Bank Capital, Survival, and Performance around Financial Crises

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What does capital do for banks around financial crises? We address this question by examining the effect of pre-crisis bank capital ratios on banks' ability to survive financial crises, and on their competitive positions, profitability, and stock returns during and after such crises. We distinguish between two banking crises and three market crises that occurred in the U.S. over the past quarter century, and examine small, medium, and large banks separately. The evidence suggests that capital helps small banks to survive banking and market crises, and helps medium and large banks to survive banking crises. Moreover, the manner in which a bank exits when it does not survive a crisis (e.g., because it is acquired with or without government assistance) also depends on its pre-crisis capital ratio. Higher capital enables banks of all size classes to improve their market shares during banking crises and these banks are generally able to maintain their improved shares afterwards. Around market crises, higher capital enables only small banks to improve their market shares. Similar, but weaker results are obtained based on profitability. Higher capital also led to higher abnormal stock returns for banks during one of the banking crises. During "normal" times between crises, most of the relative benefits of higher capital are experienced only by small banks. Overall, our results suggest that the importance of bank capital is elevated during crises, and particularly banking crises.

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1. Introduction

A sizeable corporate finance literature focuses on the strategic use of leverage in product-market competition (e.g., Brander and Lewis 1986, Campello 2006, Lyandres 2006). This literature suggests that financial leverage can affect competitive dynamics in the product markets in which firms operate. The evidence suggests that firms with higher leverage compete more aggressively on price (e.g., Phillips 1995, Chevalier 1995, and Zingales 1998), and underinvest in their customer base (e.g., Dasgupta and Titman 1998).

In banking, the effect of capital on "product market dynamics" – how banks interact with their borrowers – has been theoretically examined in numerous papers. Examples are Holmstrom and Tirole (1997), Mehran and Thakor (2009), and Allen, Carletti, and Marquez (forthcoming). While all of these papers focus on the positive impact of capital on a bank's incentive to monitor its borrowers and thus the surplus created in the bank-borrower relationship, Allen, Carletti, and Marquez (forthcoming), in particular, focus on how capital affects the way banks compete with each other.[1] In this paper, we argue that capital has a potentially powerful role to play in interbank competitive dynamics during financial crises, in part because capital may be all that stands between a bank and extinction during a crisis. The theoretical literature has also emphasized the role of capital in reducing the probability of insolvency and closure for the bank, both in static (e.g., Diamond and Rajan 2000) and dynamic (e.g., Mehran and Thakor 2009) settings.

Our main goal is to study the effect of pre-crisis equity capital ratios on the survival probabilities, competitive positions, profitability, and stock returns of banks around financial crises. Specifically, we ask the following four questions. First, are higher-capital banks more likely to survive crises? Second, are higher-capital banks able to gain market share at the expense of lower-capital banks during crises, and if so, is this improvement sustained after the crises? Third, do higher pre-crisis capital ratios translate into higher profitability during crises, and if so, is the higher profitability maintained after the crises? Fourth, how does capital affect the stock returns of banks during crises?

A financial crisis is a natural event to examine how capital affects banks' survival probabilities,

[1] Specifically, they assume that both the loan rate charged and the amount of bank capital provide monitoring incentives. They find that in a competitive market, banks will hold excess capital because borrowers prefer lower loan rates and higher capital since they do not bear the cost of holding higher capital.

competitive positions, profitability, and stock returns. During "normal" times, capital has multiple effects on the bank, some of which counteract each other, making it difficult to learn much. For example, capital helps the bank cope more effectively with risk,[2] but it also reduces the value of the deposit insurance put option (Merton 1977). Further, capital improves the bank's incentive to monitor its borrowers (e.g., Holmstrom and Tirole 1997), but it may also lead to lower liquidity creation (e.g., Diamond and Rajan 2001). During a crisis, risks are elevated and the risk-absorption capacity of capital becomes paramount. Banks with higher capital are better buffered against the shocks of the crisis, and may thus gain a competitive advantage over their lower-capital counterparts. In our analyses, we distinguish between banking crises and market crises. Banking crises are defined as those that originated in the banking sector, whereas market crises are defined as those that originated outside banking in the capital market.

To address the first question and examine the effect of capital on the bank's ability to survive crises, we use logit regressions. We regress the log odds ratio of survival on the bank's pre-crisis capital ratio (averaged over an eight-quarter pre-crisis period) and a set of control variables. The control variables include bank size, bank risk, bank holding company membership, local market competition, and proxies for the economic circumstances in the local markets in which the bank operates. Moreover, we examine small banks (gross total assets or GTA up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion) as three separate groups, since the effect of capital likely differs by bank size (e.g., Berger and Bouwman forthcoming).[3]

Our survival results indicate that higher capital ratios increase the probability for small banks to survive both banking and market crises. For medium banks and large banks, this effect is found only for banking crises.

To address the second question and examine the effect of capital on a bank's aggregate market share around banking and market crises, we use two definitions of market share. The first one is a fairly standard definition – the bank's share of aggregate gross total assets (GTA). The other is the bank's share of aggregate bank liquidity creation. Liquidity creation is a superior measure of bank output since it takes into

[2] Numerous papers argue that capital enhances the risk-absorption capacity of banks (e.g., Bhattacharya and Thakor 1993, Repullo 2004, Von Thadden 2004, Mehran and Thakor 2009).

[3] GTA equals total assets plus the allowance for loan and lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). Total assets on Call Reports deduct these two reserves, which are held to cover potential credit losses. We add these reserves back to measure the full value of the loans financed.

account all on- and off-balance sheet activities. For each definition, we regress the percentage change in market share during or after the crisis on the bank's average pre-crisis capital ratio and the same set of control variables.[4] The percentage change in its market share during (after) a crisis is calculated as the average market share during the crisis (or over the eight quarters after the crisis) minus the average market share over the eight quarters before the crisis, expressed as a proportion of the bank's average pre-crisis market share and multiplied by 100.

Our main findings on the second question are as follows. As in the case of the survival probability results, the effect of capital on market share is the strongest for small banks, and mostly stronger during banking crises than during market crises. Higher capital enables small banks to increase their market shares, measured either in terms of gross total assets (GTA) or in terms of liquidity creation, during both banking and market crises, and these higher shares are maintained in the post-crisis period. Higher capital enables medium banks to improve their market shares only during banking crises, and even this improvement is not maintained after the crisis. Higher capital also leads to higher market shares for large banks only during banking crises, but unlike the medium banks, the large banks are able to hold on to these higher shares after the crises.

Turning to our third question, we focus on the effect of pre-crisis bank capital on the profitability of the bank around banking and market crises. We run regressions that are similar to the ones described above with the change in return on equity (ROE) during and after a crisis as the dependent variables.

The profitability results are similar to the market share results, although weaker. Higher capital enables small and large banks to improve their profitability during banking crises, but only the large banks are able to sustain the improved profitability after these crises. Only large banks improve their profitability around market crises. Higher capital appears to have no effect on the profitability of medium banks during either banking or market crises.

To address our fourth question, we examine whether the market share and profitability gains of higher-capital banks translates into better stock return performance. To perform this analysis, we focus on listed banks and bank holding companies (BHCs). If multiple banks are part of the same listed BHC, their financial statements are aggregated to create pro-forma financial statements of the BHC. The stock return

[4] Defining market share this way is a departure from previous research (e.g., Laeven and Levine 2007), in which market share relates to the bank's weighted-average local market share of total deposits.

results are consistent with the change in market share findings of large banks: listed banks with higher capital ratios experienced significantly larger abnormal returns than banks with lower capital ratios during the first banking crisis (the credit crunch); capital does not impact stock returns during market crises. Our results are based on a five-factor asset pricing model that includes the three Fama-French (1993) factors, momentum, and a proxy for the slope of the yield curve.

We also examine whether the effect of capital outside crisis periods is similar to that during crises. Our intuition is that due to the concern about the viability of small banks at all times, capital would have benefits for small banks during normal times as well, so the effect of capital on these banks would be qualitatively similar to that during crises, although the magnitude of the effect may be smaller. The intuition for large banks is different. During normal times, there may be little concern about the viability of these banks, so capital may have a far smaller effect on these banks during normal times. This is what we find. We find that small banks with higher capital ratios were more likely to survive during normal times, and improved their market shares and profitability during normal times. This is similar to the small-bank results during banking crises. While higher-capital medium banks improved their market shares, they were not more likely to survive and did not improve their profitability during normal times, again similar to the banking crisis results. Large banks with higher capital did improve their market shares (similar to banking crisis result), but were not more likely to survive and did not improve their profitability (in contrast to the banking crisis result) during normal times. Moreover, outside banking crises, higher capital was not associated with higher abnormal stock returns.

As additional analysis, we also ask whether the manner in which exit occurred for banks that failed to survive a crisis was a function of their pre-crisis capital ratios. We consider three forms of exit—consolidation within a bank holding company structure, non-government-assisted mergers/acquisitions, and government-assisted mergers/acquisitions.[5] We find strong relationships between the form of the exit for non-survivors and their pre-crisis capital ratios.

We can broadly summarize our findings as follows. First, whether it is the enhanced probability of

[5] Outright bank failures, another type of exit, are relatively infrequent, likely because bank charters are valuable. As a result, when banks are insolvent, they are typically acquired or merged with government assistance. Unfortunately, outright failures cannot be distinguished in the dataset from charter changes, which also happen infrequently. We therefore provide summary statistics but do not perform formal analyses on the effect of capital on outright failures and charter changes.

surviving a crisis, market share gains or improvements in profitability, higher capital helps small banks during both banking and market crises. Moreover, higher capital also helps small banks survive and achieve higher market shares and profitability outside of crises. That is, the benefit of higher capital for small banks, in a cross-sectional sense, is virtually without any qualifications. Second, large banks also benefit from higher capital, but generally only during banking crises. During such crises, large banks with higher capital experience a higher survival probability, market share gains, higher profitability and higher abnormal stock returns than their lower-capital counterparts. No such relative gains can generally be attributed to higher capital during market crises or "normal" times. Third, the impact of capital is the most mixed for medium banks. Higher capital helps such banks improve their survival odds and market shares only during banking crises, but even during these crises, there is no discernible impact of capital on profitability. Capital has little effect on any of these variables during market crises or during "normal" times. Finally, the manner in which a non-surviving bank exits during a crisis depends on its pre-crisis capital.

The remainder of this paper is organized as follows. Section 2 discusses the related literature and provides the theoretical motivation for our analysis. Section 3 describes banking and market crises. Section 4 explains our empirical approach, describes all the variables and the sample, and provides summary statistics. Section 5 discusses the results of our empirical tests. Section 6 takes up two additional issues: the effect of capital during "normal" times, and the effect of pre-crisis capital on the manner in which non-surviving banks exit during crises. Section 7 concludes.

2. Related literature and theoretical motivation for the empirical hypotheses

This paper is related to two literatures. The first literature focuses on the strategic use of leverage in product-market competition for non-financial firms (e.g., Brander and Lewis 1986, Campello 2006, Lyandres 2006). This literature suggests that financial leverage can affect competitive dynamics. While this literature has not focused on banks, we analyze the effects of crises on the competitive positioning and profitability of banks based on their pre-crisis capital ratios. Our hypothesis is that in the case of banks, the competitive implications of capital are likely to be most pronounced during a crisis when a bank's capital has a major influence on its ability to survive the crisis, particularly in light of regulatory discretion in closing banks based on their capital ratios or otherwise resolving problem institutions. We would expect the bank's

customers to therefore be more cognizant of the bank's capital during a financial crisis, in particular a banking crisis, and it is likely to be easier for better-capitalized banks to take customers away from lesser-capitalized banks. This effect may be felt among the bank's financiers as well as among its asset-side and off-balance-sheet customers, so liquidity creation is an appropriate channel for examining how bank capital affects the bank's competitive advantage.

The second literature to which our paper is related focuses on the incentives banks have to hold capital, beyond the compulsion generated by regulatory capital requirements. The earlier-mentioned papers by Holmstrom and Tirole (1997) and Allen, Carletti, and Marquez (forthcoming) explain that higher bank capital generates stronger incentives for banks to monitor their borrowers, and this can not only improve borrowers' access to non-bank funding sources like the capital market (Holmstrom and Tirole 1997), but also increase the total surplus generated in the relationship between the bank and the borrower (Allen, Carletti and Marquez forthcoming). Allen and Gale (2004) theoretically justify the positive role of capital due to the competitive advantage of capital as well. Diamond and Rajan (2000) show that the benefit of capital in reducing the bank's expected bankruptcy cost will be an offset against the cost of capital in reducing liquidity creation. Mehran and Thakor (2009) show theoretically that higher capital leads to a higher survival probability for the bank in a dynamic setting, and they also present evidence that capital positively affects bank value in the cross-section. Their prediction that higher capital cross-sectionally implies a higher survival probability for the bank is consistent with both our theoretical motivation and the evidence we provide in this paper. Coval and Thakor (2005) show that a minimum amount of capital may be essential to the very viability of the bank in a setting in which banks arise to reduce the financing frictions produced by behavioral irrationality among agents (excessive optimism and pessimism). All of these papers focus on the role of capital in "traditional banks" that engage only in on-balance-sheet activities. The role of capital in banks that also sell off-balance-sheet claims is examined by Boot, Greenbaum, and Thakor (1993). They show that banks with higher amounts of financial capital have a greater capacity to withstand financial shocks and honor "illusory promises" like loan commitments, which in turn can facilitate the development of their reputational capital. Higher reputational capital will help generate higher associated rents for the bank, which would then suggest that off-balance-sheet banking would exhibit a positive association between capital on the one hand and measures like market share and profitability on the other, especially during times

of stress and crises.

We can therefore get some guidance from the existing theories to formulate our empirical hypotheses. Specifically, the theories predict that higher capital will: improve a bank's chances of surviving a crisis, improve its competitive position during a crisis, and positively impact its profitability. There are no predictions about the impact of capital on abnormal stock returns during crises or on the manner of exit for non-survivors. For these, we will formulate plausible testable hypotheses based on extrapolations of existing theories.

3. Banking crises and market crises

This section describes five financial crises that occurred between 1984:Q1 and 2008:Q4. Two of these are banking crises – the credit crunch of the early 1990s; and the current subprime lending crisis. The other three are market crises – the 1987 stock market crash; the Russian debt crisis plus Long-Term Capital Management (LTCM) bailout of 1998; and the bursting of the dot.com bubble and the September 11 terrorist attacks of the early 2000s.

Two banking crises:

- ***Credit crunch (1990:Q1 – 1992:Q4)***: During the first three years of the 1990s, bank commercial and industrial lending declined in real terms, particularly for small banks and for small loans (see Berger, Kashyap, and Scalise 1995, Table 8, for details). The ascribed causes of the credit crunch include a fall in bank capital from the loan loss experiences of the late 1980s (e.g., Peek and Rosengren 1995), the increases in bank leverage requirements and implementation of Basel I risk-based capital standards during this time period (e.g., Berger and Udell 1994, Hancock, Laing, and Wilcox 1995, Thakor 1996), an increase in supervisory toughness evidenced in worse examination ratings for a given bank condition (e.g., Berger, Kyle, and Scalise 2001), and reduced loan demand because of macroeconomic and regional recessions (e.g., Bernanke and Lown 1991). The existing research provides some support for each of these hypotheses.
- ***Subprime lending crisis (2007:Q3 – ?)***: The subprime lending crisis has been characterized by turmoil in financial markets as banks have experienced difficulty in selling loans in the syndicated loan market and

in securitizing loans. The supply of liquidity by banks dried up, as did the provision of liquidity of liquidity in the interbank market. Many banks experienced substantial losses in capital. Massive loan losses at Countrywide resulted in a takeover by Bank of America. Bear Stearns suffered a fatal loss of confidence among its financiers and was sold at a fire-sale price to J.P. Morgan Chase, with the Federal Reserve guaranteeing $29 billion in potential losses. Washington Mutual, the sixth-largest bank, became the biggest bank failure in the U.S. financial history. J.P. Morgan Chase purchased the banking business while the rest of the organization filed for bankruptcy. IndyMac Bank was seized by the FDIC after it suffered substantial losses and depositors had started to run on the bank. The FDIC sold all deposits and most of the assets to OneWest Bank, FSB. The Federal Reserve also intervened in some unprecedented ways in the market. It extended its safety-net privileges to investment banks and one insurance company (AIG) and began holding mortgage-backed securities and lending directly to investment banks. The Treasury initially set aside $250 billion out of its $700-billion bailout package (TARP program) to enhance capital ratios of selected banks. Some of these banks used these funds to acquire lesser-capitalized peers. For example, PNC Bank used TARP funds to acquire National City Bank.

Three market crises:

- ***Stock market crash (1987:Q4)***: On Monday, October 19, 1987, the stock market crashed, with the S&P500 index falling about 20%. During the years before the crash, the level of the stock market had increased dramatically, causing some concern that the market had become overvalued.[6] A few days before the crash, two events occurred that may have helped precipitate the crash: legislation was enacted to eliminate certain tax benefits associated with financing mergers; and information was released that the trade deficit was above expectations. Both events seemed to have added to the selling pressure and a record trading volume on Oct. 19, in part caused by program trading, overwhelmed many systems.
- ***Russian debt crisis / LTCM bailout (1998:Q3 – 1998:Q4)***: Since its inception in March 1994, hedge fund Long-Term Capital Management ("LTCM") followed an arbitrage strategy that was avowedly "market neutral," designed to make money regardless of whether prices were rising or falling. When Russia defaulted on its sovereign debt on August 17, 1998, investors fled from other government paper

[6] E.g., "Raging bull, stock market's surge is puzzling investors: When will it end?" on page 1 of the Wall Street Journal, Jan. 19, 1987.

to the safe haven of U.S. treasuries. This flight to liquidity caused an unexpected widening of spreads on supposedly low-risk portfolios. By the end of August 1998, LTCM's capital had dropped to $2.3 billion, less than 50% of its December 1997 value, with assets standing at $126 billion. In the first three weeks of September, LTCM's capital dropped further to $600 million without shrinking the portfolio. Banks began to doubt its ability to meet margin calls. To prevent a potential systemic meltdown triggered by the collapse of the world's largest hedge fund, the Federal Reserve Bank of New York organized a $3.5 billion bail-out by LTCM's major creditors on September 23, 1998. In 1998:Q4, several large banks had to take substantial write-offs as a result of losses on their investments.

- ***Bursting of the dot.com bubble and Sept. 11 terrorist attack (2000:Q2 – 2002:Q3)***: The dot.com bubble was a speculative stock price bubble that was built up during the mid- to late-1990s. During this period, many internet-based companies, commonly referred to as "dot.coms," were founded. Rapidly increasing stock prices and widely available venture capital created an environment in which many of these companies seemed to focus largely on increasing market share. At the height of the boom, many dot.com's were able to go public and raise substantial amounts of money even if they had never earned any profits, and in some cases had not even earned any revenues. On March 10, 2000, the Nasdaq composite index peaked at more than double its value just a year before. After the bursting of the bubble, many dot.com's ran out of capital and were acquired or filed for bankruptcy (examples of the latter include WorldCom and Pets.com). The U.S. economy started to slow down and business investments began falling. The September 11, 2001 terrorist attacks may have exacerbated the stock market downturn by adversely affecting investor sentiment. By 2002:Q3, the Nasdaq index had fallen by 78%, wiping out $5 trillion in market value of mostly technology firms.

4. Methodology

This section first explains our empirical approach. It then describes the survival and performance measures. Next, it discusses the key exogenous variable and the control variables. Finally, it describes the sample and provides summary statistics.

4.1. Empirical approach

To analyze how capital affects banks' ability to survive crises, we run the following logit regressions:

$$log\left(\frac{Prob(SURVIVE_i)}{1-Prob(SURVIVE_i)}\right) = \alpha_1 + \beta_1 * EQRAT_i + B_1 * Z_i \quad (1)$$

where $SURVIVE_i$ measures whether bank i survived the crisis (see Section 4.2). $EQRAT_i$ is the bank's average capital ratio before the crisis (see Section 4.5); and Z_i is a set of control variables over the pre-crisis period (see Section 4.6).

To examine the impact of capital on a bank's market share and profitability during financial crises and in the immediate post-crisis period, we use the following regression specifications:

$$\%\Delta MKTSHARE_i = \alpha_2 + \beta_2 * EQRAT_i + B_2 * Z_i \quad (2)$$

$$\Delta PROF_i = \alpha_3 + \beta_3 * EQRAT_i + B_3 * Z_i \quad (3)$$

where $\%\Delta MKTSHARE_i$ is the percentage change in bank i's aggregate market share (see Section 4.3) and $\Delta PROF_i$ is the change in bank i's profitability (see Section 4.4). To mitigate the influence of outliers, both variables are winsorized at the 3% level. $EQRAT_i$ and Z_i are as defined above.

All of the above regressions are run separately for banking and market crises. Each bank enters up to two (three) times in the banking (market) crises regressions. Nonetheless, bank fixed effects are not included. This is because the two banking crises (and the three market crises) were far apart, so a particular bank in the credit crunch of the early 1990s was quite different from the same bank in the current subprime lending crisis. The banking (market) crises regressions, however, do include one (two) crisis dummies, where appropriate, which act as time fixed effects.

Given documented differences by bank size in terms of portfolio composition (e.g., Kashyap, Rajan, and Stein 2002, Berger, Miller, Petersen, Rajan, and Stein 2005) and the effect of capital on one of our market share variables -- liquidity creation (Berger and Bouwman forthcoming), we split the sample into small banks (gross total assets (GTA) up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion) and run all regressions separately for these three sets of banks.

To examine the effect of pre-crisis capital on banks' stock return performance during crises, we do not include all banks in the analysis, but instead focus on listed independent banks and listed BHCs. In case of a listed BHC, we create a pro-forma balance sheet and income statement by aggregating the items of all

the banks in the BHC. We require that at least 90% of the traded entity's assets are banking assets. We classify listed banks and BHCs (collectively called banks in the stock return analysis) as high-capital (top 50%) and low-capital (bottom 50%) banks based on their average capitalization over the eight quarters before the crisis, and contrast the stock performance of high-capital and low-capital banks. We use a five-factor model to separately estimate the pre-crisis factor loadings of high- and low-capital banks in each crisis.[7] We do this by regressing portfolio excess returns on the three Fama-French (1993) factors, the Carhart (1997) momentum factor, and the slope of the yield curve:[8]

$$R_{p,t} - R_{f,t} = \delta_0 + \delta_1 * (R_{m,t} - R_{f,t}) + \delta_2 * SMB_t + \delta_3 * HML_t + \delta_4 * MOM_t + \delta_5 * YLDCURVE_t \quad (4)$$

The variables and exact steps taken in our stock return analysis are detailed in Appendix B. Important is that we use pre-crisis factor loadings to predict portfolio returns during the crisis, and focus on the alphas (abnormal stock returns) of the high- and low-capital bank portfolios. Note that the banks included in this analysis are more comparable to the large-bank sample than the medium- or small-bank sample because virtually all of the very largest banks are either listed or in listed BHCs, whereas many medium and most small banks are independently-owned and are not listed.

4.2. Definition of survival

We use two variables to measure whether a bank survived a crisis. *SURV1* is a dummy that equals 1 if the bank is in the sample one quarter before such a crisis started and is still in the sample one quarter after the crisis, and 0 otherwise. This definition reflects the narrowest interpretation of what it means to survive a crisis. In contrast, *SURV4* uses a slightly longer time window. It is a dummy that equals 1 if the bank is in the sample one quarter before such a crisis started and is still in the sample four quarters after the crisis.

4.3. Competitive position analysis: definitions of market share

We use two specifications of a bank's competitive position. The first measure is the bank's market share of aggregate gross total assets (GTA). This is a traditional measure of size that focuses on the bank's on-balance sheet activities. It is calculated as the dollar amount of the bank's gross total assets divided by the

[7] We examine each crisis separately due to the possibility of time variations in the pre-crisis factor loadings.
[8] We do not examine post-crisis stock returns. Since stock returns are forward-looking, the crisis period returns incorporate investors' expectations about both the crisis and the post-crisis periods.

dollar amount of the industry's gross total assets. The main shortcoming of this measure is that it ignores off-balance sheet activities and treats all assets identically, i.e. it neglects the qualitative asset transformation nature of the bank's activities (e.g., Bhattacharya and Thakor 1993, Kashyap, Rajan, and Stein 2002). For this reason, we also use a second measure.

The second measure of a bank's competitive position is the bank's market share of overall bank liquidity creation. Liquidity creation is a superior measure of banking activities since it is based on all the bank's on- and off-balance sheet activities. Thus, it avoids the weakness of our first measure. We calculate the dollar amount of liquidity created by each bank using Berger and Bouwman's (forthcoming) preferred liquidity creation measure. The three-step procedure used to construct this measure is explained in Appendix A. A bank's liquidity creation market share is the dollar amount of liquidity creation by the bank divided by the dollar amount of liquidity created by the industry.

To establish whether banks improve their competitive positions during banking and market crises, we define each bank's percentage change in gross total assets, %ΔGTA, and percentage change in liquidity creation market share, %ΔLCSHARE, as the bank's average market share during such crises minus its average market share over the eight quarters before such crises, normalized by its average pre-crisis market share and multiplied by 100. To examine whether these banks hold on to their improved performance after banking and market crises, we measure each bank's average market share over the eight quarters after such crises minus its average market share over the eight quarters before such crises, again normalized by its average pre-crisis market share and multiplied by 100.

4.4. Definition of profitability

We measure a bank's profitability using the bank's return on equity (ROE), i.e., net income divided by stockholders equity.[9] This is a comprehensive profitability measure since banks may have substantial off-balance sheet portfolios. Banks must allocate capital against every off-balance sheet activity they engage in. Hence, net income and equity both reflect the bank's on- and off-balance sheet activities.

[9] If a bank's capital to GTA ratio is less than one percent, we calculate ROE as net income divided by one percent of GTA. For observations for which equity is between 0% and 1% of GTA, dividing by equity would result in extraordinarily high values. For observations for which equity is negative, the conventionally-defined ROE would not make economic sense. We considered the alternative of dropping negative-equity observations, but rejected it because these are the banks that are most likely to be informative of banks' ability to survive crises.

To examine whether a bank improves its profitability during banking and market crises, we focus on the change in ROE (ΔROE), defined as the bank's average profitability during these crises minus the bank's average ROE over the eight quarters before these crises.[10] To analyze whether the bank is able to hold on to improved profitability, we focus on the bank's average profitability over the eight quarters after these crises minus its average profitability over the eight quarters before these crises.

4.5. Key exogenous variable and control variables

The key exogenous variable is EQRAT, the bank's capital ratio averaged over the eight quarters before the crisis. EQRAT is the ratio of equity capital to gross total assets, GTA.[11]

The control variables include: bank size, bank risk, bank holding company membership, local market competition, and proxies for the economic environment. We discuss these variables in turn. Each control variable is averaged over the eight-quarter pre-crisis period, except when noted otherwise.

Bank size is controlled for by including lnGTA, the log of GTA, in all regressions. In addition, we run regressions separately for small, medium, and large banks.

We include the z-score to control for bank risk.[12] The z-score indicates the bank's distance from default (e.g., Boyd, Graham, and Hewitt 1993), with higher values indicating that a bank is less likely to default. It is measured as a bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets over the eight quarters before the crisis.

To control for bank holding company status, we include D-BHC, a dummy variable that equals 1 if the bank was part of a bank holding company at any time in the eight quarters preceding the crisis. Bank holding company membership may affect a bank's competitive position because the holding company is required to act as a source of strength to all the banks it owns, and may also inject equity voluntarily when needed. In addition, other banks in the holding company provide cross-guarantees. Furthermore, Houston, James, and Marcus (1997) find that bank loan growth depends on BHC membership.

We control for local market competition by including HERF, the bank-level Herfindahl-Hirschman

[10] We do not divide by the bank's ROE before the crisis since ROE itself is already a scaled variable.
[11] We use the bank's ratio of equity capital to assets rather than its regulatory capital ratios. The latter are based on risk-weighted assets, which reflect the bank's on- and off-balance sheet portfolio decisions. We want to focus on the bank's capitalization decision, rather than on its portfolio allocation decisions.
[12] Results are qualitatively similar if we use the standard deviation of the bank's return on assets, ROA, instead.

index of deposit concentration for the local markets in which the bank is present.[13] From 1984-2004, we define the local market as the Metropolitan Statistical Area (MSA) or non-MSA county in which the offices are located.[14] After 2004, we use the new local market definitions based on Core Based Statistical Area (CBSA) and non-CBSA county.[15]

We also need to ensure that changes in performance are not driven by local market economic conditions. We therefore include weighted income growth, INC-GROWTH, and the weighted log of population, lnPOP, in the local markets in which the bank operates, using the bank's share of deposits in a market as weights.

4.6. Sample and summary statistics

For every commercial and credit card bank in the U.S, we obtain quarterly Call Report data from 1984:Q1 to 2008:Q4.[16] We keep a bank in the sample if it: 1) has commercial real estate or commercial and industrial loans outstanding; 2) has deposits; and 3) has gross total assets or GTA exceeding $25 million. We end up with data on 18,326 distinct banks (935,499 bank-quarter observations) over our sample period.

As indicated above, we split these banks into three size categories. Analyses that focus on the effect of capital during (after) banking crises have 16,856 (9,070) small-bank, 639 (233) medium-bank, and 446 (209) large-bank observations. The big drop in the number of observations after banking crises is primarily caused by the fact that the sub-prime lending crisis was still ongoing at the end of the sample period. Analyses that focus on the effect of capital during (after) market crises have 25,943 (24,702) small-bank, 819 (730) medium-bank, and 600 (551) large-bank observations.

Table 1 contains summary statistics on all the regression variables. The sample statistics are shown for banking crises, market crises, and normal times. Normal times will be explained in Section 6.1 below.

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[13] While our focus is on the change in banks' competitive positions measured in terms of their aggregate liquidity creation market shares, we control for "local market competition" measured as the bank-level Herfindahl index based on local market deposit market shares.

[14] When appropriate, we use New England County Metropolitan Areas (NECMAs) instead of MSAs, but refer to these as MSAs.

[15] The term CBSA collectively refers to Metropolitan Statistical Areas and newly-created Micropolitan Statistical Areas. Areas based on these new standards were announced in June 2003. For recent years, the Summary of Deposits data needed to construct HERF is available on the FDIC's website only based on the new definition. It is not possible to use the new definition for our entire sample period.

[16] Berger and Bouwman (forthcoming) include only commercial banks. We also include credit card banks to avoid an artificial $0.19 trillion drop in bank liquidity creation in the fourth quarter of 2006 when Citibank N.A. moved its credit-card lines to Citibank South Dakota N.A., a credit card bank.

All financial values are put into real 2008:Q4 dollars using the implicit GDP price deflator.

5. Main regression results

In this section, we discuss the empirical results.

5.1. Are higher-capital banks more likely to survive financial crises?

Table 2 Panels A and B present the results for banking and market crises, respectively. Each panel shows the results for small, medium, and large banks based on the two survival definitions, *SURV1* and *SURV4*.

The table shows two main results. First, in all size categories, banks with higher pre-crisis capital ratios are more likely to survive banking crises (significant in all cases based on *SURV1*, significant for small and medium banks based on *SURV4*). Second, small banks with higher capital ratios are also significantly more likely to survive market crises (significant based on SURV4). The ability of medium and large banks to survive market crises does not seem to be significantly related to their capital ratios.

These results confirm that one key role of bank capital is to fortify the bank and enhance its ability to survive a crisis (e.g., Diamond and Rajan 2000, Coval and Thakor 2005, Mehran and Thakor 2009). Small banks are the most vulnerable during virtually any financial crisis, so it is economically sensible that they stand to gain the most from the fortification provided by capital. During both banking and market crises, higher capital leads to a higher survival probability for small banks. Any crisis of confidence in financial markets – including that caused by turmoil in the markets outside the banking system – can cause safety concerns about small banks to be elevated in importance in the eyes of the banks' customers. Thus, even during a market crisis, a small bank's customers may increase their focus on the bank's capital, and banks with relatively low capital ratios may be faced with heightened withdrawal risk or otherwise diminished access to (uninsured) sources of liquidity that may eventually mean a lower survival probability. Medium and large banks, by contrast, experience higher survival probabilities associated with higher capital only during banking crises. Perhaps one reason why capital does not play a similar role during market crises for these banks is that their customers do not view them as being quite as fragile as do the customers of small banks. This would make them relatively immune to market crises. But during a banking crisis, these banks would be directly exposed to the stresses and strains of the crisis and may succumb unless they have

sufficient capital.

Table 2 Panels C and D interpret these findings using the predicted probability of surviving banking and market crises, respectively. The top part of each panel shows the average capital ratio (and the average capital ratio plus or minus one standard deviation) of small, medium, and large banks over the eight quarters before banking and market crises. The bottom part of each panel shows the predicted probability of surviving banking and market crises at these capital ratios. A small, medium, or large bank with a capital ratio one standard deviation *below* the average (5.66%, 4.25%, and 3.95%, respectively) had a probability of surviving banking crises of 85.2%, 69.3%, and 73.2%, respectively. In contrast, a small, medium, or large bank with a capital ratio one standard deviation *above* the average (13.78%, 13.25%, and 12.83%, respectively) had a probability of surviving banking crises of 95.5%, 90.8%, and 99.2%, respectively. The corresponding probabilities for market crises are generally higher and show less dispersion.[17]

5.2. Are higher-capital banks able to improve their competitive positions around financial crises?

Table 3 Panels A and B regress the change in a bank's competitive position (%ΔGTA and %ΔLCSHARE) during banking and market crises, respectively, on the bank's pre-crisis capital ratio plus control variables. Each panel first compares crisis and pre-crisis performance in order to address whether higher-capital banks are able to improve their competitive positions during crises. It then contrasts post-crisis and pre-crisis performance to shed light on whether high-capital banks are able to hold on to their improved competitive positions after crises. In the latter case, the banking crisis results are based on the credit crunch only since the subprime lending crisis was not yet over at the end of the sample period. In all cases, results are shown separately for small, medium, and large banks. t-statistics are based on robust standard errors.

We find three main results. First, small banks with higher capital ratios are able to increase their GTA and liquidity creation market shares during banking and market crises alike, and are able to maintain their improved market shares after the crisis.

Second, while medium banks are able to improve their market shares during banking crises (significant based only on the liquidity creation market share measure), they are not able to hold on to their

[17] The survival probabilities of medium and large banks actually decrease slightly when capital is higher during market crises. This is consistent with the negative but insignificant coefficients on EQRAT for these banks shown in Table 2 Panel B.

improved performance after such crises. Capital does not seem to affect their market shares around market crises.

Third, for large banks, capital helps to improve their market shares (based on both measures) during banking crises, and the higher-capital large banks are able to maintain their market share gains after such crises (significant based on the liquidity creation market share measure). Capital does not appear to produce such benefits around market crises. Rather, somewhat inexplicably, banks with higher capital ratios seem to lose market share after market crises.

The economic reasoning behind why the impact of capital on market share changes during crises is the strongest for small banks is similar to the reasoning behind why capital affects the survival probability during a crisis most strongly for small banks. Since the bank's customers are most concerned about its viability when it is small, any kind of crisis brings capital – the small bank's key protection against failure – into sharper focus for small banks. Thus, during such periods, small banks with higher capital ratios gain a bigger competitive advantage over their lower-capital competitors and this advantage appears in the form of market-share-enhancing customer migration.

To judge the economic significance of these results, consider the change in liquidity creation market share regressions for small, medium, and large banks. Focus first on the effect of capital during banking crises. The coefficients on EQRAT in those regressions (4.496, 1.308, and 3.096, respectively) suggest that if the pre-crisis capital ratio were one percentage point higher, the bank's liquidity creation market share would be around four and a half, one, and three percentage points higher, respectively, for small, medium, and large banks during such crises. In contrast, the predicted effect during market crises (2.93 for small banks and not significant for medium and large banks) is around three percentage points for small banks. Consider next the effect of capital after banking crises. The coefficients on EQRAT (7.428 and 10.59 for small and large banks, respectively; not significant for medium banks) suggest that if the pre-crisis capital ratio were one percentage point higher, then the bank's liquidity creation market share would be around seven and a half and ten and a half percentage points higher for small and large banks, respectively, after banking crises. This suggests that small and large banks with higher capital not only maintain their improved market shares subsequent to the crisis, but actually increase them after the banking crisis. Similarly, the predicted effect after market crises (6.006 for small banks and not significant for medium and large banks) is

around six percentage points for small banks, suggesting that small banks with higher capital further improve their market shares after market crises.

5.3. Are higher-capital banks able to improve their profitability around financial crises?

Table 4 Panels A and B contain the results of regressing the change in profitability (ΔROE) during banking and market crises, respectively, on the bank's pre-crisis capital ratio plus control variables. The setup of the table is similar to the previous one. As before, t-statistics are based on robust standard errors.

We again find three main results. First, small banks are able to improve their profitability during banking crises, but somewhat puzzling is the result that their profitability deteriorates after banking crises relative to that of their lower-capital peers. Around market crises, capital has no significant effect on small banks' ROE.

Second, capital does not significantly affect medium banks' profitability during either banking or market crises. As in the case of small banks, capital has a negative effect on medium banks' profitability after banking crises. Unlike small banks, however, capital has a positive effect on medium banks' profitability after market crises.

Third, large banks with higher capital ratios are able to improve their profitability during banking and market crises and are able to sustain their higher profitability in the post-crisis period.

How do we interpret these results? Although the profitability of medium banks during crises appears unaffected by capital – and this result is difficult to explain – both small and large banks experience a positive relationship between capital and profitability during banking crises. This result is consistent with our earlier findings that capital is a source of competitive advantage during crises.[18] If stress experienced by banks and their customers lingers even after the crisis is over, we would expect the positive association between capital and profitability to persist as well in the post-crisis period. This is what we find in the case of large banks. However, if the end of the crisis also means that the stress experienced during the crisis is gone, then capital may cease to be a source of competitive advantage. Moreover, the mechanical effect of capital on ROE is that higher capital leads to a lower ROE ceteris paribus. During a crisis, the competitive advantage provided by capital may overwhelm the negative mechanical effect of capital on ROE, so higher

[18] It is also consistent with the theories developed by Boot, Greenbaum, and Thakor (1993) and Allen, Carletti, and Marquez (2008).

capital leads to a more positive ROE change during a crisis. But once the crisis is over, the competitive advantage of capital may vanish, leaving only the mechanical effect. So, in the post-crisis period, higher capital may be associated with a greater negative impact on the change in ROE.[19] This is what we find for small and medium banks.

A recent survey paper by Campello, Giambona, Graham, and Harvey (2009) sheds further light on why banks with higher capital may improve their profitability during crises relative to banks with lower capital. It shows that during the sub-prime lending crisis, banks renegotiated in their own favor the terms for lines of credit with borrowers, possibly by threatening to invoke the material adverse change clause. Although they do not investigate this, it may be that banks with more capital could do this more easily because their stronger reputational capital in the loan commitment market gave them greater bargaining power with their borrowers (see Boot, Greenbaum, and Thakor 1993), which would explain the higher profitability and market share for higher-capital banks during crises.

To judge the economic significance of these results, consider first the change-in-ROE regressions during banking crises. The coefficients on EQRAT (0.035 and 0.172 for small and large banks, not significant for medium banks) suggest that if the pre-crisis capital ratio were one percentage point higher, then the small (large) bank's ROE would be 0.035 (0.172) percentage point higher during such crises. In contrast, the predicted effect during market crises (not significant for small and medium banks and 0.289 for large banks) is 0.289 percentage point for large banks, a bigger effect. Consider next the change-in-ROE regressions after banking crises. The coefficients on EQRAT (-0.157 for small banks, -0.444 for medium banks, and 0.175 for large banks) suggest that if the pre-crisis capital ratio were one percentage point higher, then the bank's ROE would be around 0.2 and 0.4 percentage points lower for small and medium banks, and 0.175 percentage points higher for large banks after banking crises. Similarly, the predicted effect after market crises (not significant for small banks, 0.167 for medium banks, and 0.457 for large banks) is around 0.2 and 0.5 percentage points for medium and large banks, respectively, suggesting that both improve their profitability after market crises.

[19] Berger (1995) finds that there is no relationship between ROE and capital during normal times, which may reflect the fact that the smaller competitive advantage of capital during normal times may be offset entirely by the negative mechanical effect of higher capital on ROE.

5.4. Do higher-capital listed banks earn higher stock returns during financial crises?

Table 5 Panels A and B presents the alphas, i.e., the abnormal stock returns, of two portfolios of high- and low-capital banks during the two banking crises and the three market crises, respectively. The difference between those alphas, HminLalph, is positive and significant for the first banking crisis. During the credit crunch, HminLalpha equals 3.97% per month: while the return on the portfolio of low-capital banks was close to that expected based on the performance of these banks before the crisis (only 0.17% per month higher), the high-capital bank portfolio earned 3.80% per month more than expected based on the pre-crisis stock performance of these banks. During the recent subprime mortgage crisis, HminLalpha is negative but not significant (-3.08% per month). The credit crunch results are consistent with the change-in-market-share results for the large banks presented above. The stock performance of high-capital banks during the subprime lending crisis is puzzling because it is at odds with the market share gains made by high-capital large banks during this crisis. One possible explanation is that investors may have viewed the higher market shares acquired by high-capital banks as exposing them to excessive liquidity risk, which has been a major concern in this crisis.

HminLalpha is positive but not significant during the three market crises. This is consistent with our findings above that capital has a weaker effect on large banks' competitive position y during market crises.

6. Additional analyses

This section presents two additional analyses. First, we analyze the effect of capital during "normal" times in order to contrast this with our crisis results. Second, we dig a little deeper into the banks that do not survive crises. We look at the manner in which exit occurred – via consolidation within a bank holding company (BHC) structure, a regular merger/acquisition, or a merger/acquisition with government assistance. We examine whether the bank's pre-crisis capital affects the likelihood of exiting in a particular manner.

6.1. Is the effect of capital on survival and performance similar during "normal" times?

While our focus has been on the role of bank capital during crises, it is interesting to ask whether there is something special about crises or whether capital plays a similar role during non-crisis, normal times. To investigate this, we rerun our regressions for two "fake" crises. The idea is to run our analysis during

"normal" times, but do it in a way that mimics our analysis of crises.

To create the "fake" crises, we use the two longest time periods between actual financial crises over our entire 1984:Q1 – 2008:Q1 sample period. These periods are between the credit crunch and the Russian debt crisis, and between the bursting of the dot.com bubble and the subprime lending crisis. In each case, we take the entire period between the crises, designate the first eight quarters as "pre-crisis" and the last eight quarters as "post-crisis" and the remaining quarters in the middle as the "fake" crisis. We thus end up with a six-quarter "fake" crisis period between the credit crunch and the Russian debt crisis (from 1995:Q1 to 1996:Q2) and a three-quarter "fake" crisis period between the dot.com bubble and the subprime lending crisis (from 2004:Q4 to 2005:Q2).[20]

To rerun our logit and OLS regressions, we do the following. We create survival dummies SURV1 and SURV4, that equal 1 if the bank was operational before the fake crisis and during the first and fourth quarter after the fake crisis, respectively. We also calculate the change in market share and profitability based on the average liquidity creation market share and profitability of all banks over the pre-crisis period, during the "fake" crisis, and over the post-crisis period. The key exogenous variable and control variables (see Section 4.5) are constructed as well.

Table 6 shows the results. The results in *Panel A* show that only small banks with higher capital ratios are more likely to survive during normal times (significant based on both SURV1 and SURV4). This is consistent with the market crisis results, but stands in stark contrast to the banking crisis results, which showed that capital helps banks survive banking crises in all size classes.

Table 6 Panels B and C show that, consistent with the banking and market crisis results, higher-capital small banks improved their market shares during "fake" crises, and were able to maintain their improved market shares (in both cases significant based on the liquidity creation market share measure). Higher-capital small banks also improved their ROE during and after "fake" crises, consistent with the banking crisis results. Higher-capital medium banks improved their market shares during "fake" crises (significant based on the liquidity creation market share measure), but were not able to maintain their improved positions afterwards; they did not improve their profitability during or after such crises. Both results are similar to the banking crisis results for medium banks. While higher-capital large banks did

[20] Results are qualitatively similar if we instead use five- or four-quarter crisis periods for the first "fake" crisis, and two- or one-quarter crisis periods for the second "fake" crisis.

improve their market shares relative to lower-capital large banks during and after these "fake" crisis periods (consistent with the banking crisis results), they did not improve their profitability during or after these crises (not consistent with the banking crisis results).

Table 6 Panel D indicates that high-capital listed banks did not earn significantly higher abnormal returns than low-capital listed banks during "fake" crises.

6.2. Is the manner of exit for non-surviving banks related to their pre-crisis capital ratios?

We next address the question of whether the manner of exit for non-surviving banks is also related to their pre-crisis capital ratios. To address this question, we focus on observations for which SURV1 equals 0, i.e., banks that were alive one quarter before the crisis, but ceased exist one quarter after the crisis. We obtain information on the disposition of these banks from the Chicago Federal Reserve Bank. As the summary statistics in *Table 7 Panel A* show, 1,311 of our sample banks exited during banking crises, 1,320 exited during market crises, and 1,017 exited during normal times (i.e., during the fake crises). The data show that banks typically exit in one of the following four ways.

First, banks ceased to exist because they were consolidated within a BHC. Until 1994, banks were not allowed to operate a multi-state branching network. The Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 changed this – it allowed mergers of banks in different states as of June 1, 1997, and allowed states to opt in early. As *Table 7 Panels A-C* show, 49% - 56% of all exits during banking crises were mere consolidations; during market crises and normal times, the percentages went up to 65% - 75% and 63% - 85%, respectively.

Second, banks ceased to exist because they were acquired or merged without government assistance. *Table 7 Panels A-C* show that depending on bank size, regular mergers and acquisitions accounted for 17% - 22% of all exits during banking crises; 21% - 30% during market crises, and 15% - 34% during normal times.

Third, banks ceased to exist because they were acquired or merged with government assistance. Not surprisingly, such deals were especially prevalent during banking crises. As *Table 7 Panels A-C* show, they accounted for 22% - 31% of all exits during banking crises. During market crises and normal times, only 0% - 3% and 0% - 1%, respectively, merge with assistance.

Fourth, banks ceased to exist because they failed outright or simply changed their charters. In the latter case, banks merely begin to operate under a new charter. Unfortunately, the data do not allow us to distinguish between these two very different cases. We therefore only provide summary statistics but do not perform any further analyses for this category. This type of non-survival was not very prevalent as can be seen in *Table 7 Panels A-C*. During banking crises, 0% - 3% failed outright or changed charters. During market crises and normal times, the percentages went up slightly to 2% - 6% and 0% - 5%, respectively.

We now ask: conditional on not surviving such crises, does the bank's pre-crisis capitalization affect the likelihood of dying via consolidation, regular M&A, or M&A with assistance? To address this, we use the following logit specifications:

$$log\left(\frac{Prob(CONSOL_i)}{1-Prob(CONSOL_i)}\right) = \alpha_5 + \beta_5 * EQRAT_i + B_5 * Z_i \quad (5)$$

$$log\left(\frac{Prob(M\&A_i)}{1-Prob(M\&A_i)}\right) = \alpha_6 + \beta_6 * EQRAT_i + B_6 * Z_i \quad (6)$$

$$log\left(\frac{Prob(ASSIST_i)}{1-Prob(ASSIST_i)}\right) = \alpha_7 + \beta_7 * EQRAT_i + B_7 * Z_i \quad (7)$$

where $CONSOL_i$, $M\&A_i$, and $ASSIST_i$ are dummy variables that equal 1 if bank *i* was in the sample during the last quarter before a crisis but ceased to exist by the first quarter after the crisis because it was consolidated, merged or was acquired without assistance, or merged or was acquired with government assistance, respectively. $EQRAT_i$ and Z_i are as defined above.

What do we expect to find? First, we do not expect banks with high capital to become insolvent during a crisis. Thus, when banks with relatively high capital exit, we expect the exits to be either in the form of consolidations within BHC structures or non-government-assisted mergers/acquisitions. Relatively large banks are more likely to be members of BHCs, so when high-capital large banks exit, we expect the exits to be mostly via consolidations within BHCs. When small banks with relatively high capital exit, we expect the exits to be more likely to occur via non-government-assisted mergers/acquisitions. Finally, when banks with relatively low capital ratios exit, these are most likely to be banks that became insolvent, so the exits are most likely to be via government-assisted mergers/acquisitions.

Table 7 Panels D-F contain the results, which are mostly consistent with the economics articulated above. The consolidation results show that large banks with higher capital ratios are more likely to exit via BHC consolidations during banking crises. One reason why a BHC may wish to consolidate a high-capital subsidiary during a banking crisis is that there may be other subsidiaries that are undercapitalized and could

be restored to capital compliance by merging them with the high-capital subsidiary. The effect is not significant during market crises and normal times, and is never significant for medium banks or small banks. The latter is not surprising, since small banks are less likely to be part of BHCs.

The M&A results show, consistent with expectations, that small banks with higher capital ratios are more likely to be acquired during banking crises and market crises, but not during normal times. This may reflect the fact that capital is at a premium during financial crises, so small banks with higher capital fetch higher prices and this reduces the takeover resistance of the managers in these banks. The effect is not significant for large or medium banks, which may be due to the fact that these are either acquirers (and hence do not exit) or are members of BHCs and hence exit via consolidations within BHCs.

The M&A-with-government-assistance results show that small banks with higher capital ratios are significantly less likely to be acquired with government assistance during banking crises, market crises, and normal times. This is not surprising since government assistance is typically provided to severely undercapitalized banks. For medium and large banks, the effect is only significant during banking crises. This is largely driven by the fact that during market crises and normal times, these banks are rarely acquired with government assistance regardless of their capitalization.

7. Conclusion

We have examined the effect of bank capital on a bank's ability to survive banking and market crises, its competitive position as reflected in its market share, its profitability, and its stock return performance around such crises. We have also explored the effect of capital during "normal" times between the crises. We find that capital has benefits that are accentuated during financial crises, especially banking crises, and that these benefits, manifested in terms of a higher ability to survive crises as well as enhanced market share, profitability, and stock returns, are the strongest for small banks. The benefits of capital decline significantly during normal times.

These findings may shed light on two somewhat contradictory phenomena – the apparent usual reluctance of banks to hold capital in excess of regulatory requirements (e.g., Mishkin 2000) and the large amounts of excess capital that many banks held prior to 2007 (e.g., Berger, DeYoung, Flannery, Lee, and Oztekin, 2008, Flannery and Rangan 2008). When times are good, capital does not seem to produce much of

a competitive advantage, so banks that do not attach a high probability to a financial crisis will be reluctant to hold capital significantly in excess of regulatory requirements. But, given the benefits of capital during crises that we have documented, those banks that attach a non-trivial probability to the occurrence of a crisis will voluntarily wish to keep excess capital.

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Table 1: Summary statistics on the regression variables

This table contains summary statistics on all the regression variables used to examine the effect of pre-crisis capital ratios on banks' ability to survive crises, and on their competitive positions and profitability during and after such crises. We distinguish between banking crises (the credit crunch of the early 1990s and the current subprime lending crisis), market crises (the 1987 stock market crash, the Russian debt crisis plus LTCM bailout in 1998, and the bursting of the dot.com bubble plus September 11), and "fake crises" or normal times (see Section 6.1).

SURV1 (SURV4) is a dummy that equals 1 if the bank is in the sample one quarter before such a crisis started and is still in the sample one quarter (four quarters) after the crisis, and 0 otherwise. The change in gross total assets (GTA) market share during the crisis (after the crisis) is measured as the bank's average market share of liquidity creation during a crisis (over the eight quarters after a crisis) minus its average market share of liquidity creation over the eight quarters before the crisis, normalized by its pre-crisis market share and multiplied by 100. GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans). The change in liquidity creation market share is defined in a similar way. The change in profitability during the crisis (after the crisis) is measured as the bank's average profitability during a crisis (over the eight quarters after a crisis) minus its average profitability over the eight quarters before the crisis. Profitability is ROE, net income divided by equity capital.

All independent variables are measured as averages over the eight quarters prior to a crisis (except as noted). EQRAT is the equity capital ratio, calculated as equity capital as a proportion of GTA. Ln(GTA) is the log of GTA. ZSCORE is the distance to default, measured as the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets. D-BHC is a dummy variable that equals 1 if the bank has been part of a bank holding company over the eight quarters before the crisis. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the local markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. INC-GROWTH is the weighted average income growth in all local markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(POP) is the natural log of weighted average population in all local markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All dollar values are expressed in real 2008:Q4 dollars using the implicit GDP price deflator.

	Banking crises	**Market crises**	**Normal times**	**Banking crises**	**Market crises**	**Normal times**	**Banking crises**	**Market crises**	**Normal times**
Survivability:									
SURV1	0.884	0.954	0.942	0.767	0.891	0.903	0.857	0.920	0.894
SURV4	0.853	0.921	0.909	0.702	0.842	0.824	0.811	0.880	0.818
Change in GTA market share:									
During the crisis	0.038	0.035	0.009	0.042	0.107	0.063	0.053	0.107	0.081
After the crisis	0.162	0.066	0.049	0.199	0.197	0.157	0.188	0.188	0.186
Change in liquidity creation market share:									
During the crisis	0.210	0.199	0.171	0.161	0.200	0.123	0.185	0.149	0.145
After the crisis	1.015	0.447	0.377	0.570	0.418	0.291	0.460	0.274	0.296
Change in profitability (ROE)									
During the crisis	-0.018	-0.012	0.001	-0.057	-0.013	-0.005	-0.067	-0.020	-0.009
After the crisis	0.022	0.004	0.003	0.025	-0.010	-0.007	0.018	-0.003	-0.003

	Banking crises	Market crises	Normal times	Banking crises	Market crises	Normal times	Banking crises	Market crises	Normal times
Independent variables:									
EQRAT	0.097	0.096	0.100	0.087	0.084	0.092	0.084	0.076	0.088
lnGTA	5.188	5.140	5.190	6.202	6.194	6.179	7.407	7.312	7.360
ZSCORE	0.021	0.021	0.022	0.032	0.031	0.034	0.030	0.029	0.028
D-BHC	0.726	0.716	0.736	0.863	0.895	0.857	0.927	0.951	0.937
HHI	0.233	0.216	0.210	0.174	0.169	0.163	0.165	0.162	0.160
INC-GROWTH	0.039	0.030	0.021	0.051	0.040	0.016	0.055	0.044	0.016
lnPOP	11.783	11.727	11.741	13.243	13.343	13.544	13.714	13.785	13.845
Obs during crises	16856	25943	15825	639	819	601	446	600	444
Obs after crises	9070	24702	14881	233	730	540	209	551	397

Table 2: The effect of the bank's pre-crisis capital ratio on its ability to survive banking crises and market crises

Panels A and B show the results of logit regressions which examine how pre-crisis capital ratios affect banks' ability to survive banking crises (the credit crunch of the early 1990s – the current subprime lending crisis is excluded because it was still ongoing at the end of the sample period) and market crises (the 1987 stock market crash, the Russian debt crisis plus LTCM bailout in 1998, and the bursting of the dot.com bubble plus September 11), respectively. Panels C and D contain the predicted probability of surviving banking and market crises, respectively, at different capital ratios. Results are shown for small banks (GTA up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion). GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

In Panels A and B, the dependent variables are $\log\left(\frac{Prob(SURV1_i)}{1-\text{Prob}(\text{SURV1}_i)}\right)$ and $\log\left(\frac{Prob(SURV4_i)}{1-\text{Prob}(\text{SURV4}_i)}\right)$, where SURV1 (SURV4) is a dummy that equals 1 if the bank is in the sample one quarter before such a crisis started and is still in the sample one quarter (four quarters) after the crisis, and 0 otherwise.

The key exogenous variable (EQRAT) and control variables are averaged over the eight quarters before a crisis (except as noted). EQRAT is the equity capital ratio, calculated as equity capital as a proportion of GTA. Ln(GTA) is the log of GTA. ZSCORE is the distance to default, measured as the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets. D-BHC is a dummy variable that equals 1 if the bank has been part of a bank holding company over the eight quarters before the crisis. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the local markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. INC-GROWTH is the weighted average income growth in all local markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(POP) is the natural log of weighted average population in all local markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. All dollar values are expressed in real 2008:Q4 dollars using the implicit GDP price deflator.
Crisis dummies are included in the market crisis regression (not reported for brevity).

t-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: The effect of the bank's pre-crisis capital ratio on its ability to survive *banking* crises

	Small banks		***Medium banks***		***Large banks***	
	SURV1	***SURV4***	***SURV1***	***SURV4***	***SURV1***	***SURV4***
EQRAT	16.054	12.759	16.422	15.968	43.567	19.427
	*(10.74)****	*(9.96)****	*(2.19)***	*(2.33)***	*(2.43)***	*(1.43)*
lnGTA	0.076	0.061	-0.028	-0.432	0.117	0.413
	*(1.87)**	*(1.63)*	*(-0.07)*	*(-1.13)*	*(0.47)*	*(1.70)**
ZSCORE	6.729	10.013	20.021	11.345	2.182	17.192
	*(2.49)***	*(4.01)****	*(2.04)***	*(1.36)*	*(0.16)*	*(1.32)*
D-BHC	-0.667	-0.713	0.103	-0.031	1.939	1.246
	*(-8.24)****	*(-9.75)****	*(0.26)*	*(-0.08)*	*(2.96)****	*(2.10)***
HHI	0.298	0.349	4.818	4.480	2.953	2.000
	(0.85)	*(1.11)*	*(2.19)***	*(2.23)***	*(0.90)*	*(0.70)*
INC-GROWTH	-1.374	-1.445	-6.845	-5.144	-6.251	-2.156
	(-0.90)	*(-1.05)*	*(-0.91)*	*(-0.71)*	*(-0.42)*	*(-0.17)*
lnPOP	-0.216	-0.228	0.049	0.032	0.076	0.060
	*(-11.88)****	*(-13.74)****	*(0.60)*	*(0.41)*	*(0.75)*	*(0.64)*
Constant	2.854	3.128	-1.158	4.786	-5.688	-8.787
	*(5.51)****	*(6.66)****	*(-0.19)*	*(0.86)*	*(-1.22)*	*(-2.00)***
Obs	10364	10364	309	309	244	244

Panel B: The effect of the bank's pre-crisis capital ratio on its ability to survive *market* crises

	Small banks		*Medium banks*		*Large banks*	
	SURV1	***SURV4***	***SURV1***	***SURV4***	***SURV1***	***SURV4***
EQRAT	1.343	6.312	-2.180	-2.222	-4.710	-6.270
	(1.31)	*(6.84)****	*(-0.98)*	*(-1.06)*	*(-1.08)*	*(-1.61)*
lnGTA	-0.194	-0.085	-0.019	0.449	0.014	0.040
	*(-4.98)****	*(-2.76)****	*(-0.06)*	*(1.75)**	*(0.10)*	*(0.32)*
ZSCORE	-4.145	-1.475	0.474	6.705	16.991	17.147
	*(-3.08)****	*(-1.19)*	*(0.11)*	*(1.51)*	*(1.90)**	*(2.32)***
D-BHC	-0.800	-0.627	-0.565	-0.315	-0.610	-1.249
	*(-9.18)****	*(-9.80)****	*(-1.21)*	*(-0.84)*	*(-0.71)*	*(-1.43)*
HHI	0.492	0.242	1.525	0.404	5.397	4.616
	(1.52)	*(0.96)*	*(0.85)*	*(0.27)*	*(1.73)**	*(1.82)**
INC-GROWTH	-8.605	-2.575	-21.804	1.397	-8.561	-10.288
	*(-6.97)****	*(-2.78)****	*(-3.04)****	*(0.26)*	*(-0.89)*	*(-1.27)*
lnPOP	-0.050	-0.111	0.140	0.020	0.063	0.022
	*(-2.71)****	*(-7.89)****	*(2.37)***	*(0.38)*	*(0.59)*	*(0.22)*
Constant	6.667	4.742	1.861	-4.806	1.402	2.041
	*(13.64)****	*(12.21)****	*(0.42)*	*(-1.29)*	*(0.50)*	*(0.83)*
Obs	25943	25943	819	819	600	600

Panel C: Predicted probability of surviving *banking* crises at different capital ratios (survival definition: SURV1)

		Small banks	***Medium banks***	***Large banks***
Capital ratio:	Average minus 1 standard deviation	5.66%	4.25%	3.95%
	Average	9.72%	8.75%	8.39%
	Average plus 1 standard deviation	13.78%	13.25%	12.83%
Predicted survival probability when capital is at:	Average minus 1 standard deviation	85.2%	69.3%	73.2%
	Average	91.7%	82.6%	95.0%
	Average plus 1 standard deviation	95.5%	90.8%	99.2%

Panel D: Predicted probability of surviving *market* crises at different capital ratios (survival definition: SURV1)

		Small banks	***Medium banks***	***Large banks***
Capital ratio:	Average minus 1 standard deviation	6.19%	4.41%	4.78%
	Average	9.61%	8.36%	7.59%
	Average plus 1 standard deviation	13.03%	12.31%	10.40%
Predicted survival probability when capital is at:	Average minus 1 standard deviation	95.8%	90.6%	93.7%
	Average	96.0%	89.8%	92.9%
	Average plus 1 standard deviation	96.2%	89.0%	92.0%

Table 3: The effect of the bank's pre-crisis capital ratio on its market share during and after banking crises and market crises

This table shows how pre-crisis bank capital ratios affect banks' competitive positions during and after banking crises (the credit crunch of the early 1990s and the current subprime lending crisis) and market crises (the 1987 stock market crash, the Russian debt crisis plus LTCM bailout in 1998, and the bursting of the dot.com bubble plus September 11). Results are shown for small banks (GTA up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion). GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

In Panels A and B, the dependent variable is the percentage change in the bank's GTA or liquidity creation market share during the crisis and averaged over the eight quarters after the crisis, respectively. The percentage change in market share is measured as the bank's average market share during a crisis minus its average market share over the eight quarters before the crisis, divided by its pre-crisis market share and multiplied by 100.

The key exogenous variable (EQRAT) and control variables are averaged over the eight quarters before a crisis. EQRAT is the equity capital ratio, calculated as total equity capital as a proportion of GTA. Ln(GTA) is the log of GTA. ZSCORE is the distance to default, measured as the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets. D-BHC is a dummy variable that equals 1 if the bank has been part of a Bank Holding Company over the prior three years. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Crisis dummies are included in every regression (not reported for brevity).

t-statistics based on robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: The effect of the bank's pre-crisis capital ratio on its liquidity creation and GTA market share during and after *banking* crises

	Small banks				**Medium banks**				**Large banks**			
	%ΔGTA		***%ΔLCSHARE***		***%ΔGTA***		***%ΔLCSHARE***		***%ΔGTA***		***%ΔLCSHARE***	
	During	***After***	***During***	***After***	***During***	***After***	***During***	***After***	***During***	***After***	***During***	***After***
EQRAT	1.118	1.019	4.496	7.428	0.495	-0.291	1.308	4.174	1.101	0.492	3.096	10.590
	*(21.29)***	*(6.71)***	*(22.01)***	*(10.55)***	*(1.48)*	*(-0.26)*	*(2.24)**	*(0.89)*	*(3.96)***	*(0.80)*	*(3.62)***	*(6.39)***
lnGTA	-0.004	-0.039	-0.029	-0.257	-0.122	-0.123	-0.266	-0.257	-0.009	-0.015	-0.067	-0.094
	*(-2.20)**	*(-7.69)***	*(-4.28)***	*(-11.60)***	*(-5.24)***	*(-1.58)*	*(-3.93)***	*(-0.98)*	*(-1.08)*	*(-0.49)*	*(-3.41)***	*(-1.25)*
ZSCORE	-0.468	0.260	-0.640	6.112	0.152	2.024	0.147	-2.516	0.226	3.488	-0.944	-8.242
	*(-6.25)***	*(1.09)*	*(-2.01)**	*(4.72)***	*(0.52)*	*(1.50)*	*(0.20)*	*(-0.53)*	*(0.58)*	*(1.99)**	*(-0.87)*	*(-1.45)*
D-BHC	-0.007	0.011	0.040	0.217	0.029	0.155	0.100	0.376	-0.008	0.074	-0.054	-0.132
	*(-2.15)**	*(1.40)*	*(2.90)***	*(5.69)***	*(1.65)**	*(2.80)***	*(1.54)*	*(1.65)*	*(-0.21)*	*(0.73)*	*(-0.38)*	*(-0.20)*
HHI	0.022	0.022	-0.063	-0.421	0.077	-0.090	0.232	2.017	0.038	-0.273	-0.145	-0.260
	*(2.89)***	*(0.81)*	*(-1.90)**	*(-2.71)***	*(1.13)*	*(-0.30)*	*(1.22)*	*(1.63)*	*(0.31)*	*(-0.72)*	*(-0.54)*	*(-0.17)*
INC-GROWTH	0.810	1.875	1.305	2.100	0.596	0.075	0.996	2.440	-0.046	-3.805	4.755	5.847
	*(14.97)***	*(12.24)***	*(6.19)***	*(2.99)***	*(1.51)*	*(0.07)*	*(0.84)*	*(0.54)*	*(-0.07)*	*(-2.18)**	*(1.81)**	*(0.87)*
lnPOP	0.010	0.024	0.001	-0.046	-0.001	0.015	0.003	-0.005	-0.011	-0.014	-0.022	-0.090
	*(12.23)***	*(10.74)***	*(0.23)*	*(-4.78)***	*(-0.16)*	*(1.32)*	*(0.22)*	*(-0.11)*	*(-1.71)**	*(-0.92)*	*(-1.29)*	*(-1.75)**
Constant	-0.245	0.171	-0.097	3.603	1.625	1.606	3.571	3.306	0.206	0.652	1.015	2.612
	*(-11.08)***	*(2.86)***	*(-1.09)*	*(13.21)***	*(4.94)***	*(1.45)*	*(3.83)***	*(0.90)*	*(1.22)*	*(1.25)*	*(2.78)***	*(1.76)**
Obs	16856	9070	16856	9070	639	233	639	233	446	209	446	209
Adj R2	0.17	0.06	0.07	0.05	0.07	0.01	0.03	0.00	0.05	0.02	0.06	0.08

Panel B: The effect of the bank's pre-crisis capital ratio on its liquidity creation and GTA market share during and after *market* crises

	Small banks				Medium banks				Large banks			
	%ΔGTA		***%ΔLCSHARE***		***%ΔGTA***		***%ΔLCSHARE***		***%ΔGTA***		***%ΔLCSHARE***	
	During	***After***	***During***	***After***	***During***	***After***	***During***	***After***	***During***	***After***	***During***	***After***
EQRAT	0.328	0.745	2.930	6.006	-0.105	-0.072	-0.665	0.673	0.268	0.817	-0.618	-2.317
	*(7.77)***	*(8.82)***	*(15.91)***	*(16.70)***	*(-0.90)*	*(-0.24)*	*(-1.46)*	*(0.71)*	*(0.82)*	*(0.94)*	*(-0.71)*	*(-1.83)**
lnGTA	0.000	-0.004	-0.023	-0.054	-0.187	-0.275	-0.285	-0.486	-0.019	-0.025	-0.033	-0.053
	(0.07)	*(-1.63)*	*(-4.31)***	*(-5.29)***	*(-11.50)***	*(-7.80)***	*(-4.19)***	*(-3.55)***	*(-2.32)**	*(-1.63)*	*(-1.78)**	*(-1.48)*
ZSCORE	-0.590	-1.200	0.514	0.023	-0.693	-0.991	0.083	-0.726	0.107	0.451	0.945	0.826
	*(-10.39)***	*(-10.64)***	*(2.10)**	*(0.04)*	*(-3.25)***	*(-2.36)**	*(0.13)*	*(-0.64)*	*(0.35)*	*(0.75)*	*(1.15)*	*(0.66)*
D-BHC	-0.006	-0.003	-0.032	-0.081	0.023	0.061	0.041	-0.013	-0.005	-0.021	-0.143	-0.287
	*(-2.88)***	*(-0.74)*	*(-3.15)***	*(-4.21)***	*(1.23)*	*(1.55)*	*(0.54)*	*(-0.10)*	*(-0.15)*	*(-0.25)*	*(-0.99)*	*(-1.24)*
HHI	0.033	0.100	0.034	0.027	0.036	0.051	0.035	0.062	0.129	-0.043	-0.007	-0.284
	*(4.38)***	*(6.88)***	*(0.90)*	*(0.38)*	*(0.35)*	*(0.28)*	*(0.12)*	*(0.12)*	*(1.03)*	*(-0.18)*	*(-0.04)*	*(-0.89)*
INC-GROWTH	0.893	1.551	2.179	3.869	1.427	2.890	1.586	4.017	0.908	2.819	1.322	4.037
	*(24.18)***	*(22.73)***	*(13.22)***	*(12.96)***	*(3.63)***	*(4.04)***	*(1.45)*	*(1.80)**	*(1.73)**	*(2.90)***	*(1.07)*	*(1.83)**
lnPOP	0.014	0.033	0.017	0.042	-0.002	-0.003	-0.001	-0.011	0.000	0.001	0.006	0.002
	*(23.89)***	*(28.40)***	*(6.99)***	*(8.96)***	*(-0.52)*	*(-0.53)*	*(-0.05)*	*(-0.46)*	*(0.06)*	*(0.13)*	*(0.66)*	*(0.11)*
Constant	-0.152	-0.339	0.010	0.189	2.746	4.064	4.339	7.601	0.362	0.457	0.789	1.636
	*(-10.07)***	*(-11.56)***	*(0.15)*	*(1.43)*	*(11.65)***	*(7.92)***	*(4.50)***	*(3.93)***	*(2.45)**	*(1.60)*	*(2.15)**	*(2.30)**
Obs	25943	24702	25943	24702	819	730	819	730	600	551	600	551
Adj R2	0.11	0.12	0.05	0.07	0.17	0.14	0.08	0.09	0.03	0.06	0.02	0.04

Table 4: The effect of the bank's pre-crisis capital ratio on its profitability during and after banking crises and market crises

This table shows how pre-crisis bank capital ratios affect banks' profitability during and after banking crises (the credit crunch of the early 1990s and the current subprime lending crisis) and market crises (the 1987 stock market crash, the Russian debt crisis plus LTCM bailout in 1998, and the bursting of the dot.com bubble plus September 11). Results are shown for small banks (GTA up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion). GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

In Panels A and B, the dependent variable is the change in profitability during and after crises, respectively. The change in profitability is measured as the bank's average ROE (net income divided by GTA) during a crisis minus its average ROE over the eight quarters before the crisis.

The key exogenous variable (EQRAT) and control variables are averaged over the eight quarters before a crisis. EQRAT is the equity capital ratio, calculated as total equity capital as a proportion of GTA. Ln(GTA) is the log of GTA. ZSCORE is the distance to default, measured as the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets. D-BHC is a dummy variable that equals 1 if the bank has been part of a Bank Holding Company over the prior three years. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Crisis dummies are included in every regression (not reported for brevity).

t-statistics based on robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A: The effect of the bank's pre-crisis capital ratio on its profitability during and after *banking* crises						**Panel B: The effect of the bank's pre-crisis capital ratio on its profitability during and after *market* crises**					
	Small banks		***Medium banks***		***Large banks***		***Small banks***		***Medium banks***		***Large banks***	
	ΔROE During	***ΔROE After***	***ΔROE During***	***ΔROE After***	***ΔROE During***	***ΔROE After***	***ΔROE During***	***ΔROE After***	***ΔROE During***	***ΔROE After***	***ΔROE During***	***ΔROE After***
EQRAT	0.035	-0.157	0.015	-0.444	0.172	0.175	0.000	0.024	0.060	0.167	0.289	0.457
	*(2.02)***	*(-4.84)****	*(0.14)*	*(-1.99)***	*(1.86)**	*(1.67)**	*(0.02)*	*(1.50)*	*(1.11)*	*(2.43)***	*(1.91)**	*(2.55)***
lnGTA	-0.010	-0.007	0.008	0.029	-0.003	0.004	-0.001	-0.004	0.001	-0.008	0.002	0.011
	*(-12.32)****	*(-6.12)****	*(0.76)*	*(1.73)**	*(-0.69)*	*(0.53)*	*(-0.96)*	*(-6.32)****	*(0.10)*	*(-1.06)*	*(0.53)*	*(3.37)****
ZSCORE	0.093	-0.959	0.312	-1.459	0.218	-1.445	0.003	-0.291	0.239	0.159	0.090	0.130
	*(3.28)****	*(-14.50)****	*(2.34)***	*(-5.13)****	*(1.20)*	*(-3.75)****	*(0.18)*	*(-12.96)****	*(2.46)***	*(1.95)**	*(0.84)*	*(1.43)*
D-BHC	0.003	0.001	-0.004	0.008	0.030	0.041	0.004	0.002	-0.006	0.002	-0.027	-0.035
	*(2.29)***	*(0.43)*	*(-0.38)*	*(0.47)*	*(1.69)**	*(1.69)**	*(3.21)****	*(1.82)**	*(-0.77)*	*(0.27)*	*(-2.66)****	*(-2.16)***
HHI	-0.006	-0.042	0.078	-0.129	0.010	-0.063	-0.008	-0.002	0.008	0.076	-0.077	0.038
	(-1.61)	*(-6.01)****	*(2.77)****	*(-1.68)**	*(0.19)*	*(-0.55)*	*(-1.73)**	*(-0.43)*	*(0.18)*	*(1.67)**	*(-1.37)*	*(0.60)*
INC-GROWTH	-0.086	-0.097	-0.271	-1.047	-0.364	-0.302	0.102	0.017	0.484	0.201	0.325	-0.007
	*(-3.59)****	*(-2.71)****	*(-1.22)*	*(-3.56)****	*(-1.32)*	*(-0.53)*	*(4.22)****	*(0.77)*	*(2.31)***	*(1.17)*	*(1.25)*	*(-0.03)*
lnPOP	-0.005	-0.001	-0.004	-0.010	0.001	-0.007	-0.001	-0.001	-0.002	0.001	-0.005	0.001
	*(-14.01)****	*(-0.96)*	*(-1.55)*	*(-2.71)****	*(0.31)*	*(-1.65)*	*(-1.74)**	*(-2.61)****	*(-1.46)*	*(0.94)*	*(-2.95)****	*(0.82)*
Constant	0.135	0.151	-0.148	-0.134	-0.087	0.053	0.008	0.057	-0.035	0.021	0.006	-0.236
	*(13.95)****	*(10.79)****	*(-0.98)*	*(-0.56)*	*(-1.10)*	*(0.37)*	*(1.06)*	*(7.77)****	*(-0.30)*	*(0.20)*	*(0.10)*	*(-3.82)****
Obs	16856	9070	639	233	446	209	25943	24702	819	730	600	551
Adj R2	0.08	0.06	0.05	0.18	0.04	0.05	0.02	0.01	0.02	0.03	0.03	0.06

Table 5: The effect of a listed bank's pre-crisis capital ratio on its abnormal stock returns during banking crises and market crises

Panels A and B examine whether the pre-crisis capital ratio of a listed bank affects its abnormal stock returns during banking crises (the credit crunch of the early 1990s and the current subprime lending crisis) and market crises (the 1987 stock market crash, the Russian debt crisis plus LTCM bailout in 1998, and the bursting of the dot.com bubble plus September 11), respectively.

In the first step, we use a five-factor model to separately estimate the pre-crisis factor loadings of high- and low-capital banks. In this step, portfolio excess returns are regressed on the three Fama-French (1993) factors, the Carhart (1997) momentum factor and the slope of the yield curve:

$$R_{p,t} - R_{f,t} = \delta_0 + \delta_1 * (R_{m,t} - R_{f,t}) + \delta_2 * SMB_t + \delta_3 * HML_t + \delta_4 * MOM_t + \delta_5 * YLDCURVE_t \quad (4)$$

where $R_{p,t}$ is the portfolio return in pre-crisis month $t \in [-24, -1]$, $R_{f,t}$ is the risk-free rate, $R_{m,t} - R_{f,t}$ is excess return on the market, SMB is the difference between a portfolio of "small" and "big" stocks, HML is the difference between a portfolio of "high" and "low" book-to-market stocks, MOM is the Carhart momentum factor, and YLDCURVE is the slope of the yield curve, proxied by the difference between the ten-year Treasury bond and the federal funds rate. See Appendix B for further details.

In the second step, we use these pre-crisis factor loadings to predict portfolio returns during the crisis. We thus obtain the portfolio returns that would have been achieved absent the crisis. We then deduct these predicted returns from the realized returns to obtain the alphas of the high- and low-capital bank portfolios.

In the last step, we calculate HminLalpha, the alpha of high-capital banks minus the alpha of low-capital banks. If HminLalpha is positive, the stock performance of high-capital banks improved more (or declined less) than that of low-capital banks during a crisis.

t-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Panel A: Banking crises		**Panel B: Market crises**		
	Credit crunch	***Subprime lending crisis***	***Stock market crash***	***Russian debt / LTCM***	***Bursting dot.com / Sept 11***
(1) Alpha of high-capital banks	3.967	-2.627	3.287	1.235	2.272
	*(7.85)****	*(-1.14)*	*(0.74)*	*(0.86)*	*(2.48)***
(2) Alpha of low-capital banks	0.165	0.448	0.480	0.193	1.286
	(0.22)	*(0.23)*	*(0.25)*	*(0.08)*	*(1.33)*
(1) – (2) HminLalpha	3.802	-3.075	2.807	1.042	0.986
	*(4.26)****	*(-1.02)*	*(0.58)*	*(0.38)*	*(0.74)*

Table 6: The effect of a bank's pre-crisis capital ratio on its ability to survive normal times, and its effect on market share, profitability and stock return performance around normal times

This table shows how pre-crisis bank capital ratios affect banks' ability to survive normal times (Panel A), and its effect on market share (Panel B), profitability (Panel C, and abnormal stock returns (Panel D) around normal times. The periods from 1995:Q1 to 1996:Q2 and from 2004:Q4 to 2005:Q2 are viewed as normal times (see Section 6.1). Results are shown for small banks (GTA up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion). GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

In Panel A, the dependent variables are $\log\left(\frac{Prob(SURV1_i)}{1-\text{Prob}(\text{SURV1}_\text{i})}\right)$ and $\log\left(\frac{Prob(SURV4_i)}{1-\text{Prob}(\text{SURV4}_\text{i})}\right)$, where SURV1 (SURV4) is a dummy that equals 1 if the bank is in the sample one quarter before normal times started and is still in the sample one quarter (four quarters) after normal times are over, and 0 otherwise. In Panel B, the dependent variable is the percentage change in the bank's GTA or liquidity creation market share during and after normal times, respectively. The percentage change in market share is measured as the bank's average market share during normal times minus its average market share over the eight quarters before normal times, normalized by its pre-normal-times market share and multiplied by 100. In Panel C, the dependent variable is the change in profitability during and after normal times, respectively, measured as the bank's average ROE (net income divided by GTA) during normal times minus its average ROE over the eight quarters before normal times. In Panel D, HminLalpha is the alpha of high-capital listed banks minus the alpha of low-capital listed banks.

Panels A – C show only the coefficients on *EQRAT* (total equity capital as a proportion of *GTA*) in the interest of parsimony. However, the regressions include all the exogenous variables as defined in Table 1 and crisis dummies where appropriate.

t-statistics based on robust standard errors are in parentheses in Panels B and C. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: The effect of the bank's pre-crisis capital ratio on its ability to survive *normal times*

	Small banks		***Medium banks***		***Large banks***	
	SURV1	***SURV4***	***SURV1***	***SURV4***	***SURV1***	***SURV4***
EQRAT	9.299	8.381	2.268	6.201	6.548	4.067
	*(6.07)****	*(6.93)****	*(0.40)*	*(1.25)*	*(0.95)*	*(0.87)*
Obs	15825	15825	601	601	444	444

Panel B: The effect of the bank's pre-crisis capital ratio on its liquidity creation and GTA market share during and after *normal times*

	Small banks				**Medium banks**				**Large banks**			
	%ΔGTA		***%ΔLCSHARE***		***%ΔGTA***		***%ΔLCSHARE***		***%ΔGTA***		***%ΔLCSHARE***	
	During	***After***	***During***	***After***	***During***	***After***	***During***	***After***	***During***	***After***	***During***	***After***
EQRAT	-0.015	0.032	2.740	5.840	-0.043	0.338	1.433	0.267	0.578	1.362	2.201	3.631
	(-0.26)	*(0.27)*	*(12.13)****	*(13.24)****	*(-0.19)*	*(0.66)*	*(1.68)**	*(0.16)*	*(1.54)*	*(1.75)**	*(1.96)**	*(1.99)***
Obs	15825	14881	15825	14881	601	540	601	540	444	397	444	397
Adj R2	0.06	0.08	0.04	0.03	0.18	0.13	0.17	0.03	0.02	0.04	0.06	0.03

Panel C: Effect of pre-crisis capital on profitability during and after *normal times*

	Small banks		***Medium banks***		***Large banks***	
	ΔROE During	***ΔROE After***	***ΔROE During***	***ΔROE After***	***ΔROE During***	***ΔROE After***
EQRAT	0.053	0.112	0.062	0.000	-0.099	0.011
	*(3.24)***	*(6.28)***	*(1.10)*	*(0.00)*	*(-1.00)*	*(0.10)*
Obs	15825	14881	601	540	444	397
Adj R2	0.02	0.02	0.00	0.03	0.01	0.02

Panel D: Abnormal stock performance during *normal times*

	Listed banks	
	Fake crisis 1	**Fake crisis 2**
(1) Alpha of high-capital banks	0.686	0.011
	(1.63)	*(0.01)*
(2) Alpha of low-capital banks	1.315	-1.941
	*(2.73)****	*(-2.15)***
(1) – (2) HminLalpha	-0.629	1.952
	(-0.98)	*(1.52)*

Table 7: The effect of a bank's pre-crisis capital ratio on the likelihood of exiting in a specific manner during banking crises, market crises, and normal times

This table examines whether a bank's pre-crisis capital ratio affects the likelihood of exiting in various ways during banking crises (the credit crunch of the early 1990s – the current subprime lending crisis is excluded because it was still ongoing at the end of the sample period) and market crises (the 1987 stock market crash, the Russian debt crisis plus LTCM bailout in 1998, and the bursting of the dot.com bubble plus September 11), respectively. Results are shown for small banks (GTA up to $1 billion), medium banks (GTA exceeding $1 billion and up to $3 billion), and large banks (GTA exceeding $3 billion). GTA equals total assets plus the allowance for loan and the lease losses and the allocated transfer risk reserve (a reserve for certain foreign loans).

Panels A – C present summary statistics on the frequency of exit via consolidations within a bank holding company (CONSOL), non-government-assisted mergers/acquisitions (M&A), government-assisted mergers/acquisitions (ASSIST), and outright failures or changes in charter (FAIL/CHARTER). Panels D – F show the results of logit regressions for the first three types of exit. The dependent variables are $\log\left(\frac{Prob(SURV1_i)}{1-\text{Prob}(\text{SURV1}_i)}\right)$ and $\log\left(\frac{Prob(SURV4_i)}{1-\text{Prob}(\text{SURV4}_i)}\right)$, where SURV1 (SURV4) is a dummy that equals 1 if the bank is in the sample one quarter before such a crisis started and is still in the sample one quarter (four quarters) after the crisis, and 0 otherwise.

The key exogenous variable (EQRAT) and control variables are averaged over the eight quarters before a crisis. EQRAT is the equity capital ratio, calculated as total equity capital as a proportion of GTA. Ln(GTA) is the log of GTA. ZSCORE is the distance to default, measured as the bank's return on assets plus the equity capital/GTA ratio divided by the standard deviation of the return on assets. D-BHC is a dummy variable that equals 1 if the bank has been part of a Bank Holding Company over the prior three years. HERF is a bank-level Herfindahl index based on bank and thrift deposits (the only variable for which geographic location is publicly available). We first establish the Herfindahl index of the markets in which the bank has deposits and then weight these market indices by the proportion of the bank's deposits in each of these markets. INC-GROWTH is the weighted average income growth in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Ln(POP) is the natural log of weighted average population in all markets in which a bank has deposits, using the proportion of deposits held by a bank in each market as weights. Crisis dummies are included in every regression (not reported for brevity).

t-statistics are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Frequency of the four ways of exit occurring during *banking* crises

	Small banks		***Medium banks***		***Large banks***	
	Obs	***Mean***	***Obs***	***Mean***	***Obs***	***Mean***
CONSOL	1204	0.56	72	0.49	35	0.51
M&A	1204	0.19	72	0.22	35	0.17
ASSIST	1204	0.22	72	0.26	35	0.31
FAIL/CHARTER	1204	0.02	72	0.03	35	0.00

Panel B: Frequency of the four ways of exit occurring during *market* crises

	Small banks		***Medium banks***		***Large banks***	
	Obs	***Mean***	***Obs***	***Mean***	***Obs***	***Mean***
CONSOL	1183	0.65	89	0.71	48	0.75
M&A	1183	0.30	89	0.22	48	0.21
ASSIST	1183	0.03	89	0.01	48	0.00
FAIL/CHARTER	1183	0.02	89	0.06	48	0.04

Panel C: Frequency of the four ways of exit occurring during *normal times*

	Small banks		*Medium banks*		*Large banks*	
	Obs	***Mean***	***Obs***	***Mean***	***Obs***	***Mean***
CONSOL	912	0.63	58	0.71	47	0.85
M&A	912	0.34	58	0.24	47	0.15
ASSIST	912	0.01	58	0.00	47	0.00
FAIL/CHARTER	912	0.03	58	0.05	47	0.00

Panel D: The effect of the bank's pre-crisis capital ratio on the likelihood of exiting in a specific manner during *banking* crises

	Small banks			*Medium banks*			*Large banks*		
	CONSOL	***M&A***	***ASSIST***	***CONSOL***	***M&A***	***ASSIST***	***CONSOL***	***M&A***	***ASSIST***
EQRAT	3.515	4.730	-17.117	32.796	10.363	-76.291	149.445	128.253	-285.857
	(1.47)	*(2.25)***	*(-4.96)****	*(1.58)*	*(0.84)*	*(-2.26)***	*(1.96)**	*(1.60)*	*(-2.14)***
Obs	1204	1204	1204	72	72	72	28	35	35

Panel E: The effect of the bank's pre-crisis capital ratio on the likelihood of exiting in a specific manner during *market* crises

	Small banks			*Medium banks*			*Large banks*		
	CONSOL	***M&A***	***ASSIST***	***CONSOL***	***M&A***	***ASSIST***	***CONSOL***	***M&A***	***ASSIST***
EQRAT	-1.417	3.837	-38.296	-14.158	-10.001	n/a	0.479	8.862	n/a
	(-0.69)	*(1.88)**	*(-3.35)****	*(-1.34)*	*(-0.85)*	*n/a*	*(0.02)*	*(0.33)*	*n/a*
Obs	1183	1183	1183	89	89	n/a	46	48	n/a

Panel F: The effect of the bank's pre-crisis capital ratio on the likelihood of exiting in a specific manner during *normal times*

	Small banks			*Medium banks*			*Large banks*		
	CONSOL	***M&A***	***ASSIST***	***CONSOL***	***M&A***	***ASSIST***	***CONSOL***	***M&A***	***ASSIST***
EQRAT	-1.512	-3.422	-147.948	-17.419	-0.006	n/a	-21.336	21.336	n/a
	(-0.51)	*(-1.30)*	*(-2.28)***	*(-1.12)*	*(-0.00)*	*n/a*	*(-0.70)*	*(0.70)*	*n/a*
Obs	912	912	912	58	58	n/a	47	47	n/a

Appendix A: Construction of bank liquidity creation (Berger and Bouwman forthcoming)

We calculate a bank's dollar amount of liquidity creation using a three-step procedure, which is discussed below and illustrated in Table A-1.

Step 1: All bank activities (assets, liabilities, equity, and off-balance sheet activities) are classified as liquid, semi-liquid, or illiquid. For assets, this is done based on the ease, cost, and time for banks to dispose of their obligations in order to meet liquidity demands. For liabilities and equity, this is done based on the ease, cost, and time for customers to obtain liquid funds from the bank. We follow a similar approach for off-balance sheet activities, classifying them based on functionally similar on-balance sheet activities. For all activities other than loans, this classification process uses information on both product category and maturity. Due to data restrictions, loans are classified entirely by category.

Step 2: Weights are assigned to all the bank activities classified in Step 1. The weights are consistent with liquidity creation theory, which argues that banks create liquidity on the balance sheet when they transform illiquid assets into liquid liabilities. Positive weights are therefore applied to illiquid assets and liquid liabilities. Following similar logic, negative weights are applied to liquid assets and illiquid liabilities and equity, since banks destroy liquidity when they use illiquid liabilities to finance liquid assets. Weights of ½ and -½ are used because liquidity creation is only half attributable to the source or use of funds alone.[21] An intermediate weight of 0 is applied to semi-liquid assets and liabilities. Weights for off-balance sheet activities are assigned using the same principles.

Step 3: The activities as classified in Step 1 and as weighted in Step 2 are combined to construct Berger and Bouwman's (forthcoming) preferred liquidity creation measure. This measure classifies loans by category, while all activities other than loans are classified using information on product category and maturity, and includes off-balance sheet activities.[22] To obtain the dollar amount of liquidity creation at a particular bank, we multiply the weights of ½, -½, or 0, respectively, times the dollar amounts of the corresponding bank activities and add the weighted dollar amounts.

[21] The following examples illustrate this principle. Maximum liquidity is created when $1 of liquid liabilities is used to finance $1 in illiquid assets: ½ * $1 + ½ * $1 = $1. When $1 of liquid liabilities is used to finance $1 in liquid assets, no liquidity is created (½ * $1 + -½ * $1 = $0) because the bank holds items of approximately the same liquidity as those it gives to the nonbank public. Maximum liquidity is destroyed when $1 of illiquid liabilities or equity is used to finance $1 of liquid assets: -½ * $1 + -½ * $1 = -$1.

[22] Berger and Bouwman (forthcoming) construct four liquidity creation measures by alternatively classifying loans by category or maturity, and by alternatively including or excluding off-balance sheet activities. However, they argue that the measure we use here is the preferred measure since for liquidity creation, banks' ability to securitize or sell loans is more important than loan maturity, and banks do create liquidity both on the balance sheet and off the balance sheet.

Table A-1: Liquidity classification of bank activities and construction of the liquidity creation measure

This table explains the Berger and Bouwman (forthcoming) methodology to construct their preferred liquidity creation measure that classifies loans by category and includes off-balance sheet activities in three steps.

Step 1: Classify all bank activities as liquid, semi-liquid, or illiquid. For activities other than loans, information on product category and maturity are combined. Due to data limitations, loans are classified entirely by product category.

Step 2: Assign weights to the activities classified in Step 1.

ASSETS:

Illiquid assets (weight = ½)	**Semi-liquid assets (weight = 0)**	**Liquid assets (weight = - ½)**
Commercial real estate loans (CRE)	Residential real estate loans (RRE)	Cash and due from other institutions
Loans to finance agricultural production	Consumer loans	All securities (regardless of maturity)
Commercial and industrial loans (C&I)	Loans to depository institutions	Trading assets
Other loans and lease financing receivables	Loans to state and local governments	Fed funds sold
Other real estate owned (OREO)	Loans to foreign governments	
Investment in unconsolidated subsidiaries		
Intangible assets		
Premises		
Other assets		

LIABILITIES PLUS EQUITY:

Liquid liabilities (weight = ½)	**Semi-liquid liabilities (weight = 0)**	**Illiquid liabilities plus equity (weight = - ½)**
Transactions deposits	Time deposits	Subordinated debt
Savings deposits	Other borrowed money	Other liabilities
Overnight federal funds purchased		Equity
Trading liabilities		

OFF-BALANCE SHEET GUARANTEES (notional values):

Illiquid guarantees (weight = ½)	**Semi-liquid guarantees (weight = 0)**	**Liquid guarantees (weight = - ½)**
Unused commitments	Net credit derivatives	Net participations acquired
Net standby letters of credit	Net securities lent	
Commercial and similar letters of credit		
All other off-balance sheet liabilities		

OFF-BALANCE SHEET DERIVATIVES (gross fair values):

Liquid derivatives (weight = -½)
Interest rate derivatives
Foreign exchange derivatives
Equity and commodity derivatives

Step 3: Combine bank activities as classified in Step 1 and as weighted in Step 2 to construct the liquidity creation (LC) measure.

LC =	+ ½ * illiquid assets	+ 0 * semi-liquid assets	– ½ * liquid assets
	+ ½ * liquid liabilities	+ 0 * semi-liquid liabilities	– ½ * illiquid liabilities
			– ½ * equity
	+ ½ * illiquid guarantees	+ 0 * semi-liquid guarantees	– ½ * liquid guarantees
	– ½ * liquid derivatives		

Appendix B: Five-factor model to examine the stock return performance of banks

We use the following approach for our examination. In the first step, we use a five-factor model to separately estimate the pre-crisis factor loadings of high- and low-capital banks in each crisis.[23] In this step, portfolio excess returns are regressed on the three Fama-French (1993) factors, the Carhart (1997) momentum factor and the slope of the yield curve:

$$R_{p,t} - R_{f,t} = \delta_0 + \delta_1 * (R_{m,t} - R_{f,t}) + \delta_2 * SMB_t + \delta_3 * HML_t + \delta_4 * MOM_t + \delta_5 * YLDCURVE_t \quad (4)$$

where $R_{p,t}$ is the portfolio return in pre-crisis month $t \in [-24, -1]$, $R_{m,t} - R_{f,t}$ is excess return on the market, SMB (Small Minus Big) is the difference between the average return on portfolios of "small" and "big" stocks, HML (High Minus Low) is the difference between the average return on portfolios of "high" and "low" book-to-market stocks, MOM (the Carhart momentum factor) is the difference between the average return on portfolios of high and low prior stock returns, and YLDCURVE is the slope of the yield curve, proxied by the difference between the ten-year Treasury bond and the federal funds rate. The slope of the yield curve is included because commercial bank performance is strongly related to the interest rate environment (e.g., Flannery and James 1984). This is because banks typically derive a large part of their revenues from net interest income, the difference between what the bank earns on assets and what it pays on deposits, and the slope of the yield curve affects net interest income because a bank's assets are typically of longer duration than its liabilities. The slope of the yield curve has been used in the literature on the predictability of non-bank returns, starting with Fama and French (1989). The pre-crisis factor loadings are assumed to represent the information set of investors prior to the crisis and are hence the best estimates to compute returns investors expected going into the crisis.

In the second step, we use these pre-crisis factor loadings to predict portfolio returns during the crisis. We thus obtain the portfolio returns that were predicted to have been achieved absent the crisis. We then deduct these predicted returns from the realized returns to obtain the alphas of the high- and low-capital bank portfolios. If the abnormal return, represented by the alpha of a portfolio, is positive (negative) then that portfolio earned more (less) during the crisis than expected.

In the last step, we calculate HminLalpha, the alpha of high-capital listed banks minus the alpha of low-capital listed banks. If HminLalpha is positive during banking crises, then we can conclude that the stock performance of high-capital listed banks improved more (or declined less) than that of low-capital listed banks during these crises.

[23] We examine each crisis separately due to the possibility of time variations in the pre-crisis factor loadings.