CORP
AUBURN NATIONAL BANCORP
BANCFIRST CORP/OK
BANCO LATINOAMERICANO DE COM
BANCO SANTANDER SA
BANCO SANTANDER-CHILE
BANCORP RHODE ISLAND INC
BANCORPSOUTH BANK
BANCTRUST FINANCIAL GRP INC
BANK OF AMERICA CORP
BANK OF GRANITE CORP
BANK OF HAWAII CORP
BANK OF MARIN BANCORP
BANK OF MONTREAL
BANK OF NEW YORK MELLON CORP
BANK OZK
BANK SOUTH CAROLINA CORP
BANKUNITED FINANCIAL CORP
BANNER CORP
BAR HARBOR BANKSHARES
BARCLAYS PLC
BB&T CORP
BBVA
BBVA BANCO FRANCES SA
BBX CAPITAL CORP
BBX CAPITAL CORPORATION
BCSB BANCORP INC
BEAR STATE FINANCIAL INC
BLUE RIVER BANCSHARES INC
BNCCORP INC
BOE FINANCIAL SERVICES VA
BOK FINANCIAL CORP
BOSTON PRIVATE FINL HOLDINGS
BRITTON & KOONTZ CAP CORP
BROADWAY FINANCIAL CORP/DE
BROOKLINE BANCORP INC
BRYN MAWR BANK CORP
C&F FINANCIAL CORP
CAMCO FINANCIAL CORP
CAMDEN NATIONAL CORP
CAPITAL BANK CORP/NC
CAPITAL CITY BK GROUP INC
CAPITAL CORP OF THE WEST
CAPITOL BANCORP LTD
FIDELITY SOUTHERN CORP
FIFTH THIRD BANCORP
FIRST BANCORP P R
FIRST BANCORP/NC
FIRST BANCSHARES INC/MO
FIRST CHARTER CORP
FIRST CITIZENS BANCSH -CL A
FIRST CMNTY BANCSHARES INC
FIRST COMMONWLTH FINL CP/PA
FIRST COMMUNITY CORP/SC
FIRST DEFIANCE FINANCIAL CP
FIRST FED BANKSHARES INC
FIRST FED NOR MICH BANCORP
FIRST FINANCIAL CORP/IN
FIRST FINANCIAL HOLDINGS-OLD
FIRST FINANCIAL SERVICE CORP
FIRST FINL BANCORP INC/OH
FIRST FINL BANKSHARES INC
FIRST FRANKLIN CORP
FIRST HORIZON NATIONAL CORP
FIRST INDIANA CORP
FIRST KEYSTONE FINANCIAL INC
FIRST LONG ISLAND CORP
FIRST M&F CORP
FIRST MERCHANTS CORP
FIRST MIDWEST BANCORP INC
FIRST MUTUAL BANCSHARES INC
FIRST NIAGARA FINANCIAL GRP
FIRST REGIONAL BANCORP
FIRST SOUTH BANCORP INC/VA
FIRST STATE BANCORPORATION
FIRST UNITED CORP
FIRSTBANK CORP
FIRSTMERIT CORP
FLAGSTAR BANCORP INC
FLUSHING FINANCIAL CORP
FMS FINANCIAL CORP
FRONTIER FINANCIAL CORP/WA
FULTON FINANCIAL CORP
GERMAN AMERICAN BANCORP INC
GLACIER BANCORP INC
GREAT PEE DEE BANCORP INC
GREAT SOUTHERN BANCORP
GREATER BAY BANCORP
GREATER COMMUNITY BANCORP
GS FINANCIAL CORP
GUARANTY FED BANCSHARES INC
HABERSHAM BANCORP INC
HANCOCK WHITNEY CORP
HANMI FINANCIAL CORP
HARLEYSVILLE FINANCIAL CORP
HARLEYSVILLE NATL CORP/PA
HEARTLAND FINANCIAL USA INC
HERITAGE COMMERCE CORP
HERITAGE FINANCIAL CORP
HF FINANCIAL CORP
HINGHAM INSTN FOR SAVINGS
HMN FINANCIAL INC
HOPFED BANCORP INC
HORIZON FINANCIAL CORP/WA
HSBC HLDGS PLC
HUNTINGTON BANCSHARES
OFG BANCORP
OHIO VALLEY BANC CORP
OLD NATIONAL BANCORP
OLD POINT FINANCIAL CORP
OLD SECOND BANCORP INC/IL
OMEGA FINANCIAL CORP
PAB BANKSHARES INC
PACIFIC CAPITAL BANCORP
PACIFIC CONTINENTAL CORP
PAMRAPO BANCORP INC
PARK BANCORP INC
PARK NATIONAL CORP
PARKVALE FINANCIAL CORP
PATHFINDER BANCORP INC
PATRIOT NATIONAL BANCORP INC
PEAPACK-GLADSTONE FINL CORP
PENNS WOODS BANCORP INC
PEOPLES BANCORP INC/OH
PEOPLES BANCORP NC INC
PEOPLES BANCTRUST INC
PEOPLE'S UNITED FINL INC
PFF BANCORP INC
PINNACLE BANCSHARES
PLUMAS BANCORP
PNC FINANCIAL SVCS GROUP INC
POPULAR INC
PREMIER CMNTY BANKSHARES INC
PREMIER FINANCIAL BANCORP
PREMIERWEST BANCORP
PRINCETON NATL BANCORP INC
PROVIDENT BANKSHARES CORP
PROVIDENT COMMUN BANCSHS INC
PROVIDENT FINANCIAL HOLDINGS
PULASKI FINANCIAL CORP
PVF CAPITAL CORP
QCR HOLDINGS INC
REGIONS FINANCIAL CORP
RENASANT CORP
REPUBLIC BANCORP INC/KY
REPUBLIC FIRST BANCORP INC
RIVER VALLEY BANCORP
RIVERVIEW BANCORP INC
ROYAL BANCSHARES/PA -CL A
ROYAL BANK OF CANADA
S & T BANCORP INC
SANDY SPRING BANCORP INC
SAVANNAH BANCORP INC
SB FINANCIAL GROUP INC
SB ONE BANCORP
SEACOAST BANKING CORP/FL
SECURITY BANK CORP
SHORE FINANCIAL CORP
SIERRA BANCORP/CA
SIMMONS FIRST NATL CP -CL A
SKY FINANCIAL GROUP INC
SLADE'S FERRY BANCORP
SMITHTOWN BANCORP INC
SOUTH FINANCIAL GROUP INC
SOUTH STATE CORP
SOUTHERN CMNTY FINL CORP
SOUTHERN MISSOURI BANCP INC
SOUTHSIDE BANCSHARES INC

CARDINAL FINANCIAL CORP
CAROLINA BANK HOLDINGS INC
CARVER BANCORP INC
CASCADE BANCORP
CASCADE FINANCIAL CORP
CATHAY GENERAL BANCORP
CCF HOLDING CO
CENTER FINANCIAL CORP/CA
CENTRAL BANCORP INC/MA
CENTRAL PACIFIC FINANCIAL CP
CENTRAL VIRGINIA BANKSHARES
CENTRUE FINANCIAL CORP
CENTURY BANCORP INC/MA
CFS BANCORP INC
CHEMICAL FINANCIAL CORP
CHITTENDEN CORP
CITIZENS & NORTHERN CORP
CITIZENS REPUBLIC BANCORP
CITIZENS SOUTH BANKING CORP
CITY HOLDING CO
CITY NATIONAL CORP
CIVISTA BANCSHARES INC
COBIZ FINANCIAL INC
CODORUS VALLEY BANCORP
COLONIAL BANCGROUP
COLONY BANKCORP INC
COLUMBIA BANCORP/OR
COLUMBIA BANKING SYSTEM INC
COMERICA INC
COMM BANCORP INC
COMMERCE BANCSHARES INC
COMMERCIAL NATL FINL CP/PA
COMMONWEALTH BANKSHARES INC
COMMUNITY BANK SYSTEM INC
COMMUNITY BANKS INC
COMMUNITY BANKSHARES INC/SC
COMMUNITY CAPITAL CORP
COMMUNITY CENTRAL BK CORP
COMMUNITY FINANCIAL CORP/VA
COMMUNITY TRUST BANCORP INC
COMMUNITY WEST BANCSHARES
COMMUNITYONE BANCORP
CONNECTONE BANCORP INC
COOPERATIVE BANKSHARES INC
CORUS BANKSHARES INC
COWLITZ BANCORPORATION
CREDICORP LTD
CRESCENT BANKING CO
CULLEN/FROST BANKERS INC
CVB FINANCIAL CORP
DEARBORN BANCORP INC
DESERT COMMUNITY BANK
DIME COMMUNITY BANCSHARES
DOWNEY FINANCIAL CORP
EASTERN VA BANKSHARES INC
ELECTRONIC CLEARING HOUSE
ELMIRA SVGS BANK ELMIRA/NY
ESB FINANCIAL CORP
EURONET WORLDWIDE INC
F N B CORP/FL
F N B CORP/VA
FARMERS CAPITAL BANK CORP
FEDERAL TRUST CORP
FFD FINANCIAL CORP
FIDELITY BANCORP INC/PA
IBERIABANK CORP
IMPERIAL CAPITAL BANCORP INC
INDEPENDENT BANK CORP/MA
INDEPENDENT BANK CORP/MI
INDIANA COMMUNITY BANCORP
INTEGRA BANK CORP
INTERVEST BANCSHARES CORP
INTL BANCSHARES CORP
INVESTORS FINANCIAL SVCS CP
IRWIN FINANCIAL CORP
JACKSONVILLE BANCORP INC/MD
JEFFERSONVILLE BANCORP
JPMORGAN CHASE & CO
KEYCORP
LAKE SUNAPEE BANK GROUP
LAKELAND BANCORP INC
LAKELAND FINANCIAL CORP
LANDMARK BANCORP INC/KS
LML PAYMENT SYSTEMS INC
LNB BANCORP INC
LSB CORP
LSB FINANCIAL CORP
M & T BANK CORP
MACATAWA BANK CORP
MAF BANCORP INC
MAINSOURCE FINL GROUP INC
MARSHALL & ILSLEY CORP
MASSBANK CORP
MAYFLOWER BANCORP INC
MB FINANCIAL INC/MD
MBT FINANCIAL CORP
MELLON FINANCIAL CORP
MERCANTILE BANK CORP
MERCHANTS BANCSHARES INC/VT
META FINANCIAL GROUP INC
METRO BANCORP INC
MFB CORP
MID PENN BANCORP INC
MIDDLEBURG FINANCIAL CORP
MIDSOUTH BANCORP INC
MIDWEST BANC HOLDINGS INC
MIDWESTONE FINANCIAL GP-OLD
MONEYGRAM INTERNATIONAL INC
MONROE BANCORP
N B T BANCORP INC
NASB FINANCIAL INC
NATIONAL AUSTRALIA BK
NATIONAL BANKSHARES INC VA
NATIONAL CITY CORP
NATIONAL PENN BANCSHARES INC
NB & T FINANCIAL GROUP INC
NETBANK INC
NEW YORK CMNTY BANCORP INC
NEWBRIDGE BANCORP
NORTH CENTRAL BANCSHARES INC
NORTH VALLEY BANCORP
NORTHEAST BANCORP/ME
NORTHERN STATES FINANCIAL CP
NORTHERN TRUST CORP
NORTHRIM BANCORP INC
NORTHWEST BANCSHARES INC
NORWOOD FINANCIAL CORP
OAK HILL FINANCIAL INC
OCEANFIRST FINANCIAL CORP
OCWEN FINANCIAL CORP
SOUTHWEST BANCORP INC
SOUTHWEST GEORGIA FINL CORP
STATE BANCORP/NY
STATE STREET CORP
STERLING BANCORP/NY -OLD
STERLING BANCSHARES INC/TX
STERLING FINANCIAL CORP
STERLING FINANCIAL CORP/WA
STOCK YARDS BANCORP INC
SUFFOLK BANCORP
SUN BANCORP INC/NJ
SUNTRUST BANKS INC
SUSQUEHANNA BANCSHARES INC
SVB FINANCIAL GROUP
SYNOVUS FINANCIAL CORP
TCF FINANCIAL CORP
TF FINANCIAL CORP
TIB FINANCIAL CORP
TIMBERLAND BANCORP INC
TOMPKINS FINANCIAL CORP
TORONTO DOMINION BANK
TRICO BANCSHARES
TRUSTCO BANK CORP/NY
TRUSTMARK CORP
U S B HOLDING CO INC
U S BANCORP
UMB FINANCIAL CORP
UMPQUA HOLDINGS CORP
UNION BANKSHARES CORP
UNITED BANCORP INC/OH
UNITED BANCSHARES INC/OH
UNITED BANKSHARES INC/WV
UNITED COMMUNITY FINL CORP
UNITED SECURITY BANCSHARS CA
UNITY BANCORP INC
UNIVERSITY BANCORP INC
UNIVEST FINANCIAL CORP
VALLEY NATIONAL BANCORP
VINEYARD NATIONAL BANCORP
VIRGINIA COMM BANCORP INC
VIST FINANCIAL CORP
W HOLDING CO INC
WACHOVIA CORP
WAINWRIGHT BANK & TRUST CO
WASHINGTON BANKING CO
WASHINGTON FEDERAL INC
WASHINGTON TR BANCORP INC
WAYNE SAVINGS BANCSHARES INC
WEBSTER FINANCIAL CORP
WELLS FARGO & CO
WESBANCO INC
WEST COAST BANCORP/OR
WESTAMERICA BANCORPORATION
WESTPAC BANKING
WHITNEY HOLDING CORP
WILMINGTON TRUST CORP
WILSHIRE BANCORP INC
WINTRUST FINANCIAL CORP
WSB HOLDINGS INC
WSFS FINANCIAL CORP
WVS FINANCIAL CORP
YARDVILLE NATIONAL BANCORP
YOUR COMMUNITY BANKSHARES
ZIONS BANCORPORATION NA

Panel B. Non-depository institutions (SIC code: 6100-6299):

ADVANTA CORP -CL B
EATON VANCE CORP
LEHMAN BROTHERS HOLDINGS INC

ADVANTA CORP -CL B
AFFILIATED MANAGERS GRP INC
AFP PROVIDA SA
ALLIED CAPITAL CORP
AMERICAN EXPRESS CO
AMERITRANS CAPITAL CORP
ASTA FUNDING INC
BEAR STEARNS COMPANIES INC
BISYS GROUP INC
CALIF FIRST NATIONAL BANCORP
CAPITAL ONE FINANCIAL CORP
CITIGROUP INC
CONSUMER PORTFOLIO SVCS INC
COUNTRYWIDE FINANCIAL CORP
CREDIT ACCEPTANCE CORP
CREDIT SUISSE GROUP
DELTA FINANCIAL CORP
DIAMOND HILL INVESTMENT GRP
E TRADE FINANCIAL CORP
EDWARDS (A G) INC
FANNIE MAE
FEDERAL AGRICULTURE MTG CP
FEDERAL AGRICULTURE MTG CP
FEDERAL HOME LOAN MORTG CORP
FEDERATED INVESTORS INC
FINANCIAL FEDERAL CORP
FRANKLIN RESOURCES INC
GLEACHER & COMPANY INC
IMPAC MORTGAGE HOLDINGS INC
INCOME OPPORTUNITY RLTY INVS
INDYMAC BANCORP INC
ING GROEP NV
INTL FCSTONE INC
INVESTMENT TECHNOLOGY GP INC
KENT FINANCIAL SERVICES INC
KNIGHT CAPITAL GROUP INC
LADENBURG THALMANN FINL SERV
LEGG MASON INC
MORGAN STANLEY
NICHOLAS FINANCIAL INC
OPPENHEIMER HOLDINGS INC
PRICE (T. ROWE) GROUP
RAYMOND JAMES FINANCIAL CORP
RESOURCE AMERICA INC
SCHWAB (CHARLES) CORP
SECURITY NATL FINL CP -CL A
SEI INVESTMENTS CO
SIEBERT FINANCIAL CORP
STIFEL FINANCIAL CORP
STUDENT LOAN CORP
SWS GROUP INC
TD AMERITRADE HOLDING CORP
TRADESTATION GROUP INC
U S GLOBAL INVESTORS INC
UNITED PANAM FINANCIAL CORP
WADDELL&REED FINL INC -CL A
WORLD ACCEPTANCE CORP/DE

Panel C. Other institutions (SIC code: 6300-6999):

ACACIA RESEARCH CORP
ACADIA REALTY TRUST
ACRE REALTY INVESTORS INC
AEGON NV
AETNA INC
AFLAC INC
AGREE REALTY CORP
ALEXANDER'S INC
ALEXANDRIA R E EQUITIES INC
ALLEGHANY CORP
ALLIANCEBERNSTEIN HOLDING LP
ALLSTATE CORP
ALON BLUE SQUARE ISRAEL
ALUMINA LTD
AMERICA FIRST APT INVESTORS
AMERICAN CAPITAL LTD
AMERICAN FINANCIAL GROUP INC
AMERICAN INDEPENDENCE CORP
AMERICAN INTERNATIONAL GROUP
AMERICAN LAND LEASE INC
AMERICAN NATIONAL INSURANCE
AMERICAN PHYSICIANS SVC GP
AMERICAN REALTY INVESTORS
AMERICAN SAFETY INS HLDG LTD
AMERICAN TOWER CORP
ANNALY CAPITAL MANAGEMENT
ANTHRACITE CAPITAL INC
ANWORTH MTG ASSET CORP
AON PLC
APARTMENT INVST & MGMT CO
ARCH CAPITAL GROUP LTD
ARGO GROUP INTL HOLDINGS LTD
ARLINGTON ASSET INVESTMENT
ARM HOLDINGS PLC
ARTHUR J GALLAGHER & CO
ASA GOLD AND PRECIOUS METALS
ASSOCIATED ESTATES RLTY CORP
ATLANTIC AMERICAN CORP
AVALONBAY COMMUNITIES INC
AXA SA
BERKLEY (W R) CORP
BEXIL CORP
BLACKSTONE MORTGAGE TR INC
BOSTON PROPERTIES INC
BP PRUDHOE BAY ROYALTY TRUST
EQUITY RESIDENTIAL
ERIE INDEMNITY CO -CL A
ESSEX PROPERTY TRUST
EVEREST RE GROUP LTD
FBL FINANCIAL GROUP INC-CL A
FEDERAL REALTY INVESTMENT TR
FELCOR LODGING TRUST INC
FIRST ACCEPTANCE CORP
FIRST INDL REALTY TRUST INC
FPIC INSURANCE GROUP INC
FRP HOLDINGS INC
GEO GROUP INC
GETTY REALTY CORP
GGP INC
GLIMCHER REALTY TRUST
GREAT AMERN FINL RESOURCES
GREAT NORTHERN IRON ORE PPTY
GRIFFIN INDUSTRIAL REALTY
HALLMARK FINANCIAL SERVICES
HANOVER INSURANCE GROUP INC
HARLEYSVILLE GROUP INC
HARTFORD FINANCIAL SERVICES
HCC INSURANCE HOLDINGS INC
HEALTH NET INC
HEALTHCARE REALTY TRUST INC
HIGHWOODS PROPERTIES INC
HILB ROGAL & HOBBS CO
HMG COURTLAND PROPERTIES
HMS HOLDINGS CORP
HOME PROPERTIES INC
HORACE MANN EDUCATORS CORP
HOSPITALITY PROPERTIES TRUST
HOST HOTELS & RESORTS INC
HUMANA INC
ICONIX BRAND GROUP INC
ILX RESORTS INC
IMAGE SENSING SYSTEMS INC
INDEPENDENCE HOLDING CO
INTERDIGITAL INC
INVESTORS REAL ESTATE TRUST
INVESTORS TITLE CO
IPC HOLDINGS LTD
IRON MOUNTAIN INC
IRSA INVERSIONES Y REPSTN SA
ISTAR INC
NEVADA CHEMICALS INC
NEW ENGLAND REALTY ASSC -LP
NEWTEK BUSINESS SERVICES CP
NORTH EUROPEAN OIL RTY TR
NYMAGIC INC
OHIO CASUALTY CORP
OMEGA HEALTHCARE INVS INC
PACIFIC OFFICE PROPERTIES TR
PARKWAY PROPERTIES INC
PARTNERRE LTD
PENN TREATY AMERN CORP
PENNSYLVANIA RE INVS TRUST
PERMIAN BASIN ROYALTY TRUST
PHILADELPHIA CONS HLDG CORP
PICO HOLDINGS INC
PMI GROUP INC
POST PROPERTIES INC
POST PROPERTIES INC
POWER REIT
PREPAID LEGAL SERVICES INC
PRESIDENTIAL LIFE CORP
PRESIDENTIAL RLTY NEW -CL B
PRESIDENTIAL RLTY NEW -CL B
PROASSURANCE CORP
PROGRESSIVE CORP-OHIO
PROLOGIS INC
PROTECTIVE INSURANCE CORP
PROTECTIVE INSURANCE CORP
PROTECTIVE LIFE CORP
PRUDENTIAL PLC
PS BUSINESS PARKS
PUBLIC STORAGE
QSOUND LABS INC
RADIAN GROUP INC
RAIT FINANCIAL TRUST
RAMBUS INC
RAND CAPITAL CORP
RAYONIER INC
REALTY INCOME CORP
REDWOOD TRUST INC
REGENCY CENTERS CORP
REINSURANCE GROUP AMER INC
RLI CORP
ROYAL GOLD INC
RTW INC

BRANDYWINE REALTY TRUST
BRE PROPERTIES INC
BROWN & BROWN INC
BRT APARTMENTS CORP
CAMDEN PROPERTY TRUST
CAPITAL PROPERTIES INC
CAPITAL SOUTHWEST CORP
CAPSTEAD MORTGAGE CORP
CBL & ASSOCIATES PPTYS INC
CEDAR REALTY TRUST INC
CHEROKEE INC/DE
CHOICE HOTELS INTL INC
CHOICEPOINT INC
CHUBB CORP
CIGNA CORP
CINCINNATI FINANCIAL CORP
CITIZENS INC
CKX LANDS INC
CNA FINANCIAL CORP
CNA SURETY CORP
COLLIERS INTL GROUP INC
COLONIAL PROPERTIES TRUST
COMMERCE GROUP INC/MA
CONDOR HOSPITALITY TR INC
CONSOLIDATED TOMOKA LAND CO
CORECIVIC INC
CORPORATE OFFICE PROPERT
CORVEL CORP
COUSINS PROPERTIES INC
COVENTRY HEALTH CARE INC
CRAWFORD & CO
CRAWFORD & CO
CROSS TIMBERS ROYALTY TRUST
DELPHI FINANCIAL GROUP INC
DINE BRANDS GLOBAL INC
DOMINION RES BLACK WARRIOR
DONEGAL GROUP INC
DORCHESTER MINERALS -LP
DUKE REALTY CORP
DYNEX CAPITAL INC
EASTGROUP PROPERTIES
ELRON ELECTRONIC INDS LTD
EMC INSURANCE GROUP INC
EPR PROPERTIES
EQUITY COMMONWEALTH
EQUITY INNS INC
EQUITY LIFESTYLE PROPERTIES
EQUITY ONE INC
JONES LANG LASALLE INC
KANSAS CITY LIFE INS CO
KEMPER CORP/DE
KILROY REALTY CORP
KIMCO REALTY CORP
KINGSTONE COS INC
LAMAR ADVERTISING CO -CL A
LANDAMERICA FINANCIAL GP
LASALLE HOTEL PROPERTIES
LEXINGTON REALTY TRUST
LIBERTY PROPERTY TRUST
LINCOLN NATIONAL CORP
LL&E ROYALTY TRUST
LOEWS CORP
LTC PROPERTIES INC
MACC PRIVATE EQUITIES INC
MACERICH CO
MACK-CALI REALTY CORP
MARINE PETROLEUM TRUST
MARKEL CORP
MARSH & MCLENNAN COS
MARVEL ENTERTAINMENT INC
MAUI LAND & PINEAPPLE CO
MAXUS REALTY TRUST INC
MAYS (J.W.) INC
MBIA INC
MEADOWBROOK INS GROUP INC
MEDALLION FINANCIAL CORP
MERCURY GENERAL CORP
MESA ROYALTY TRUST
MESABI TRUST
MFA FINANCIAL INC
MGIC INVESTMENT CORP/WI
MID-AMERICA APT CMNTYS INC
MIDLAND CO
MIPS TECHNOLOGIES INC
MMA CAPITAL HOLDINGS
MONMOUTH CAPITAL CORP
MONMOUTH RE INVESTMENT CP
NAM TAI PROPERTY INC
NATIONAL HEALTH INVESTORS
NATIONAL HEALTH REALTY INC
NATIONAL RETAIL PROPERTIES
NATIONAL SEC GROUP INC
NATIONAL WESTERN LIFE GROUP
NATIONWIDE FINL SVCS -CL A
NATIONWIDE HEALTH PPTYS INC
NAVIGATORS GROUP INC
RYMAN HOSPITALITY PPTYS INC
SABINE ROYALTY TRUST
SAFECO CORP
SAFEGUARD SCIENTIFICS INC
SAN JUAN BASIN ROYALTY TR
SAUL CENTERS INC
SELECTIVE INS GROUP INC
SIERRA HEALTH SERVICES
SIMON PROPERTY GROUP INC
SITE CENTERS CORP
SL GREEN REALTY CORP
SRS LABS INC
STATE AUTO FINANCIAL CORP
STEWART INFORMATION SERVICES
SUN COMMUNITIES INC
TANGER FACTORY OUTLET CTRS
TARRAGON CORP
TAUBMAN CENTERS INC
TEL OFFSHORE TRUST
TEXAS PACIFIC LAND TRUST
THORNBURG MORTGAGE INC
TORCH ENERGY ROYALTY TRUST
TORCHMARK CORP
TRANSATLANTIC HOLDINGS INC
TRANSCONTINENTAL RLTY INVS
TRIAD GUARANTY INC
TRINITY PLACE HOLDINGS INC
UDR INC
UMH PROPERTIES INC
UNICO AMERICAN CORP
UNITED FIRE GROUP INC
UNITEDHEALTH GROUP INC
UNIVERSAL HEALTH RLTY INCOME
UNUM GROUP
URSTADT BIDDLE PROPERTIES
URSTADT BIDDLE PROPERTIES
VECTOR GROUP LTD
VENTAS INC
VORNADO REALTY TRUST
W P CAREY INC
WASHINGTON REIT
WEINGARTEN REALTY INVST
WELLTOWER INC
WHITE MTNS INS GROUP LTD
WILLIAMS COAL SEAM RYL TRUST
WINMARK CORP
WINTHROP REALTY TRUST
ZENITH NATIONAL INSURANCE CP

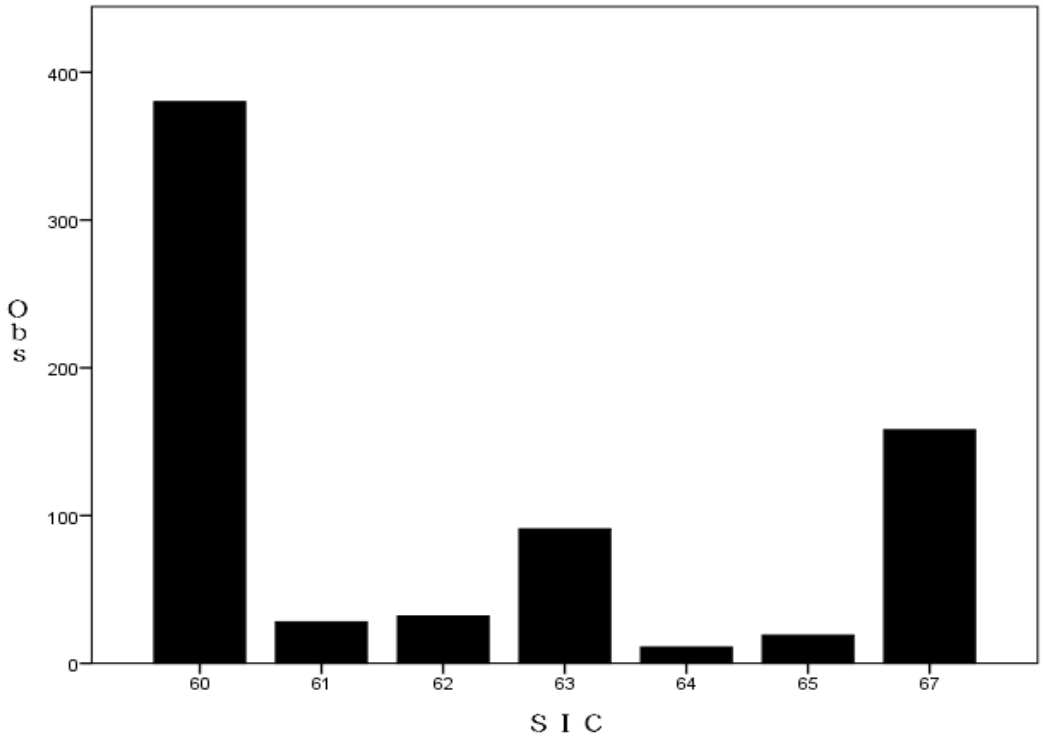

Figure 1 Distribution of sample banks

This figure reports the distribution of sample banks based on two-digit SIC codes.