Does Efficiency Help Banks Survive and Thrive during Financial Crises?*

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Abstract

We examine how bank efficiency during normal times affects survival, risk, and profitability during subsequent financial crises using data from five U.S. financial crises and preceding normal times. We find cost efficiency during normal times helps reduce bank failure probabilities, decrease risk, and enhance profitability during subsequent financial crises, while profit efficiency has limited benefits. Results suggest that cost efficiency better measures management quality, while profit efficiency may partially reflect temporary high returns from risky investments during normal times. Findings imply policymakers, regulators, supervisors, and managers may focus on cost efficiency during normal times to promote better financial crisis performance.

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Regulators agree that “the worst loans are made at the top of the business cycle.” (Alan Greenspan, Chicago Bank Structure Conference May 10, 2001)

“Historically, the goals of banking regulation have included…the promotion of competition and efficiency in banking…” (Ben Bernanke, Bank Regulation and Supervision: Balancing Benefits and Costs, 2006)

1. Introduction

Financial crises can have strong detrimental effects on the real economy. To illustrate, the subprime financial crisis of the late 2000s is estimated to have cost the U.S. economy in the range of $12-$22 trillion, although many of the economic costs remain difficult to determine (U.S. Department of the Treasury, 2012; Atkinson, Luttrell, and Rosenblum, 2013; Government Accountability Office, 2013; Garcia, 2015). Much of the damage was from the banking industry, which suffered a significant number of failures and generally performed poorly during the crisis. Bank failures and performance problems often result in significant negative externalities for 1) other financial institutions that suffer losses through interconnections and contagion; 2) governments that frequently get involved in costly bailouts; and 3) borrowers, creditors, and other counterparties in the real economy that depend on credit and other services from the failed and distressed institutions (e.g., Barth, Bartholomew, and Bradley, 1990; James, 1991; Lang and Stulz, 1992; Ashcraft, 2005; Reinhart and Rogoff, 2009; Acharya, Cooley, Richardson, and Walter, 2011; Laeven and Valencia, 2012; Kupiec and Ramirez, 2013; Kang, Lowery, and Wardlaw, 2014). It is critical that bank policymakers, regulators, supervisors, and managers be aware of the major determinants of bank performance during financial crises to tailor their policies, regulations, supervision, and management practices, respectively, to target the sources of potential banking problems.

As noted in one of the quotes above, bank problems during crises are frequently the result of bad decisions made during the normal times that precede them (Greenspan, 2001). One important reason may be institutional memory loss. When bank problems have not been prevalent for some time, bank loan officers and managers may suffer atrophy in their ability to recognize and deal with such problems (e.g., Berger and Udell, 2004). It is therefore logical to look to the normal times that precede financial crises to

discover the determinants of bank performance during these crises. The extant literature on the determinants of bank performance generally focuses on the time periods immediately previous to this performance, irrespective of whether these are crisis or normal times.[2] This paper extends the literature by examining the determinants of bank crisis performance in terms of survival, risk, and profitability by focusing on the preceding normal time periods, when the problems that are manifested during the crises most likely originated.

The literature on bank performance during crises is also generally limited in the factors that are examined. The focus is usually on accounting variables such as capital, liquidity, profitability, and loan quality (e.g., Lane, Looney, and Wansley, 1986; Espahbodi, 1991; Cole and Gunther, 1995, 1998; Helwege, 1996; Wheelock and Wilson, 1995, 2000; Calomiris and Mason, 1997, 2003; Molina, 2002; Elsinger, Lehar, and Summer, 2006; Schaeck, 2008; Admati, DeMarzo, Hellwig, and Pfleiderer, 2011; Cole and White, 2012; Knaup and Wagner, 2012; Berger and Bouwman, 2013; Hong, Huang, and Wu, 2014; Berger, Imbierowicz, and Rauch, 2016), the scope of bank activities (investment banking, private equity, new financial products (e.g., Cole and White, 2012; DeYoung and Torna, 2013), bank ownership and corporate governance (e.g., Berger, DeYoung, Genay, and Udell, 2000; Giannetti and Ongena, 2009; Fahlenbrach and Stulz, 2011; Berger and Bouwman, 2013; Berger, Imbierowicz, and Rauch, 2016; Calomiris and Carlson, forthcoming), and regional economic conditions (e.g., Aubuchon and Wheelock, 2010).

One potentially overlooked factor affecting bank performance during crises is bank efficiency in the normal times prior to the crises. Researchers often study the effects of bank efficiency on bank performance (e.g., Berger and Humphrey, 1992; Cebenoyan, Cooperman, Register, and Hudgins 1993; Hermalin and Wallace, 1994; Berger and Mester, 1997; Fiordelisi, Marques-Ibanez, and Molyneux 2011; Hughes and Mester, 2015), but none examines the effects of efficiency during normal times on

[2] One exception is Berger and Bouwman (2013), which examines the effects of capital during eight quarters of normal times prior to a crisis on bank outcomes during a crisis.

performance during subsequent crises.

We evaluate the effects of normal-times bank efficiency on bank performance (failure, risk, and profitability) during subsequent financial crises. We analyze both cost and profit efficiency because they measure different concepts and may affect future outcomes through different channels. Cost efficiency measures the proximity of a bank's cost to that of a best-practice bank producing the same output under the same conditions. Profit efficiency measures the proximity of bank profits to best-practice profits, and is inclusive of revenue as well as cost.

Relatively high cost and profit efficiency during normal times may result in either favorable or unfavorable performance during subsequent financial crises. High cost efficiency in normal times may reflect superior managerial quality that endures through the following crisis and produces favorable performance. Alternatively, high cost efficiency may reflect "skimping" on resources to screen and monitor loan applicants, which saves resources during normal times, but creates poor loan outcomes which only become apparent during subsequent financial crises (e.g., Berger and DeYoung, 1997). Both of these channels may also apply to profit efficiency, which encompasses costs as well as revenues.

Additional channels may also apply to profit efficiency. High profit efficiency may be associated with high charter values that result in favorable performance during subsequent financial crises because bank act to preserve these charter values. Alternatively, high profit efficiency during normal times may reflect excessive risk taking that earns high returns in normal times, but creates problems during subsequent crises.

Based on these channels, we formulate and test hypotheses for the effects of both cost and profit efficiency during normal times on bank failure, risk, and profitability during subsequent financial crises. The data include virtually all U.S. banks from five financial crises originally classified by Berger and Bouwman (2013), and their pre-crisis normal time periods – a total of 15,993 banks over the interval from 1986:Q1 to 2009:Q4. We include multiple financial crises and normal time periods to draw general

conclusions about the role of bank efficiency during subsequent financial crises, and minimize the impact of idiosyncratic circumstances of a single crisis.

We regress measures of bank failure, risk, and profitability during financial crises on normal-times cost and profit efficiency prior to the crises. The tests include a broad set of control variables taken from the literature discussed above to account for other factors affecting bank performance that might be correlated with bank efficiency.

We find that cost efficiency during normal times reduces failure probabilities, decreases risk, and enhances profitability during subsequent financial crises, while profit efficiency has limited benefits. These findings suggest that cost efficiency may proxy well for management quality, while profit efficiency may partially reflect temporary high returns during normal times from risky investments. Our results strongly suggest that policymakers, regulators, supervisors, and managers pay close attention to cost efficiency during normal times to promote better outcomes during financial crises.

We perform a variety of robustness checks. First, we test the sensitivity of our results to using alternative measures of bank performance. Second, we run the regressions separately for banking and market crises, those that originated in the banking sector and in financial markets, respectively (Berger and Bouwman, 2013). Third, we exclude banks that may be too-big-to-fail (TBTF) to mitigate the potential concern that our results may be driven by such banks. Finally, we consider the effects of efficiency on small versus large banks. Our main findings stand up to all of these robustness checks except those on bank size – the results are considerably stronger for small banks.

The remainder of the paper is organized as follows. Section 2 discusses the cost and profit efficiency concepts and measurement. Section 3 describes the channels through which normal-times bank cost and profit efficiency may influence subsequent financial crisis performance and develops opposing hypotheses from these channels. Section 4 discusses our empirical framework – it explains our approach, describes the financial crises and normal times, and explains the regression models and key bank

performance variables. Section 5 gives the data sample and sources. Section 6 reports our main empirical analysis – it reviews the summary statistics and presents the regression results. Section 7 discusses the robustness checks, Section 8 provides a deeper analysis of our cost efficiency results, and Section 9 concludes.

2. Cost and Profit Efficiency Concepts and Measurement

2.1 Cost and Profit Efficiency Concepts

The cost efficiency of a bank is the ratio of the minimum cost which a best-practice bank would incur in producing that bank's output quantities if it faced that bank's input prices and other environmental conditions to the bank's actual cost. Profit efficiency is a broader concept that takes into account the effects of actions that affect revenues as well as costs. The profit efficiency of a bank is the ratio of its actual profit earned to the maximum profit a best-practice bank would attain for the same input prices and either output prices or output quantities (e.g., Mullineaux, 1978; Berger, Hancock, and Humphrey, 1993; Soteriou and Zenios (1999); Maudos, Pastor, Perez, and Quesada, 2002). For our purposes, we take output quantities, rather than output prices as given, and measure "alternative profit efficiency." As discussed in Berger and Mester (1997), alternative profit efficiency is preferred when some of the assumptions required by standard profit efficiency are not met, such as no substantial differences in output quality, easily changed output quantities, highly competitive output markets, and well-measured output prices. Because of the inherent benefits, most bank profit efficiency papers over the past 20 years use alternative profit efficiency (e.g., Vander Vennet, 2002; Restrepo-Tobon and Kumbhakar, 2014; Wheelock and Wilson, 2016).

It might be expected that bank managers would strive for both high cost and profit efficiency and that the two measures would be positively correlated and both would predict favorable future outcomes, but the reality is more complex. Cost and profit efficiency may not be strongly positively related because bank outputs that have quality differences that are difficult to measure. Higher-quality services may

require higher costs and result in lower measured cost efficiency, but fetch higher output prices that result in higher profits and measured profit efficiency (e.g., Berger and Mester, 1997; Lozano-Vivas, 1997; Rogers, 1998; Maudos, Pastor, Perez, and Quesada, 2002). As discussed further in Section 3, high cost and profit efficiency during normal times may predict either favorable or unfavorable bank performance during subsequent financial crises, depending on the relative importance of several different channels.

2.2 Efficiency Measurement

Correct measurement of normal-times cost and profit efficiency is important to our analysis, since these are our key independent variables affecting financial crisis performance in the regression models below. We measure both types of efficiency for every quarter of the normal times periods, and use statistics computed over all the quarters of these periods to reduce the impact of outliers.

2.2.1 Variables Included in the Cost and Alternative Profit Functions

The first step in computing efficiency is the choice of variables specified in the cost and alternative profit functions. We define total costs as total interest expenses plus total noninterest expenses, and total profits as total bank net income. We specify four input prices: w_1, price of labor (ratio of total personnel expenses to number of employees); w_2, price of physical capital (total operating and administrative expenses to total premises and fixed assets); w_3, price of purchased funds ((total interest expenses - total interest on core deposits)/(quantity of total liabilities – core deposits)); and w_4, price of core deposits ((total interest on deposits - interest on time deposits over $100,000)/quantity of core deposits).[3] We use the following five output quantities: y_1, consumer loans; y_2, commercial and industrial (C&I) loans; y_3, residential real estate (RRE) loans (1-4 family); y_4, commercial real estate (CRE) loans (total real estate loans - RRE loans); y_5, other loans (total loans - (y_1+ y_2 + y_3 + y_4)). We also include quantities of two fixed netputs

[3] Complete data for the input prices w_3 and w_4 are not available in the Call Report prior to 1997 due to insufficient information on the core deposits. Therefore, we calculate an average ratio of core deposits to total deposits for each bank over the periods that data are available. We assume that the bank uses the same ratio in the earlier time periods where we cannot determine this based on the Call Report (1986 - 1996). If for a bank we cannot compute the ratio described as no reports are available, we use the industry ratio average by size class.

(inputs or outputs): z_1, the notional value of total bank off-balance sheet activities; and z_2, bank financial equity capital. Finally, we include an environmental variable to account for the risk exposure of the bank, v, the weighted nonperforming loan ratio of all banks in the bank's state, where the weights are based on the proportions of deposits of the banks in the state.[4]

2.2.2 Specification of the Cost and Alternative Profit Functions

We employ the Fourier-flexible functional form, a global approximation to an unknown function. The Fourier-flexible is preferable to functional forms based on second-order Taylor series expansions, such as the translog or normalized quadratic (Gallant, 1981, 1982). For the cost function, we specify:

$$\begin{aligned}\ln\left(C/w_4z_2\right) &= \delta+\sum_{i=1}^{3}\beta_i\ln\left(w_i/w_4\right)+\frac{1}{2}\sum_{i=1}^{3}\sum_{i=1}^{3}\beta_{ij}\ln\left(w_i/w_4\right)\ln\left(w_i/w_4\right)+\sum_{k=1}^{5}\gamma_k\ln\left(y_k/z_2\right)\\ &+\frac{1}{2}\sum_{k=1}^{5}\sum_{m=1}^{5}\gamma_{km}\ln\left(y_k/z_2\right)\ln\left(y_m/z_2\right)+\delta_1\ln\left(z_1/z_2\right)+\frac{1}{2}\delta_{11}\ln\left(z_1/z_2\right)\ln\left(z_1/z_2\right)\\ &+\sum_{i=1}^{3}\sum_{k=1}^{5}\eta_{ik}\ln\left(w_i/w_4\right)\ln\left(y_k/z_2\right)+\sum_{i=1}^{3}\rho_i\ln\left(w_i/w_4\right)\ln\left(z_1/z_2\right)\\ &+\sum_{k=1}^{5}\tau_k\ln\left(y_k/z_2\right)\ln\left(z_1/z_2\right)+\sum_{n=1}^{9}\left[\phi_n\cos\left(x_n\right)+\omega_n\sin\left(x_n\right)\right]\\ &+\sum_{n=1}^{9}\sum_{q=n}^{9}\left[\phi_{nq}\cos\left(x_n+x_q\right)+\omega_{nq}\sin\left(x_n+x_q\right)\right]\\ &+\sum_{n,n',n''=1}^{9}\left[\phi_{nn'n''}\cos\left(x_n+x_{n'}+x_{n''}\right)+\omega_{nnn}\sin\left(x_n+x_{n'}+x_{n''}\right)\right]+\varsigma_1\ln v+\ln u_c+\ln\varepsilon_c\end{aligned} \tag{1}$$

where $\left(y_k/z_3\right)$ and $\left(z_1/z_2\right)$ have one added to avoid taking the natural log of zero, the x_n's are rescaled terms of the $\ln\left(w_i/w_4\right)$, $\ln\left(y_k/z_3\right)$, and $\ln\left(z_1/z_2\right)$, so that each of the x_n lies in the interval $\left[0,2\pi\right]$, where π indicates radians (rather than profits as below). We apply the standard

[4] A small minority of banks are in multiple states. Since we only know the location of deposits from the Summary of Deposits data for these banks, we allocate nonperforming loans proportionately to the states according to the location of their deposits.

symmetry restrictions to the translog part of the function (i.e., $\beta_{ij} = \beta_{ji}, \gamma_{km} = \gamma_{mk}$). In the composed error term, $\ln \varepsilon_c$ represents noise and $\ln u_c$ represents cost inefficiency.

The alternative profit function requires a few changes. The dependent variable is $\ln\left[\left(\pi / w_4 z_2\right) + \left|\left(\pi / w_4 z_2\right)^{\min}\right| + 1\right]$, where $\left|\left(\pi / w_4 z_2\right)^{\min}\right|$ indicates that the absolute value of the minimum value of normalized profit, and the $\left|\left(\pi / w_4 z_2\right)^{\min}\right| + 1$ is added so we can take the natural log of a positive number, since minimum profits are usually negative. The composed error is $\ln u_\pi + \ln \varepsilon_\pi$.

As shown above, we normalize the cost, profit, and input price terms by the last input price w_4 to ensure linear homogeneity and normalize the cost, profit, output quantities and fixed netput quantities by the last fixed netput financial equity capital z_2 to help control for scale biases in estimation. Normalization ensures that both the dependent and independent variables are roughly of the same order of magnitude (e.g., Berger and Mester, 1997).

2.2.3 Measuring Efficiency from the Estimated Cost and Alternative Profit Functions

The key to measuring efficiency is disentangling inefficiency $\ln u$, from random error $\ln \varepsilon$. Since we have a number of time periods, our preferred method for the estimation of efficiency is the distribution-free approach, which disentangles them by assuming that inefficiencies are relatively stable and random errors tend to average over time (Berger 1993).

We estimate the cost and alternative profit functions separately for each quarter of a normal-times interval to account for possible changes over time in technology, regulation, and external environment. We then average the residuals over all the quarters of the normal-times period to obtain preliminary estimates of $\ln u$ for each bank. To avoid the impact of extreme values, we follow Berger and Mester (1997) and truncate the extreme values. Specifically, those banks in the top and bottom 5% are assigned

values of banks at the 95th and 5th percentiles, respectively. Cost efficiency for each bank and each quarter is estimated as the ratio of minimum predicted cost for that bank (using the values of the cost function arguments and the minimum cost function truncated average residual) to the actual predicted costs (using the values of the cost function arguments and the actual cost function truncated average residual for that bank). These cost efficiencies are then ranked for each quarter in descending order of efficiency, so that a bank that is more efficient than 80% of the observations for quarter that is assigned an 80% cost efficiency rank for that quarter. We then average the ranks over all the quarters of the normal-times period to obtain a comparable measure to use in our regression models of bank performance in the subsequent financial crisis. We prefer efficiency ranks to levels because they remove changes in the distributions of efficiency over time that are not relevant to our hypotheses. Average profit efficiency ranks are determined in similar fashion, except that they are based on the estimated as the ratio of actual predicted profit for that bank to the maximum predicted profit.

3. Hypothesis Development

We next discuss channels through which normal-times bank cost and profit efficiency may affect likelihood of failure, risk, and profitability of banks during subsequent financial crises, and form hypotheses from these channels. Section 3.1 describes the cost efficiency channels, Section 3.2 explains the profit efficiency channels, and Section 3.3 gives the resulting hypotheses.

3.1. Channels for Bank Cost Efficiency

High cost efficiency during normal times can have either favorable or unfavorable effects on bank performance during subsequent financial crises. The favorable effects go through the following channel:

- **Good management channel**: If management that is proficient at keeping costs down during normal times is also proficient at managing portfolios, then high cost efficiency may be associated with lower likelihood of bank failure, lower risk, and greater profitability during subsequent financial crises (e.g., Berger and DeYoung, 1997; Kwan and Eisenbeis, 1997;

Williams, 2004).

The unfavorable effects of high cost efficiency operate through the following alternative channel:

- **Skimping channel**: Banks may achieve high cost efficiency during normal times by devoting relatively few resources to screen and monitor loan applicants. This "skimping" channel, introduced by Berger and DeYoung (1997), improves cost efficiency during normal times and may not be noticed because the resulting poor loan performance only becomes apparent during subsequent financial crises.

3.2. Channels for Bank Profit Efficiency

Profit efficiency may operate through the same two channels as cost efficiency because profit efficiency includes the effects of costs as well as revenues. Thus, the good management channel may also apply to profit efficiency because good cost managers are not expected to be significantly worse at managing revenues. Similarly, the skimping channel may also apply to profit efficiency as long as revenues during normal times are not significantly adversely affected by skimping. This may occur because even poor loans may perform reasonably well outside of crisis periods.

There are two additional channels through which profit efficiency during normal times may favorably or unfavorably affect financial crisis performance. The additional favorable effects go through the following channel:

- **Charter value channel**: A bank with high profit efficiency may be expected to have relatively high future profits, and therefore greater charter value. It is often found that banks with greater charter value due to a different source, market power, behave more prudently to protect this value (e.g., Marcus 1984, Keeley 1990, Demsetz, Saidenberg, and Strahan 1996, Hellmann, Murdock, and Stiglitz 2000, Carletti and Hartmann 2003, Jimenez, Lopez, and Saurina 2013). The same logic applies to high charter value due to high profit efficiency. Thus, banks with high normal-times profit efficiency may more likely to survive, have relatively low risk, and relatively high

profits during the subsequent financial crises.

The additional unfavorable effects go through the following channel:

- **Risk-taking channel**: Banks may achieve high profit efficiency during normal times by taking on more risk, since high-risk investments generally have higher returns during normal times. For example, banks' investments in mortgage backed securities (MBS) appeared very profitable during the normal time period prior to the subprime financial crisis, but proved very risky and a significant contributing factor to bank failures and the crisis (e.g., Acharya, Philippon, Richardson, and Roubini, 2009; Acharya and Richardson, 2009; Diamond and Rajan, 2009). The higher risk-taking during normal times may turn into higher failure probabilities, higher risk, and lower profitability during subsequent crises, when high-risk investments generally suffer losses.

3.3. Hypotheses Derived from the Channels

These channels imply two opposing hypotheses each for the effects of normal-times bank cost and profit efficiency on performance during subsequent financial crises:

Hypothesis 1a. Higher cost efficiency during normal times results in better performance (lower likelihood of failure, lower risk, and higher profitability) during subsequent financial crises.

Hypothesis 1b. Higher cost efficiency during normal times results in worse performance (higher likelihood of failure, higher risk, and lower profitability) during subsequent financial crises.

Hypothesis 2a. Higher profit efficiency during normal times results in better performance (lower likelihood of failure, lower risk, and higher profitability) during subsequent financial crises.

Hypothesis 2b. Higher profit efficiency during normal times results in worse performance (higher likelihood of failure, higher risk, and lower profitability) during subsequent financial crises.

Hypotheses 1a and 1b as well as 2a and 2b are not mutually exclusive, and each of them may apply to different sets of banks. Our empirical analysis tests which of 1a or 1b and which of 2a and 2b

empirically dominates the other one overall.

4. Empirical Framework

This section explains our empirical approach for the failure, risk, and profitability analyses. It also describes the financial crises and normal times.

4.1. Empirical Approach and Descriptions of Financial Crises and Normal Times

We examine the effects of pre-crisis normal-times cost and profit efficiency on bank failure, risk, and profitability during the subsequent financial crises. We measure efficiency before the crises for several reasons. First, as discussed above, problems during financial crises are often created during the preceding normal time periods. Second, it is not known *a priori* when a crisis will occur, and it may be too late to take any prophylactic actions such as building up more capital once a crisis has occurred. Third, our approach helps mitigate endogeneity concerns because cost and profit efficiency are themselves affected by financial crises once these crises have started, so measurement of efficiency during the prior period reduces the odds that bank performance and efficiency are jointly determined.

Our main approach pools the data to treat financial crises and their preceding normal times as a group. We focus on five crises that occurred between 1986:Q1 and 2009:Q4, which were first employed by Berger and Bouwman (2013). They include two banking crises (crises that originated in the banking sector) and three market crises (crises that originated outside banking in the financial markets). The banking crises are the credit crunch of the early 1990s (1990:Q1–1992:Q4) and the subprime lending crisis (2007:Q3–2009:Q4). The market crises are the 1987 stock market crash (1987:Q4); the Russian debt crisis and Long-Term Capital Management (LTCM) bailout of 1998 (1998:Q3–1998:Q4); and the bursting of the dot.com bubble and the September 11 terrorist attacks of the early 2000s (2000:Q2–2002:Q3). Normal times include all the quarters since previous crisis, except the first normal times period begins at the start of the data set. The financial crises and normal times are graphed in Figure 1.

4.2 Regression Models

We estimate the effect of cost and profit efficiency during a normal time period on bank performance during the subsequent financial crisis using the following model:

$$Performance\ Indicator_{i,t} = f(COSTEFF_{i,PRE\text{-}t},\ PROFITEFF_{i,PRE\text{-}t},\ Other\ Bank\ Characteristics_{i,PRE\text{-}t},\ Crisis_{i,t}). \quad (2)$$

$Performance\ Indicator_{i,t}$ is a measure of bank *i*'s failure, risk, or profitability during crisis period *t*, where $t \in \{1,2,3,4,5\}$. Specifically, our performance measures are as follows. For failure, we use:

i) $FAILED1_{i,t}$, a dummy equal to one if bank *i* failed as it was placed under receivership or closed by the Federal Deposit Insurance Corporation (FDIC), given it was unable to meet its obligations to depositors and other stakeholders,[5] and thus was included in the FDIC failure list, or experienced book-value insolvency or technical default (bank became critically undercapitalized, its equity capitalization fell below 2% of bank gross total assets (GTA[6]))[7] in crisis period *t*.

ii) $FAILED2_{i,t}$, a dummy equal to one if bank *i* failed as it was placed under receivership or closed by the Federal Deposit Insurance Corporation (FDIC), given it was unable to meet its obligations to depositors and other stakeholders, and thus was included in the FDIC failure list in crisis period *t*.

We prefer *FAILED1* as our main measure of bank failure, given it is more comprehensive, including bank

[5] As receiver, the FDIC has the role to resolve a failed institution in order to maximize the return on the assets of the failed bank and minimize any loss to the deposit insurance fund. To accomplish a resolution, FDIC can 1) merge a failed institution with another insured depository institution and transfer its assets and liabilities, 2) form a new institution, known as a bridge bank, to take over the assets and liabilities of the failed institution, or 3) sell or pledge the assets of the failed institution to the FDIC in its corporate capacity (e.g., FDIC, 2013). The FDIC bank failure list is available at: https://www.fdic.gov/bank/individual/failed/banklist.html.

[6] Gross total assets (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 assets financed.

[7] This definition of technical default is consistent with the FDIC Improvement Act of 1991, which requires regulators to close or impose prompt corrective actions on any bank whose equity ratio falls below 2% (critically undercapitalized).

technical defaults, consistent with other prior research in banking (e.g., Wheelock and Wilson, 1995, 2000; Cole and White, 2012; Berger, Li, Morris, and Roman, 2016). However, *FAILED2* is also used as an alternative.

As proxies for risk[8], we use:

i) $LN(ZSCORE)_{i,t}$, log of the sum of a bank's mean *ROA* (net income over GTA) and mean *CAPITAL RATIO* (equity capital over GTA) divided by σROA (the volatility of ROA), where the means of the components are calculated over crisis period *t*.

ii) $\sigma_{ROA\,i,t}$, volatility of return on assets (ROA) of bank *i* over crisis period *t*.

As proxies for profitability, we use:

i) $ROA_{i,t}$, return on assets of bank *i* averaged over crisis period *t*.

ii) $ROE_{i,t}$, return on equity of bank *i* averaged over crisis period *t*.

Equation (2) is run as a logit for the failure variables, and as OLS for the continuous outcome measures. $COSTEFF_{i,PRE\text{-}t}$, and $PROFITEFF_{i,PRE\text{-}t}$ are profit and cost efficiency ranks over the normal-times period prior to the financial crisis. $Other\ Bank\ Characteristics_{i,PRE\text{-}t}$ is a set of control variables averaged over the normal times period. $Crisis_{i,t}$ is a set of individual crises dummies, which act as time fixed effects. We exclude one crisis dummy to avoid perfect collinearity.

5. Data Sample, Sources, and Control Variables

This section first explains our data sample and sources, followed by details on the control variables used in the analysis. The key independent variables measuring efficiency are described in Section 2 above. Table 1 Panel A shows variable definitions.

[8] Both risk measures, *LN(ZSCORE)* and σ_{ROA}, cannot be calculated over one of the market crises – the stock market crash of 1987:Q4 – which lasts only one quarter. The statistics and regressions using these measures therefore have smaller numbers of observations than the variables for failure and performance, dropping from 48,532 to 35,151 observations.

5.1. Data Sample and Sources

We acquire bank data from quarterly Call Reports, which contain financial information on all U.S. banks, over the period 1986:Q1 to 2009:Q4. We adjust the data to be in real 2009:Q4 terms using the GDP price deflator. We omit observations that do not refer to commercial banks, observations with missing or incomplete financial data on basic accounting variables such as total assets and equity, as well as those with no outstanding loans or deposits. Finally, following Berger and Bouwman (2013) and others, for all observations with total equity less than 1% of total assets, we replace equity with 1% of total assets to minimize distortions in ratios that contain equity.[9] Variables are aggregated for each bank over financial crises and normal time periods. These leaves us with a final sample of 48,532 bank-time period observations for 15,993 commercial banks over the sample period.

5.2. Control Variables

In our main performance regressions, we specify both a basic and a broad set of control variables. The basic set includes only variables measuring *COST IMPROVEMENTS* and *PROFIT IMPROVEMENTS* over the pre-crisis normal times periods and *CRISIS FIXED EFFECTS*, the set of individual crises dummies, which act as time fixed effects. *COST IMPROVEMENTS* is the proportions of quarters in which the cost function residual rank increased over the normal times period, and similarly for *PROFIT IMPROVEMENTS*, in order to allow trends or improvements in costs and profits to influence financial crisis performance. In the broad set of control variables, we also include proxies for risk and opacity, size and safety net protection, ownership, organizational structure and strategy, competition, and location, described below. In all cases, the control variables are measured during each pre-crisis normal-times period before the performance variables, which are measured during the subsequent crises.

[9] For example, if a bank's capital to GTA ratio is less than 1%, we calculate ROE as net income divided by 1% of assets. Otherwise, for observations for which equity is between 0% and 1% of assets, dividing by equity would result in extraordinarily high values. When equity is negative, the conventionally-defined ROE would have a reversed sign and would not make economic sense. We do not drop these low or negative capital observations because they are likely the most informative of banks' ability to survive and thrive during financial crises.

5.2.1. Risk and Opacity

Banks with riskier and more opaque portfolios in the pre-crisis normal times may be more likely to fail, have higher risk, and less profitability during subsequent financial crises (e.g., Ng and Rusticus, 2011). Proxies for risk and opacity are as follows. *CAPITAL RATIO*: Bank capitalization is defined as the bank's equity divided by GTA. It measures the extent to which a bank can absorb potential losses and is generally thought to be associated with improved monitoring and reduced moral hazard incentives to take risk. This variable is found to reduce probability of failure in almost all bank failure studies (e.g., Cole and White, 2012) and to improve performance during financial crises (e.g., Berger and Bouwman, 2013). *TOTAL LOANS / GTA*: The ratio of total loans to GTA. Banks with higher loan ratios tend to have greater credit risk. *COMMERCIAL RE RATIO*: Commercial real estate loans divided by GTA. Research finds that commercial real estate loans is an important determinant of bank failures during the recent financial crisis (e.g., Cole and White, 2012; Berger, Imbierowicz, and Rauch, 2016). *BROKERED DEPOSITS RATIO*: Brokered deposits divided by GTA. Some banks obtain large deposits from deposit brokers. Such deposits however are expensive, and the funds are usually invested in high-risk activities to cover the high costs. While some researchers suggest that brokered deposits cannot directly explain bank failure (e.g., Rossi, 2010), others suggest otherwise (e.g., Federal Deposit Insurance Corporation, 2011; Cole and White, 2012). *UNUSED COMMITMENTS RATIO*: Unused commitments divided by GTA. As noted in Cornett, McNutt, Strahan, and Tehranian (2011), unused commitments expose banks to liquidity risk, and also experience an increase in demand during crises. *CASH HOLDINGS RATIO*: Cash holdings divided by GTA. High cash holding can reduce liquidity risk for banks and could help them survive, but they can also be associated with more agency problems (e.g., Jensen 1986). *LLA / GTA*: Loan loss allowance divided by GTA. The loan loss allowance measures expected future loan losses, and indicates greater credit risk. *LOAN CONCENTRATION*: A bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. The larger is the

loan HHI is, the more concentrated and potentially riskier is the loan portfolio.

5.2.2. Size and Safety Net Protection

We control for size and safety net protection using several indicators. *LN(GTA)*: The natural log of GTA. Bank size is expected to have favorable effects on future performance because larger banks are better diversified, have higher survival odds, and scale economies. The largest banks may also have better safety net protection, which we deal with in a robustness check below. We control for the primary federal supervisor, which may affect bank performance during financial crises because of differences in quality of oversight and leniency: *SUPERVISOR_OCC* (for national banks), *SUPERVISOR_FDIC* (for state nonmember banks), and *SUPERVISOR_FRSFRS* (for state banks that are members of the Federal Reserve System). We exclude the latter from the regressions to avoid perfect collinearity.

5.2.3. Bank Ownership

We use two indicators of bank ownership. *BHC MEMBER*: Dummy equal to one if the bank was part of a bank holding company at any time in the period preceding the crisis. BHC membership is expected to help a bank survive, reduce its risk, improve its profitability during a crisis because the holding company may act as a source of strength to all the banks it owns (Houston, James, and Marcus, 1997). *PUBLICLY LISTED*: Dummy equal to 1 if a bank is listed or is part of a BHC that is listed. Banks that are publicly listed have increased monitoring from shareholders and an additional source for raising capital, which may positively affect performance. Alternatively, it may increase failure probability and risk because of heightened incentives to take advantage of debt holders and the government safety net relative to private owners, which are often family members (e.g., Armour and Gordon, 2014; Cheng, Hong, and Scheinkman, 2015; Roman, 2016). *FOREIGN OWNERSHIP*: Foreign ownership dummy equal to 1 if a bank has 50% or more foreign ownership. In developed nations like the U.S., foreign banks are found to

underperform domestic banks (e.g., Berger, DeYoung, Genay, and Udell, 2000).[10]

5.2.4. Organizational Structure

Centralized organizations are complex and tend to rely on hard information, while decentralized organizations are less complex and rely more on soft information (Stein, 2002), so organizational complexity may affect performance. We create two variables that capture this complexity: *BRANCHES / GTA*: (ratio of total bank branches over GTA) x 1000, and *LN (NUMBER STATES)*: Natural log of the number of states in which the bank has branches. Banks with more branches per dollar of assets and those that operate in more states tend to have more complex organizational structures.

5.2.5. Competition

Some research suggests that increased competition reduces franchise value and increases risk and the likelihood of failure (e.g., Keeley, 1990). Others argue that competition reduces risk and the likelihood of failure (e.g., Boyd and De Nicolo, 2005). Still others suggest the relation may be nonmonotonic (e.g., Martinez-Miera and Repullo, 2010). The empirical research finds some merit in all of these positions (e.g., Beck, Demirguc-Kunt, and Levine, 2006; Beck, 2008; Berger, Klapper, and Turk-Ariss, 2009; Beck, De Jonghe, and Schepens, 2013; Berger, Imbierowicz, and Rauch, 2016). We control for the degree of bank local competition, proxied by *HHI Deposits*, which we measure using the Herfindahl-Hirschman Index (HHI) of market concentration based on the bank's weighted market share of deposits in the markets in which it operates. Markets are defined as Metropolitan Statistical Areas (MSAs), New England County Metroplitan Areas (NECMAs), or rural counties.[11] The larger is HHI, the greater is a bank's market power. Finally, we control for *PERCENT METROPOLITAN* – percentage of bank deposits in metropolitan

[10] In contrast, foreign banks in emerging markets tend to be associated with improved profitability and stability of the banking sector, in part because they reduce problems of related lending (e.g., Giannetti and Ongena, 2009).

[11] HHI is the sum of the squares of the market shares (deposits) of each individual bank. We use the bank deposit data from the FDIC Summary of Deposits for the period 2005 to 2009 combined with data from Christa Bouwman for the period 1986 to 2004, which was collected for Berger and Bouwman (2009).

markets (MSAs and CBSAs). Banks with a higher metropolitan presence may experience more competition.

5.2.6. Local Economic Conditions

We use two indicators of local economic conditions. *CHANGE COINCIDENT INDEX*: Weighted average of the changes in the Philadelphia Federal Reserve's state coincident indices based on deposit shares. The coincident index combines four state-level indicators to summarize economic conditions in a single statistic.[12] Banks in states with more economic growth may be less likely to fail, less risky, and more profitable (e.g., Bayazitova and Shivdasani, 2012). *HOUSE PRICE INFLATION*: House price index (HPI) growth is the weighted average growth in a state-level HPI from the Federal Housing Finance Agency based on deposit shares. This may have important effects on bank performance since real estate is often used as collateral.

6. Empirical Analysis

6.1. Summary Statistics

Table 1 Panel B contains summary statistics on the regression variables for all financial crises, and separately for banking and market crises. The dependent performance variables are measured during the crises and the independent efficiency and control variables are measured during the prior normal-times periods. The average bank has a failure (*FAILED1*) likelihood of 1.7% when considering actual FDIC bank failures and bank technical default (capitalization ratio of less than 2%), and a failure (*FAILED2*) likelihood of 0.8% when considering actual FDIC failures alone. The risk variables are *LN(ZSCORE)*, with a mean of 3.200 (mean of *ZSCORE* is 49.243), and standard deviation of *ROA*, *σROA*, with a mean of 0.008. Bank *ZSCORE*, which measures risk inversely, is considered to be the more complete measure of risk, since it takes into account capital and mean earnings, as well as the standard deviation of earnings.

[12] The four indicators are: nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index.

Profitability is measured by return on assets (*ROA*) with a mean of 0.005; and return on equity (*ROE*) with a mean of 0.059.

Our key independent variables measured during the pre-crisis normal times periods are *COSTEFF*, with a mean of 0.500, and *PROFITEFF*, with a mean of 0.498. The efficiency means are around 0.50 by construction of the ranks.

Turning to the controls, *COST IMPROVEMENTS* and *PROFIT IMPROVEMENTS* have means of 0.596 and 0.591, respectively. Regarding risk and opacity characteristics, the average bank has capitalization ratio (*CAPITAL RATIO*) of 0.101, *TOTAL LOANS / GTA* of 0.557, *COMMERCIAL RE RATIO* of 0.146, *BROKERED DEPOSITS RATIO* of 0.007, *UNUSED COMMITMENTS RATIO* of 0.075, *CASH HOLDINGS RATIO* of 0.070, *LLA / GTA* ratio of 0.009, and a *LOAN CONCENTRATION* of 0.316. Regarding size and safety net protection characteristics, the average bank has a size *LN(GTA)* of 11.454 (mean of GTA is $621.583 million) and 29.7%, 60.9%, and 9.4% have OCC, FDIC, and FRS as their primary federal regulator, respectively.[13] As regards ownership, 72.1% of the banks are in bank holding companies (BHC), 11.5% of the banks are publicly listed, and 9% of the banks are foreign-owned. For ownership structure, the average banks has *BRANCHES / GTA* of 0.030 and *LN(NUMBER STATES)* of 0.012. In terms of competition, the average bank has a *HHI DEPOSITS* of 0.086 and *PERCENT METROPOLITAN* of 0.466. Finally, local economic indicators show that the average bank is exposed in the markets in which it operates to a *CHANGE COINCIDENT INDEX* of 0.206 and *HOUSE PRICE INFLATION* of 0.426.

When looking at key variables over banking versus market financial crises, statistics are mostly consistent, except that we observe more failures and higher risk during banking crises. With regard to controls, the average bank has a higher *COMMERCIAL RE RATIO*, higher *BROKERED DEPOSITS RATIO*, higher *LLA / GTA*, negative values for the *CHANGE COINCIDENT INDEX*, and lower increases

[13] This last regulatory dummy is omitted from the regressions to avoid perfect collinearity.

in *HOUSE PRICE INFLATION* prior to banking crises, suggesting more increases in risk in the normal times leading to banking crises.

6.2. Regression Analysis Based on Grouping Financial Crises Together

In this section, we discuss the main empirical results based on grouping financial crises together.

6.2.1. How Does Pre-Crisis Efficiency Affect Banks' Likelihood of Failure during Financial Crises?

Table 2 Panel A present the bank failure regression coefficients with minimal controls. Columns (1), (3), and (5) use the *FAILED1* measure, while columns (2), (4), and (6) show results using *FAILED2*. We use logit models and include only cost efficiency in Columns (1) and (2), only profit efficiency in Columns (3) and (4), and both efficiency measures in Columns (5) and (6). Panel B has the same format, but uses the full set of control variables.

We consistently find that pre-crisis cost efficiency statistically significantly helps banks reduce their probability of failure during financial crises. Turning to economic significance, in the most complete specifications in Panel B Columns (5) and (6), we find that moving cost efficiency during normal times from 0 to 1, i.e., from the most inefficient to the most efficient, decreases the probability of bank failure during financial crises by 64% (from 0.028 to 0.010) in Column (5) for *FAILED1* and 95% (from 0.043 to 0.002) in Column (6) for *FAILED2*. These results support the **good management channel** over the **skimping channel**, consistent with the empirical dominance of Hypothesis 1a over 1b.

The results also suggest that profit efficiency generally has no statistically or economically significant effect on the likelihood of failure. When controlling for cost efficiency, the coefficient is only marginally statistically significant in one case and much smaller than the cost efficiency effect. Since profit efficiency is inclusive of both costs and revenues, and cost efficiency has a strong negative effect on the probability of failure, these results provide at least modest evidence of the **risk-taking channel** – that revenues decline during subsequent financial crises from high revenues from additional risk-taking during pre-crisis normal times. These results suggest that neither Hypothesis 2a or 2b empirically

dominate because the cost and revenue effects cancel each other out.

Turning to the controls in Table 2 Panel B, the coefficients generally have the predicted signs. Banks with cost and profit improvement trends, larger size, higher capitalization, lower ratio of total loans, members of BHCs, lower ratios of commercial real estate loans, fewer brokered deposits, less unused commitments, reduced loan loss allowance ratios, publicly traded, with positive changes in coincident indices and house price inflation, and lower loan concentrations are less likely to fail during the financial crises. The other controls do not have clear sign predictions.

6.2.2. How Does Pre-Crisis Efficiency Affect Bank Risk during Financial Crises?

Table 3 presents the results for our proxies of bank risk during financial crises, *LN(ZSCORE)* and *LN(σROA)*, following the same format as Table 2.

Cost efficiency tends to decrease risk during crises in all cases, and is statistically significant in all but one case. The findings are economically significant for the more complete *LN(ZSCORE)* measure, but not for *σROA*. In the most complete specification in Panel B Columns (5) and (6), we find that moving cost efficiency during normal times from 0 to 1 increases *LN(ZSCORE)* during financial crises by 8.5% (from 3.07 to 3.33) in Column (5), which is economically significant, and produces an average reduction in *σROA* by 33% (from 0.009 to 0.006) in Column (6). The risk results again support the **good management channel**, rather than the **skimping channel**, and the empirical dominance of Hypothesis 1a over 1b.

Profit efficiency does not have statistically significant effects on risk in the full specification in Panel B, and has a deleterious effect on risk in Panel A, as reflected by statistically lower *LN(ZSCORE)*. Since cost efficiency during normal times is found above to reduce risk during financial crises, the profit efficiency findings suggest that high revenues during normal times are associated with increased risk during the subsequent financial crises. Thus, the data suggests that profit efficiency during normal times may partially reflect engagement in high expected return-high risk activities that have negative

consequences during subsequent crises, consistent with the **risk-taking channel** and the empirical dominance of Hypothesis 2b over 2a.

Turning to the controls, most of the coefficients are in line with expectations. Banks with more cost improvements, larger sizes, lower loan ratio, BHC members, with lower ratios of commercial real estate loans, lower ratios of brokered deposits, with positive changes in economic conditions, and lower loan concentration tend to reduce have lower risk during subsequent financial crises.

6.2.3. How Does Pre-Crisis Efficiency Affect Banks' Profitability during Financial Crises?

Table 4 presents the results for the two measures of bank profitability, ROA and ROE, again following the same format.

Cost efficiency consistently increases profitability during subsequent crises, while profit efficiency has little effect. The cost efficiency coefficients are all statistically significant and are economically significant for *ROE* as well. In Panel B Columns (5) and (6), we find that moving cost efficiency during normal times from 0 to 1 increases *ROA* during financial crises by 75% (from 0.004 to 0.007) in Column (5), and increases *ROE* during financial crises by 51% (from 0.047 to 0.071) in Column (6). Again, the results support the **good management channel** over the **skimping channel** and are consistent with the empirical dominance of Hypothesis 1a over 1b.

The profit efficiency results, by contrast, show no increase in profitability during subsequent crises. The coefficients are small, and the only ones that are significant are negative. Again, since profit efficiency is inclusive of cost efficiency, the marginal effects of higher revenues during normal times presage decreases in profitability during the following financial crises, more consistent with the **risk-taking channel** than the **charter value channel** and the empirical dominance of Hypothesis 2b over 2a.

Turning to the controls, we find that banks with higher proportions of cost and profit efficiency increases, greater size, members of a bank holding company, higher ratio of unused commitments, being

publicly traded, having positive changes in the local market conditions where they operate as proxied by the coincident index and house price inflation, and a lower loan concentration are more likely to have strong profit performance during subsequent financial crises.

7. Robustness Checks

This section presents our robustness checks. In all cases, we use only the full specifications with both cost and profit efficiency and all of the controls, although most of the controls are not shown for brevity.

7.1. Effects for Banking Crises and Market Crises

We examine whether the results differ for the two banking crises versus the three market crises in our sample. Table 5 shows the results. They suggest that our effects of cost efficiency on failure and risk are primarily applicable to the banking crises, while the profitability results hold for both banking and market crises.

7.2. Excluding Too-Big-to-Fail (TBTF) Banks

A potential concern is that our results may be driven by the very large banks that may be considered too-big-to-fail (TBTF), and more likely to be bailed out in the event of problems. To mitigate this concern, we rerun our main analyses while excluding these banks. There is no formal definition of TBTF, so we use two alternative definitions. First, in every period, we deem all banks with GTA exceeding $50 billion to be TBTF, consistent with the Dodd-Frank Act definition of systemically important financial institutions (SIFIs). Second, we classify the 19 largest banks in each period as TBTF, consistent with the government's disclosure in early 2009 that the 19 largest banks were subject to stress tests, and would be assisted with capital injections if they could not raise capital on their own, essentially making them TBTF.

Table 6 shows the results excluding the banks with over $50 billion and excluding the top 19 banks. We find similar results to our main findings, suggesting that our conclusions are not driven by the

TBTF banks.[14]

7.3. Controlling for Cost-to-Income

A potential concern is that a simpler measure of efficiency used on the literature – *COST-TO-INCOME* – which measures total bank costs relative to total revenues (e.g., Beck, Demirgüç-Kunt, and Merrouche, 2013) may be driving our main results. To ensure that our efficiency measures are more comprehensive than this measure, we rerun our main analyses while controlling for the *COST-TO-INCOME*. These results are reported in Table 7 and they show that the *COST-TO-INCOME* is generally marginally statistically significant or insignificant, while our main results remain unaffected.

8. A Deeper Analysis of the Cost Efficiency Findings

Our results so far suggest that cost efficiency during normal times helps banks perform better during subsequent financial crises, consistent with the **good management channel** underlying Hypothesis 1a. We next examine more carefully the extent to which this channel explains the data and whether or not the alternative **skimping channel** may find any support.

To do so, we first test whether the cost efficiency-performance relations are stronger for well managed versus poorly managed banks using regulatory enforcement actions against bank management data to proxy for management quality following the extant research (e.g., Duchin and Sosyura, 2014; Berger and Roman, 2015, forthcoming; Fiordelisi, Raponi, and Rau, 2015; Delis, Staikouras, and Tsoumas, 2016). Banking regulators issue formal, publicly announced enforcement actions against bank management officials if these individuals engaged in unsafe, unsound, or illegal banking practices,[15] or other significant violations of laws, rules, or regulations. Information on regulatory enforcement actions against management is acquired via manual collection from the federal regulators discussed earlier: OCC, FDIC, and FRS. We group banks according to whether they did not or did receive enforcement actions

[14] There are not enough observations to analyze the TBTF banks by themselves.

[15] Unsafe or unsound practices refer to any actions or omissions which are contrary to generally accepted standards of prudent bank operation and, if continued, are likely to lead to abnormal risk or loss to the institution and its stakeholders.

against management, *Enforcement Actions against Management = 0* or *Enforcement Actions against Management > 0*, and estimate the model for both subsamples. To the extent that the **good management channel** is in effect, it is expected that cost efficiency would have its most favorable effects for the better-managed banks that have no enforcement actions.

Regression estimates testing this are shown in Table 8, columns (1) through (12), where we show the full specifications for the performance measures for the subsamples of banks without and with enforcement actions. We find that the effects of cost efficiency are statistically significant in all cases for the banks without enforcement actions. In contrast, they are insignificant in all cases and have the opposing signs for failure and profitability for banks with enforcement actions.

Results for the banks without enforcement actions are also economically significant. First, looking at bank failure for banks without enforcement actions, we find that moving cost efficiency during normal times from 0 to 1 decreases the probability of bank failure during financial crises by 64% (from 0.028 to 0.010) in Column (1) for *FAILED1* and 96% (from 0.045 to 0.002) in Column (6) for *FAILED2.* Similarly, looking at bank risk for banks without enforcement actions, we find that moving cost efficiency during normal times from 0 to 1 increases *LN(ZSCORE)* during financial crises by 8.5% (from 3.07 to 3.33) in Column (5), reduces *σROA* by 22% (from 0.009 to 0.007) in Column (6). Finally, looking at bank risk for banks without enforcement actions, we find that moving cost efficiency during normal times from 0 to 1, increases *ROA* during financial crises by 75% (from 0.004 to 0.007) in Column (9), and increases *ROE* during financial crises by 51% (from 0.047 to 0.071) in Column (10). The results are strongly consistent with the **good management channel** – the effects of normal-times cost efficiency on subsequent financial crisis performance are only favorable and statistically and economically significant for the banks with no enforcement actions against management.

Table 8 columns (13) – (14) provide direct tests of the **skimping channel** by examining whether high cost efficiency during normal times is associated with more loan performance problems during subsequent financial crises. To measure loan performance problems during crises, we use the nonperforming loans ratio, *NPL*, the bank ratio of nonperforming loans (past due at least 90 days or in

nonaccrual status) to total loans (e.g., Berger, Klapper, and Turk-Ariss, 2009), and the loan loss allowance ratio, *LLA*, the ratio of the loan and lease loss allowance to total loans (e.g., Berger, El Ghoul, Guedhami, and Roman, forthcoming). The evidence does **not** support the **skimping channel** – cost efficiency is instead associated with fewer loan performance problems.

9. Conclusions

We test the effects of bank efficiency in normal times on bank performance during subsequent financial crises. We find that cost efficiency during normal times helps banks reduce failure probabilities, decrease risk, and enhance profitability during subsequent financial crises, while profit efficiency has limited benefits. This suggests that cost efficiency may better proxy management quality, while profit efficiency may partially reflect temporary high returns during normal times from risky investments that are reversed during subsequent financial crises. Results are robust to various checks. A deeper analysis confirms that high cost efficiency is associated with good management.

These results also yield important potential policy and research implications. They suggest that policymakers, regulators, supervisors, and managers might focus on cost efficiency during normal times to promote better performance during subsequent financial crises. The results also suggest that future explorations of the economic roles of bank efficiency may find it fruitful to pay attention to its intertemporal implications.

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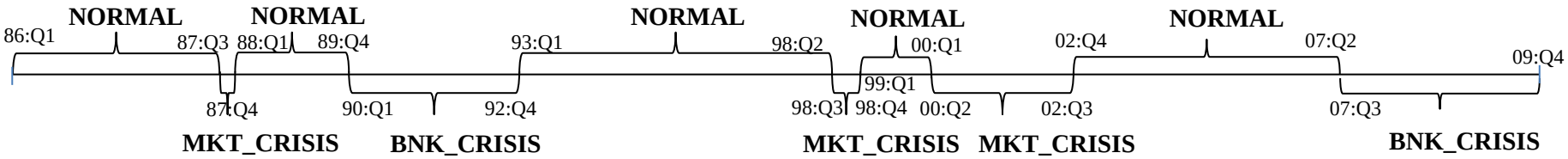
Figure 1. Timeline. This figure shows the banking crises (BNKCRISIS), market crises (MKTCRISIS), and normal times (NORMAL) that occurred during our sample period from 1986:Q1 until 2009:Q4.



Detailed periods and sequence for our sample period from 1986:Q1 until 2009:Q4 are represented below:

Period Type	Exact time period
NORMAL	86:Q1 - 87:Q3
MKT_CRISIS	87:Q4
NORMAL	88:Q1 - 89:Q4
BNK_CRISIS	90:Q1 - 92:Q4
NORMAL	93:Q1 - 98:Q2
MKT_CRISIS	98:Q3 - 98:Q4
NORMAL	99:Q1 - 00:Q1
MKT_CRISIS	00:Q2 - 02:Q3
NORMAL	02:Q4 - 07:Q2
BNK_CRISIS	07:Q3 - 09:Q4

Table 1: Variable Definitions and Summary Statistics

Panel A provides definitions for all variables used in our analysis. Panel B reports summary statistics of the variables for our analysis for the period 1986:Q1-2009:Q4. All variables using dollar amounts are expressed in real 2009:Q4 dollars using the implicit GDP price deflator. It contains means, medians, standard deviations and number of observations on all the regression variables used to examine the effect of pre-crisis cost and profit efficiency on banks' ability to survive crises, reduce risk, and increase their performance during such crises. We first present statistics for all financial crises, and then we distinguish between banking crises (the credit crunch of the early 1990s and the recent 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).

Panel A – Variable Definitions

Dependent Variables

FAILURE

FAILED1 is a dummy equal to one if bank *i* failed as it was placed under receivership or closed by the FDIC given it was unable to meet its obligations to depositors and other stakeholders and thus it was included in the FDIC failure list, or experienced book-value insolvency or technical default (bank became critically undercapitalized, its equity capitalization fell below 2% of bank GTA.

FAILED2 is a dummy equal to one if bank *i* failed as it was placed under receivership or closed by the FDIC given it was unable to meet its obligations to depositors and other stakeholders and thus it was included in the FDIC failure list.

RISK

LN(ZSCORE) is a measure of bank financial risk. It is calculated as the log of the sum of a bank's mean *ROA* (net income over GTA) and mean *CAPITAL RATIO* (equity capital over GTA) divided by *σROA* (the volatility of ROA), where the means of the components are calculated over the crises periods.

σROA is the volatility of return on assets *ROA* over the crises periods.

PROFITABILITY

ROA is the bank return on assets over the crises periods.

ROE is the bank return on equity over the crises periods winsorized at the 1% level.

OTHER DEPENDENT VARIABLES (Robustness)

NPL/TL is the bank ratio of nonperforming loans (past due at least 90 days or in nonaccrual status) to total loans.

LLA / GTA is loan loss allowance divided by GTA.

Key Independent Variables

COSTEFF is bank cost efficiency over the pre-crisis periods.

PROFFEFF is bank profit efficiency over the pre-crisis periods.

Basic Characteristics

COST IMPROVEMENTS is the proportion of cost efficiency increases.

PROFIT IMPROVEMENTS is the proportion of profit efficiency increases.

Other Bank Characteristics

A. Risk and Opacity

CAPITAL RATIO is bank capitalization, defined as the bank's total equity divided by GTA.

TOTAL LOANS / GTA is the ratio of total loans to GTA.

Other Bank Characteristics (cont.)

A. Risk and Opacity (cont.)

COMMERCIAL RE RATIO is the commercial real estate loans divided by GTA.

BROKERED DEPOSITS RATIO is brokered deposits divided by GTA.

UNUSED COMMITMENTS RATIO is unused commitments divided by GTA.

CASH HOLDINGS RATIO is cash holdings divided by GTA.

LLA / GTA is loan loss allowance divided by GTA.

LOAN CONCENTRATION is a bank's loan portfolio concentration measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans.

B. Size and Safety Net Protection

LN(GTA) is bank size calculated as the natural log of GTA.

SUPERVISOR_OCC is a dummy equal 1 if the OCC is the primary supervisor of the bank.

SUPERVISOR_FDIC is a dummy equal 1 if the FDIC is the primary supervisor of the bank.

SUPERVISOR_FRS is a dummy equal 1 if the FRS is the primary supervisor of the bank.

C. Bank Ownership

BHC MEMBER is a dummy variable that equals one if a bank was part of a bank holding company at any time in the pre-crisis period.

PUBLICLY LISTED is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange.

FOREIGN OWNERSHIP is a dummy equal to 1 if a bank has 50% or more foreign ownership.

D. Organizational Structure

BRANCHES / GTA is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000.

LN (NUMBER STATES) is the log of the number of states in which bank has branches.

E. Competition

HHI DEPOSITS is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present.

PERCENT METROPOLITAN is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active.

F. Local Economic Conditions

CHANGE COINCIDENT INDEX is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights.

HOUSE PRICE INFLATION is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights.

G. Other Variables (Robustness)

CRISIS FIXED EFFECTS are a set of individual crisis dummies, which act as time fixed effects.

Enforcement Actions against Management is the number of regulatory enforcement actions against bank management by the corresponding banking regulator (Federal Reserve System (FRS), Federal Deposit Insurance Corporation (FDIC), and Office of the Comptroller of the Currency (OCC)) during the time period.

COST-TO-INCOME is the ratio of bank total costs to total revenue.

Panel B – Summary Statistics

	ALL FINANCIAL CRISES				BANKING CRISES				MARKET CRISES			
Summary Statistics	**mean**	**p50**	**sd**	**N**	**mean**	**p50**	**sd**	**N**	**mean**	**p50**	**sd**	**N**
Dependent Crisis Variables												
FAILURE												
FAILED1	0.017	0.000	0.128	48,532	0.030	0.000	0.170	19,066	0.008	0.000	0.091	29,466
FAILED2	0.008	0.000	0.089	48,532	0.019	0.000	0.138	19,066	0.001	0.000	0.023	29,466
RISK												
LN(ZSCORE)	3.200	3.332	1.368	35,150	2.768	3.021	1.387	18,990	3.708	3.699	1.153	16,160
σROA	0.008	0.004	0.015	35,151	0.010	0.005	0.019	18,990	0.005	0.003	0.009	16,160
PROFITABILITY												
ROA	0.005	0.009	0.020	48,532	0.005	0.009	0.015	19,066	0.005	0.010	0.023	29,466
ROE	0.059	0.097	0.183	48,532	0.060	0.093	0.142	19,066	0.059	0.100	0.205	29,466
OTHER DEPENDENT VARIABLES (Robustness)												
NPL/TL	0.019	0.011	0.025	48,532	0.021	0.015	0.024	19,066	0.018	0.009	0.256	29,466
LLA/GTA	0.009	0.008	0.006	48,532	0.010	0.009	0.006	19,066	0.009	0.008	0.006	29,466
Independent Pre-Crisis Variables												
Key Independent Variables												
COSTEFF	0.500	0.495	0.173	48,532	0.505	0.502	0.169	19,066	0.497	0.491	0.175	29,466
PROFITEFF	0.498	0.507	0.282	48,532	0.504	0.516	0.282	19,066	0.495	0.501	0.281	29,466
Basic Characteristics												
COST IMPROVEMENTS	0.596	0.500	0.535	48,532	0.781	0.579	0.747	19,066	0.475	0.429	0.273	29,466
PROFIT IMPROVEMENTS	0.591	0.421	0.744	48,532	0.770	0.500	1.020	19,066	0.475	0.400	0.452	29,466
Other Bank Characteristics												
A. Risk and Opacity												
CAPITAL RATIO	0.101	0.088	0.055	48,532	0.103	0.088	0.061	19,066	0.099	0.088	0.050	29,466
TOTAL LOANS / GTA	0.557	0.573	0.148	48,532	0.566	0.580	0.156	19,066	0.552	0.569	0.142	29,466
COMMERCIAL RE RATIO	0.146	0.120	0.111	48,532	0.165	0.131	0.130	19,066	0.133	0.115	0.094	29,466
BROKERED DEPOSITS RATIO	0.007	0.000	0.042	48,532	0.011	0.000	0.060	19,066	0.004	0.000	0.025	29,466
UNUSED COMMITMENTS RATIO	0.075	0.041	0.662	48,532	0.075	0.042	0.436	19,066	0.075	0.041	0.774	29,466
CASH HOLDINGS RATIO	0.070	0.053	0.056	48,532	0.070	0.054	0.057	19,066	0.069	0.052	0.055	29,466
LLA / GTA	0.009	0.008	0.005	48,532	0.009	0.008	0.005	19,066	0.008	0.008	0.005	29,466
LOAN CONCENTRATION	0.316	0.290	0.099	48,532	0.325	0.296	0.106	19,066	0.310	0.287	0.093	29,466
B. Size and Safety Net Protection												
LN(GTA)	11.454	11.308	1.243	48,532	11.504	11.352	1.270	19,066	11.422	11.279	1.224	29,466
SUPERVISOR OCC	0.297	0.000	0.454	48,532	0.289	0.000	0.451	19,066	0.302	0.000	0.457	29,466
SUPERVISOR FDIC	0.609	1.000	0.485	48,532	0.617	1.000	0.483	19,066	0.604	1.000	0.486	29,466
SUPERVISOR FRS	0.094	0.000	0.288	48,532	0.094	0.000	0.289	19,066	0.094	0.000	0.287	29,466
C. Bank Ownership												
BHC MEMBER	0.721	1.000	0.436	48,532	0.728	1.000	0.433	19,066	0.716	1.000	0.437	29,466
PUBLICLY LISTED	0.115	0.000	0.309	48,532	0.120	0.000	0.317	19,066	0.112	0.000	0.304	29,466
FOREIGN OWNERSHIP	0.009	0.000	0.088	48,532	0.008	0.000	0.084	19,066	0.009	0.000	0.090	29,466
D. Organizational Structure												
BRANCHES / GTA	0.030	0.024	0.024	48,532	0.030	0.024	0.024	19,066	0.030	0.024	0.023	29,466
LN (NUMBER STATES)	0.012	0.000	0.107	48,532	0.017	0.000	0.131	19,066	0.008	0.000	0.089	29,466
E. Competition												
HHI DEPOSITS	0.086	0.059	0.087	48,532	0.092	0.073	0.086	19,066	0.083	0.052	0.087	29,466
PERCENT METROPOLITAN	0.466	0.204	0.477	48,532	0.505	0.526	0.465	19,066	0.440	0.000	0.483	29,466
F. Local Economic Conditions												
CHANGE COINCIDENT INDEX	0.206	0.272	0.544	48,532	-0.008	0.041	0.276	19,066	0.345	0.514	0.624	29,466
HOUSE PRICE INFLATION	0.426	0.450	1.006	48,532	0.313	0.281	0.934	19,066	0.499	0.570	1.044	29,466
G. Other Variables (Robustness)												
Enforcement Actions against Management	0.056	0.000	1.594	48,532	0.087	0.000	2.471	19,066	0.035	0.000	0.483	29,466
COST-TO-INCOME	3.949	5.962	425.725	48,532	7.116	6.265	204.696	19,066	1.901	5.805	520.957	29,466

Table 2: Do Cost and Profit Efficiency Protect Banks from Failing during Financial Crises? – Main Results (All Crises)

This table reports estimates from regression estimates for analyzing whether cost and profit efficiency protect banks from failure during financial crises. Panel A presents the estimates using minimal controls, while Panel B presents the results using all controls. The dependent variables are *FAILED1* and *FAILED2*. *FAILED1* is a dummy equal to 1 during a crisis if the bank failed anytime during the crisis or of the bank became insolvent (capitalization ratio is less or equal to 2%). *FAILED2* is a dummy equal to 1 during a crisis if the bank failed anytime during the crisis. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRSS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA. *CASH HOLDINGS RATIO* is cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

Panel A – Failure with Minimal Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*
Independent Variables & Regression Method	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT
Key Independent Variables and Basic Characteristics						
COSTEFF	-1.424***	-2.990***			-1.388***	-2.912***
	(-5.044)	(-7.275)			(-4.935)	(-7.117)
PROFITEFF			-0.308	-0.614**	-0.193	-0.351
			(-1.506)	(-2.077)	(-0.935)	(-1.147)
COST IMPROVEMENTS	-0.903***	-1.782***	-0.490***	-0.797***	-0.863***	-1.703***
	(-8.000)	(-12.617)	(-6.941)	(-9.116)	(-7.751)	(-12.646)
PROFIT IMPROVEMENTS	-0.158***	-0.345***	-0.332***	-0.712***	-0.225***	-0.494***
	(-2.980)	(-3.908)	(-4.133)	(-5.917)	(-2.628)	(-3.534)
CONSTANT	-1.887***	-1.009***	-2.635***	-2.612***	-1.791***	-0.834**
	(-9.170)	(-3.729)	(-16.699)	(-11.985)	(-7.507)	(-2.545)
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	48,532	40,067	48,532	40,067	48,532	40,067
PSEUDO R^2	0.0830	0.144	0.0803	0.135	0.0831	0.145

Panel B – Failure with All Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*
Independent Variables & Regression Method	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT	LOGIT
Key Independent Variables and Basic Characteristics						
COSTEFF	-1.273***	-3.557***			-1.183***	-3.367***
	(-3.780)	(-7.264)			(-3.556)	(-6.848)
PROFITEFF			-0.492**	-1.001***	-0.370	-0.645*
			(-2.121)	(-3.189)	(-1.577)	(-1.905)
COST IMPROVEMENTS	-0.889***	-2.147***	-0.468***	-0.820***	-0.803***	-1.983***
	(-6.316)	(-10.529)	(-5.335)	(-7.782)	(-5.766)	(-10.033)
PROFIT IMPROVEMENTS	-0.154***	-0.301***	-0.386***	-0.844***	-0.287***	-0.590***
	(-2.598)	(-3.203)	(-4.011)	(-5.799)	(-2.826)	(-3.385)

Other Bank Characteristics:						
A. Risk and Opacity						
CAPITAL RATIO	-21.894***	-8.374***	-22.063***	-8.633***	-21.883***	-8.440***
	(-5.755)	(-3.643)	(-5.815)	(-3.663)	(-5.770)	(-3.679)
TOTAL LOANS / GTA	2.878***	2.446***	2.920***	2.461***	2.884***	2.466***
	(6.542)	(4.463)	(6.634)	(4.490)	(6.550)	(4.491)
COMMERCIAL RE RATIO	3.061***	3.787***	3.051***	3.703***	3.071***	3.782***
	(8.731)	(8.222)	(8.718)	(8.176)	(8.766)	(8.248)
BROKERED DEPOSITS RATIO	1.770	1.034*	1.793	1.005*	1.829	1.017*
	(0.642)	(1.859)	(0.645)	(1.882)	(0.652)	(1.706)
UNUSED COMMITMENTS RATIO	0.069*	0.046*	0.069*	0.043*	0.070**	0.049**
	(1.945)	(1.942)	(1.844)	(1.655)	(1.996)	(2.075)
CASH HOLDINGS RATIO	0.014	-0.478	0.072	-0.365	-0.004	-0.527
	(0.017)	(-0.382)	(0.087)	(-0.286)	(-0.004)	(-0.419)
LLA / GTA	66.413***	39.092***	66.501***	39.884***	66.185***	38.881***
	(9.110)	(5.315)	(9.199)	(5.183)	(9.067)	(5.328)
LOAN CONCENTRATION	2.897***	3.292***	2.901***	3.357***	2.878***	3.276***
	(7.117)	(7.567)	(7.105)	(7.862)	(7.016)	(7.560)
B. Size and Safety Net Protection						
LN(GTA)	-0.247***	-0.099	-0.250***	-0.101	-0.250***	-0.107
	(-4.495)	(-1.315)	(-4.529)	(-1.336)	(-4.541)	(-1.400)
SUPERVISOR OCC	0.109	0.043	0.111	0.039	0.112	0.048
	(0.754)	(0.221)	(0.763)	(0.197)	(0.769)	(0.242)
SUPERVISOR FDIC	-0.181	-0.177	-0.181	-0.179	-0.181	-0.175
	(-1.282)	(-0.960)	(-1.287)	(-0.965)	(-1.283)	(-0.947)
C. Bank Ownership						
BHC MEMBER	-0.563***	-0.526***	-0.555***	-0.483***	-0.565***	-0.528***
	(-6.433)	(-4.157)	(-6.350)	(-3.852)	(-6.452)	(-4.170)
PUBLICLY LISTED	-1.027***	-1.273***	-1.019***	-1.256***	-1.025***	-1.268***
	(-6.045)	(-6.057)	(-6.007)	(-5.974)	(-6.037)	(-6.049)
FOREIGN OWNERSHIP	-0.556	-0.680	-0.560	-0.621	-0.562	-0.685
	(-0.926)	(-0.999)	(-0.916)	(-0.894)	(-0.936)	(-1.005)
D. Organizational Structure						
BRANCHES / GTA	-3.492	-4.834	-3.540	-4.466	-3.664	-5.231
	(-1.354)	(-1.221)	(-1.368)	(-1.132)	(-1.417)	(-1.299)
LN (NUMBER STATES)	1.437***	1.571***	1.412***	1.534***	1.429***	1.568***
	(4.361)	(4.914)	(4.270)	(4.802)	(4.320)	(4.876)
E. Competition						
HHI DEPOSITS	1.106**	2.238***	1.081**	2.259***	1.102**	2.251***
	(2.235)	(3.571)	(2.156)	(3.519)	(2.224)	(3.584)
PERCENT METROPOLITAN	0.623***	0.570***	0.638***	0.592***	0.627***	0.576***
	(5.921)	(3.606)	(6.054)	(3.737)	(5.955)	(3.651)
F. Local Economic Conditions						
CHANGE COINCIDENT INDEX	-0.718***	-1.310***	-0.714***	-1.347***	-0.719***	-1.315***
	(-7.425)	(-6.826)	(-7.424)	(-7.016)	(-7.442)	(-6.854)
HOUSE PRICE INFLATION	-0.183***	-0.155**	-0.184***	-0.144**	-0.183***	-0.153**
	(-3.282)	(-2.222)	(-3.310)	(-2.092)	(-3.289)	(-2.198)
CONSTANT	-0.917	-1.843*	-1.450	-3.668***	-0.697	-1.458
	(-1.036)	(-1.701)	(-1.636)	(-3.477)	(-0.760)	(-1.303)
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	48,532	40,067	48,532	40,067	48,532	40,067
PSEUDO R^2	0.288	0.294	0.287	0.284	0.289	0.295

Table 3 - How Do Cost and Profit Efficiency during Normal Times Impact Bank Risk During Financial Crises? (All Crises)

This table reports estimates from regression estimates for analyzing how does cost and profit efficiency during normal times impact bank risk during financial crises. Panel A presents the estimates using minimal controls, while Panel B presents the results using all controls. The dependent variables are as follows: *LN(ZSCORE)* is the log of the sum of a bank's mean *ROA* (net income over GTA) and mean *CAPITAL RATIO* (equity capital over GTA) divided by *σROA* (the volatility of ROA), where the means of the components are calculated over the crises periods. *σROA* is the volatility of return on assets *ROA* over the crises periods. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA. *CASH HOLDINGS RATIO* is cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

Panel A – Risk with Minimal Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*
Independent Variables & Regression Method	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics						
COSTEFF	0.309***	-0.003***			0.319***	-0.003***
	(5.864)	(-4.057)			(6.057)	(-4.179)
PROFITEFF			-0.063*	0.000	-0.082**	0.000
			(-1.763)	(0.639)	(-2.291)	(1.008)
COST IMPROVEMENTS	0.165***	-0.001***	0.110***	-0.001***	0.178***	-0.002***
	(10.620)	(-7.854)	(9.112)	(-7.501)	(11.232)	(-8.496)
PROFIT IMPROVEMENTS	0.043***	-0.000***	0.041***	-0.000***	0.020*	-0.000**
	(5.449)	(-4.697)	(3.550)	(-3.434)	(1.719)	(-2.069)
CONSTANT	2.444***	0.012***	2.685***	0.010***	2.488***	0.012***
	(57.045)	(21.451)	(84.915)	(24.293)	(51.652)	(18.028)
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	35,150	35,151	35,150	35,151	35,150	35,151
ADJ. R^2	0.141	0.041	0.140	0.041	0.141	0.041

Panel B – Risk with All Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*
Independent Variables & Regression Method	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics						
COSTEFF	0.249***	-0.003***			0.256***	-0.003***
	(4.907)	(-4.027)			(5.039)	(-3.977)
PROFITEFF			-0.040	-0.001	-0.054	-0.000
			(-1.115)	(-1.405)	(-1.526)	(-1.100)
COST IMPROVEMENTS	0.145***	-0.001***	0.099***	-0.001***	0.154***	-0.001***
	(9.913)	(-7.445)	(8.613)	(-5.763)	(10.270)	(-7.228)

PROFIT IMPROVEMENTS	0.033***	-0.000	0.034***	-0.000***	0.017	-0.000**
	(4.330)	(-1.537)	(3.142)	(-3.449)	(1.608)	(-2.170)
Other Bank Characteristics:						
A. Risk and Opacity						
CAPITAL RATIO	1.135***	0.018***	1.175***	0.018***	1.148***	0.019***
	(8.472)	(9.480)	(8.783)	(9.335)	(8.577)	(9.473)
TOTAL LOANS / GTA	-0.392***	0.002***	-0.393***	0.002***	-0.391***	0.002***
	(-5.987)	(2.823)	(-6.011)	(2.846)	(-5.981)	(2.827)
COMMERCIAL RE RATIO	-1.091***	0.010***	-1.085***	0.010***	-1.087***	0.010***
	(-12.140)	(6.685)	(-12.080)	(6.684)	(-12.103)	(6.701)
BROKERED DEPOSITS RATIO	-2.012**	0.021*	-2.002**	0.021*	-2.010**	0.021*
	(-2.007)	(1.947)	(-2.011)	(1.945)	(-2.009)	(1.944)
UNUSED COMMITMENTS RATIO	-0.012	0.000	-0.011	0.000	-0.012	0.000
	(-1.102)	(0.666)	(-1.077)	(0.663)	(-1.089)	(0.674)
CASH HOLDINGS RATIO	-1.063***	0.003*	-1.078***	0.003*	-1.064***	0.003*
	(-7.275)	(1.709)	(-7.378)	(1.803)	(-7.276)	(1.707)
LLA / GTA	-28.796***	0.329***	-28.924***	0.330***	-28.844***	0.329***
	(-13.809)	(9.340)	(-13.826)	(9.340)	(-13.812)	(9.325)
LOAN CONCENTRATION	-0.955***	0.016***	-0.962***	0.016***	-0.955***	0.016***
	(-9.623)	(10.691)	(-9.734)	(10.739)	(-9.633)	(10.686)
B. Size and Safety Net Protection						
LN(GTA)	0.137***	-0.001***	0.137***	-0.001***	0.137***	-0.001***
	(15.351)	(-8.027)	(15.320)	(-8.075)	(15.277)	(-8.041)
SUPERVISOR OCC	-0.048**	0.000	-0.048**	0.000	-0.048*	0.000
	(-1.964)	(0.217)	(-1.962)	(0.241)	(-1.947)	(0.229)
SUPERVISOR FDIC	-0.009	-0.001	-0.008	-0.001	-0.009	-0.001
	(-0.393)	(-1.582)	(-0.356)	(-1.601)	(-0.388)	(-1.579)
C. Bank Ownership						
BHC MEMBER	0.122***	-0.001***	0.121***	-0.001***	0.122***	-0.001***
	(7.012)	(-4.847)	(6.966)	(-4.827)	(7.001)	(-4.854)
PUBLICLY LISTED	0.074***	0.000	0.071***	0.000	0.074***	0.000
	(2.989)	(0.947)	(2.846)	(1.045)	(2.974)	(0.935)
FOREIGN OWNERSHIP	-0.356***	0.004***	-0.355***	0.004***	-0.357***	0.004***
	(-3.827)	(2.842)	(-3.814)	(2.826)	(-3.834)	(2.838)
D. Organizational Structure						
BRANCHES / GTA	-2.308***	0.001	-2.341***	0.001	-2.331***	0.001
	(-6.105)	(0.224)	(-6.189)	(0.199)	(-6.173)	(0.174)
LN (NUMBER STATES)	-0.550***	0.004***	-0.547***	0.004***	-0.550***	0.004***
	(-9.605)	(4.556)	(-9.537)	(4.527)	(-9.596)	(4.559)
E. Competition						
HHI DEPOSITS	-0.342***	0.003***	-0.342***	0.003***	-0.343***	0.003***
	(-3.622)	(2.775)	(-3.618)	(2.765)	(-3.625)	(2.771)
PERCENT METROPOLITAN	-0.187***	0.001***	-0.188***	0.001***	-0.186***	0.001***
	(-10.031)	(3.824)	(-10.098)	(3.931)	(-10.000)	(3.843)
F. Local Economic Conditions						
CHANGE COINCIDENT INDEX	0.369***	-0.003***	0.367***	-0.003***	0.370***	-0.003***
	(10.690)	(-6.701)	(10.641)	(-6.658)	(10.705)	(-6.697)
HOUSE PRICE INFLATION	-0.001	0.001***	-0.001	0.001***	-0.001	0.001***
	(-0.078)	(3.385)	(-0.074)	(3.387)	(-0.074)	(3.389)
CONSTANT	1.887***	0.010***	2.078***	0.008***	1.920***	0.010***
	(14.566)	(6.143)	(16.144)	(5.452)	(14.373)	(6.119)
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	35,150	35,151	35,150	35,151	35,150	35,151
ADJ. R^2	0.211	0.101	0.210	0.101	0.211	0.101

Table 4 - How Do Cost and Profit Efficiency during Normal Times Impact Bank Profitability during Financial Crises? (All Crises)

This table reports estimates from regression estimates for analyzing how does cost and profit efficiency during normal times impact bank profitability during financial crises. Panel A presents the estimates using minimal controls, while Panel B presents the results using all controls. The dependent variables are as follows: *ROA* is the bank return on assets over the crises periods. *ROE* is the bank return on equity over the crises periods. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA. *CASH HOLDINGS RATIO* is cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

Panel A – Profitability with Minimal Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*ROA*	*ROE*	*ROA*	*ROE*	*ROA*	*ROE*
Independent Variables & Regression Method	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics						
COSTEFF	0.002***	0.019***			0.002***	0.020***
	(3.274)	(3.095)			(3.520)	(3.354)
PROFITEFF			-0.001***	-0.012***	-0.002***	-0.014***
			(-2.839)	(-2.974)	(-3.122)	(-3.256)
COST IMPROVEMENTS	0.002***	0.015***	0.001***	0.013***	0.002***	0.018***
	(9.397)	(9.661)	(9.401)	(9.469)	(10.566)	(10.848)
PROFIT IMPROVEMENTS	0.001***	0.007***	0.001***	0.005***	0.000***	0.003***
	(8.656)	(8.137)	(3.965)	(3.807)	(2.578)	(2.580)
CONSTANT	0.004***	0.049***	0.006***	0.069***	0.004***	0.056***
	(6.759)	(10.588)	(15.354)	(20.458)	(7.424)	(10.852)
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	48,532	48,532	48,532	48,532	48,532	48,532
ADJ. R^2	0.047	0.060	0.047	0.060	0.047	0.060

Panel B – Profitability with All Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*ROA*	*ROE*	*ROA*	*ROE*	*ROA*	*ROE*
Independent Variables & Regression Method	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics						
COSTEFF	0.002***	0.023***			0.002***	0.024***
	(3.712)	(4.145)			(3.846)	(4.275)
PROFITEFF			-0.001	-0.005	-0.001*	-0.006
			(-1.402)	(-1.284)	(-1.702)	(-1.632)
COST IMPROVEMENTS	0.001***	0.014***	0.001***	0.009***	0.002***	0.015***
	(8.586)	(9.532)	(6.977)	(7.428)	(9.154)	(10.010)

PROFIT IMPROVEMENTS	0.001***	0.005***	0.000***	0.005***	0.000**	0.003***
	(6.023)	(6.033)	(3.770)	(4.277)	(2.318)	(2.774)
Other Bank Characteristics:						
A. Risk and Opacity						
CAPITAL RATIO	-0.023***	-0.218***	-0.023***	-0.215***	-0.023***	-0.217***
	(-7.336)	(-13.583)	(-7.202)	(-13.349)	(-7.261)	(-13.472)
TOTAL LOANS / GTA	-0.007***	-0.045***	-0.007***	-0.045***	-0.007***	-0.045***
	(-7.406)	(-6.084)	(-7.409)	(-6.096)	(-7.396)	(-6.076)
COMMERCIAL RE RATIO	-0.013***	-0.118***	-0.013***	-0.117***	-0.013***	-0.117***
	(-10.186)	(-11.192)	(-10.148)	(-11.140)	(-10.166)	(-11.160)
BROKERED DEPOSITS RATIO	-0.021**	-0.187**	-0.021**	-0.187**	-0.021**	-0.187**
	(-1.973)	(-2.017)	(-1.977)	(-2.022)	(-1.976)	(-2.020)
UNUSED COMMITMENTS RATIO	0.000**	0.002***	0.000**	0.002***	0.000**	0.002***
	(2.411)	(2.613)	(2.451)	(2.658)	(2.429)	(2.631)
CASH HOLDINGS RATIO	-0.003*	-0.024	-0.003*	-0.025	-0.003*	-0.024
	(-1.725)	(-1.434)	(-1.777)	(-1.484)	(-1.723)	(-1.432)
LLA / GTA	-0.233***	-3.525***	-0.234***	-3.535***	-0.234***	-3.529***
	(-5.328)	(-11.716)	(-5.357)	(-11.746)	(-5.343)	(-11.731)
LOAN CONCENTRATION						
	-0.007***	-0.075***	-0.007***	-0.076***	-0.007***	-0.075***
B. Size and Safety Net Protection	(-5.632)	(-7.317)	(-5.697)	(-7.401)	(-5.639)	(-7.324)
LN(GTA)	0.001***	0.013***	0.001***	0.013***	0.001***	0.013***
	(8.518)	(12.058)	(8.510)	(12.053)	(8.478)	(12.016)
SUPERVISOR OCC	0.001**	0.002	0.001**	0.002	0.001**	0.002
	(2.304)	(0.818)	(2.297)	(0.806)	(2.321)	(0.835)
SUPERVISOR FDIC	0.002***	0.009***	0.002***	0.009***	0.002***	0.009***
	(4.476)	(3.350)	(4.492)	(3.368)	(4.483)	(3.357)
C. Bank Ownership						
BHC MEMBER	0.002***	0.030***	0.002***	0.029***	0.002***	0.030***
	(8.726)	(14.500)	(8.680)	(14.449)	(8.718)	(14.495)
PUBLICLY LISTED	0.001***	0.024***	0.001***	0.024***	0.001***	0.024***
	(5.372)	(9.673)	(5.261)	(9.570)	(5.349)	(9.653)
FOREIGN OWNERSHIP	-0.004***	-0.051***	-0.004***	-0.051***	-0.004***	-0.051***
	(-3.612)	(-5.223)	(-3.611)	(-5.217)	(-3.621)	(-5.231)
D. Organizational Structure						
BRANCHES / GTA	-0.042***	-0.233***	-0.042***	-0.236***	-0.042***	-0.235***
	(-7.348)	(-4.896)	(-7.399)	(-4.959)	(-7.390)	(-4.943)
LN (NUMBER STATES)	-0.004***	-0.047***	-0.004***	-0.046***	-0.004***	-0.047***
	(-5.860)	(-7.570)	(-5.827)	(-7.527)	(-5.857)	(-7.565)
E. Competition						
HHI DEPOSITS	0.002	0.021*	0.002	0.021*	0.002	0.021*
	(1.480)	(1.714)	(1.490)	(1.726)	(1.476)	(1.710)
PERCENT METROPOLITAN	-0.004***	-0.041***	-0.004***	-0.041***	-0.004***	-0.041***
	(-16.091)	(-17.396)	(-16.135)	(-17.450)	(-16.066)	(-17.382)
F. Local Economic Conditions						
CHANGE COINCIDENT INDEX	0.006***	0.079***	0.006***	0.079***	0.006***	0.079***
	(16.430)	(24.257)	(16.390)	(24.213)	(16.432)	(24.259)
HOUSE PRICE INFLATION	0.001***	0.007***	0.001***	0.007***	0.001***	0.007***
	(4.744)	(5.880)	(4.753)	(5.887)	(4.752)	(5.887)
CONSTANT	0.003*	0.004	0.005***	0.024*	0.004**	0.008
	(1.746)	(0.296)	(2.936)	(1.655)	(1.992)	(0.555)
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	48,532	48,532	48,532	48,532	48,532	48,532
ADJ. R^2	0.126	0.179	0.126	0.179	0.126	0.179

Table 5: Do Cost and Profit Efficiency Affect Bank Failure, Risk, and Profitability during Financial Crises? – Banking Crises and Market Crises Results

This table reports estimates from regression estimates for analyzing how cost and profit efficiency affect bank failure, risk, and profitability during banking crises and market crises. The dependent variables are: *FAILED1* and *FAILED2* for bank failure, *LN(ZSCORE)* and *σROA* for bank risk, and *ROA* and *ROE* for bank profitability. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA *CASH HOLDINGS RATIO* is total bank cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Performance Indicator	**FAILURE**				**RISK**				**PROFITABILITY**			
Subsample	Banking Crises		Market Crises		Banking Crises		Market Crises		Banking Crises		Market Crises	
Dependent Variable	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*	*ROA*	*ROE*	*ROA*	*ROE*
Independent Variables & Regression Method	LOGIT	LOGIT	LOGIT	LOGIT	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics												
COSTEFF	-1.533***	-3.525***	1.059	1.480	0.410***	-0.005***	0.228**	0.000	0.002**	0.033***	0.007***	0.050***
	(-3.922)	(-6.837)	(0.835)	(0.369)	(5.419)	(-4.292)	(2.188)	(0.125)	(2.364)	(4.392)	(3.750)	(3.699)
PROFITEFF	-0.365	-0.666*	0.020	1.773	-0.017	-0.001	-0.122*	0.000	-0.001	-0.008	0.000	0.001
	(-1.389)	(-1.898)	(0.030)	(0.884)	(-0.327)	(-1.238)	(-1.646)	(0.288)	(-1.318)	(-1.462)	(0.228)	(0.151)
PROP OF COSTEFF INCREASES	-0.896***	-2.060***	0.509	1.118	0.145***	-0.001***	0.206***	0.000	0.001***	0.016***	0.004***	0.035***
	(-6.116)	(-9.935)	(0.628)	(0.486)	(8.658)	(-6.599)	(3.035)	(0.050)	(8.205)	(9.730)	(3.510)	(3.848)
PROP OF PROFITEFF INCREASES	-0.277***	-0.599***	-0.020	0.749	0.020	-0.000	-0.051	0.000	0.000*	0.002	0.001	0.008
	(-2.583)	(-3.281)	(-0.051)	(0.649)	(1.601)	(-1.389)	(-1.131)	(0.161)	(1.815)	(1.603)	(1.399)	(1.394)
OTHER BANK CHARACTERISTICS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	19,066	19,066	29,172	20,826	18,990	18,990	16,160	16,161	19,066	19,066	29,466	29,466
PSEUDO R^2 / ADJ. R^2	0.197	0.223	0.497	0.300	0.159	0.104	0.114	0.057	0.153	0.188	0.130	0.192

Table 6: Robustness – Excluding Too-Big-to-Fail Institutions

This table reports estimates from regression estimates for analyzing how does cost and profit efficiency during normal times impact bank performance (failure, risk, and profitability) during financial crises when excluding the too-big-to-fail banks defined in two different ways: GTA greater or equal to 50 Billion and top 19 banks as per GTA in each time period. The dependent variable for failure are: *FAILED1* and *FAILED2*. The dependent variables for bank risk are: bank *LN(ZSCORE)* and *σROA*. The dependent variables for bank profitability are: *ROA* and *ROE*. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA. *CASH HOLDINGS RATIO* is total bank cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Performance Indicator	**FAILURE**				**RISK**				**PROFITABILITY**			
Test	Excluding Banks with GTA ≥ 50 Billion		Excluding top 19 banks (per GTA) in each time period		Excluding Banks with GTA ≥ 50 Billion		Excluding top 19 banks (per GTA) in each time period		Excluding Banks with GTA ≥ 50 Billion		Excluding top 19 banks (per GTA) in each time period	
Dependent Variable	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*	*ROA*	*ROE*	*ROA*	*ROE*
Independent Variables & Regression Method	LOGIT	LOGIT	LOGIT	LOGIT	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics												
COSTEFF	-1.191***	-3.447***	-1.177***	-3.404***	0.258***	-0.003***	0.259***	-0.003***	0.002***	0.024***	0.002***	0.024***
	(-3.569)	(-6.922)	(-3.531)	(-6.852)	(5.076)	(-3.908)	(5.108)	(-3.928)	(3.800)	(4.241)	(3.789)	(4.223)
PROFITEFF	-0.368	-0.657*	-0.382	-0.692**	-0.053	-0.000	-0.053	-0.000	-0.001*	-0.006	-0.001*	-0.006
	(-1.561)	(-1.909)	(-1.621)	(-2.005)	(-1.499)	(-1.063)	(-1.509)	(-1.047)	(-1.683)	(-1.596)	(-1.686)	(-1.623)
PROP OF COSTEFF INCREASES	-0.804***	-2.010***	-0.800***	-1.993***	0.154***	-0.001***	0.155***	-0.001***	0.002***	0.015***	0.002***	0.015***
	(-5.753)	(-9.982)	(-5.733)	(-9.947)	(10.295)	(-7.234)	(10.313)	(-7.251)	(9.130)	(9.993)	(9.096)	(9.901)
PROP OF PROFITEFF INCREASES	-0.291***	-0.611***	-0.294***	-0.620***	0.017	-0.000**	0.017	-0.000**	0.000**	0.003***	0.000**	0.003***
	(-2.846)	(-3.401)	(-2.874)	(-3.451)	(1.600)	(-2.187)	(1.608)	(-2.170)	(2.343)	(2.811)	(2.362)	(2.856)
OTHER BANK CHARACTERISTICS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	48,455	40,002	48,437	39,991	35,084	35,085	35,074	35,075	48,455	48,455	48,437	48,437
PSEUDO R^2 / ADJ. R^2	0.292	0.299	0.292	0.298	0.211	0.101	0.211	0.101	0.126	0.179	0.126	0.180

Table 7: Robustness – Controlling for Cost-to-Income

This table reports estimates from regression estimates for analyzing how does cost and profit efficiency during normal times impact bank performance (failure, risk, and profitability) during financial crises when controlling for *COST-TO-INCOME*. The dependent variable for failure is *FAILED1* and *FAILURE2*. The dependent variables for bank risk are: bank *LN(ZSCORE)* and *σROA*. The dependent variables for bank profitability are: *ROA* and *ROE*. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA. *CASH HOLDINGS RATIO* is total bank cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Performance Indicator	**FAILURE**		**RISK**		**PROFITABILITY**	
Dependent Variable	*FAILED1*	*FAILED2*	*LN(ZSCORE)*	*σROA*	*ROA*	*ROE*
Independent Variables & Regression Method	LOGIT	LOGIT	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics						
COSTEFF	-1.182***	-3.367***	0.256***	-0.003***	0.002***	0.024***
	(-3.555)	(-6.848)	(5.038)	(-3.978)	(3.842)	(4.270)
PROFITEFF	-0.370	-0.645*	-0.054	-0.000	-0.001*	-0.006
	(-1.577)	(-1.905)	(-1.525)	(-1.099)	(-1.699)	(-1.627)
PROP OF COSTEFF INCREASES	-0.803***	-1.983***	0.154***	-0.001***	0.002***	0.015***
	(-5.764)	(-10.035)	(10.269)	(-7.229)	(9.150)	(10.005)
PROP OF PROFITEFF INCREASES	-0.287***	-0.590***	0.017	-0.000**	0.000**	0.003***
	(-2.827)	(-3.385)	(1.608)	(-2.169)	(2.323)	(2.781)
COST-TO-INCOME	-0.000	-0.000	0.000	0.000	0.000*	0.000*
	(-0.384)	(-0.013)	(0.314)	(0.245)	(1.851)	(1.660)
OTHER BANK CHARACTERISTICS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	48,532	40,067	35,150	35,151	48,532	48,532
PSEUDO R^2 / ADJ. R^2	0.289	0.295	0.211	0.101	0.126	0.179

Table 8: A Deeper Analysis of the Cost Efficiency Findings

This table reports estimates from regression estimates for analyzing how does cost and profit efficiency during normal times impact bank performance (failure, risk and profitability) for banks with Good Management (*Enforcement Actions against Management* = 0) versus banks with Bad Management (*Enforcement Actions against Management* > 0) in columns (1)-(12), and how cost and profit efficiency during normal times affect bank loan performance (*NPL/TL* and *LLA/GTA*) during financial crises in columns (13)-(14). The dependent variable for failure are *FAILED1* and *FAILED2*. The dependent variables for bank risk are: bank *LN(ZSCORE)* and *σROA*. The dependent variables for bank profitability are: *ROA* and *ROE*. All independent variables are measured as averages over the pre-crisis periods. The key explanatory variables are cost efficiency *COSTEFF* and Profit efficiency *PROFITEFF*. *COST IMPROVEMENTS* is the proportion of cost efficiency increases. *PROFIT IMPROVEMENTS* is the proportion of profit efficiency increases. *LN(GTA)* is bank size calculated as the natural log of GTA.*CAPITAL RATIO* is bank capitalization, defined as the bank's total equity divided by GTA. *TOTAL LOANS / GTA* is the ratio of total loans to GTA. *BHC MEMBER* is a dummy variable that equals one if the bank was part of a bank holding company at any time in the pre-crisis period. *COMMERCIAL RE RATIO* is the commercial real estate loans divided by GTA. *SUPERVISOR_OCC* and *SUPERVISOR_FDIC* are dummies that equal 1 if the OCC and FDIC are the primary supervisor of the bank, respectively; both dummies are used in regressions (left out category: *SUPERVISOR_FRS*). *FOREIGN OWNERSHIP* is a dummy equal to 1 if a bank has 50% or more foreign ownership. *BROKERED DEPOSITS RATIO* is brokered deposits divided by GTA. *UNUSED COMMITMENTS RA*TIO is unused commitments divided by GTA. *CASH HOLDINGS RATIO* is total bank cash holdings divided by GTA. *LLA / GTA* is loan loss allowance divided by GTA. *HHI DEPOSITS* is the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present. *PERCENT METROPOLITAN* is the percentage of bank deposits in metropolitan markets (MSAs and CBSAs) as a fraction of deposits in all markets in which a bank is active. *BRANCHES / GTA* is a measure of bank organizational complexity calculated as (ratio of the number of branches the bank has active over GTA) x 1000. *LN (NUMBER STATES)* is the natural log of the number of states in which bank has branches. *PUBLICLY LISTED* is a dummy equal to 1 if a bank is listed or is part of a BHC that is listed on a stock exchange. *CHANGE COINCIDENT INDEX* is the weighted average of the changes in the Philadelphia Federal Reserve's state coincident indexes with the share of the deposits of a given bank taken as weights. *HOUSE PRICE INFLATION* is the weighted average growth in a state-level house price index with the share of the deposits of a given bank taken as weights. *LOAN CONCENTRATION* is a bank's loan portfolio concentration is measured as a Herfindahl-Hirschman Index (HHI) of the following six loan categories: commercial real estate, residential real estate, construction and industrial, consumer, agriculture, and other loans. All variables are defined in Table 1. *, **, and *** denote significance at 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Performance Indicator	**FAILURE**				**RISK**				**PROFITABILITY**				**OTHER MEASURES**	
Subsample	Good Management (*Enforcement Actions against Management* = 0)		Bad Management (*Enforcement Actions against Management* >0)		Good Management (*Enforcement Actions against Management* = 0)		Bad Management (*Enforcement Actions against Management* >0)		Good Management (*Enforcement Actions against Management* = 0)		Bad Management (*Enforcement Actions against Management* >0)		Testing the *Cost Skimping Hypothesis*	
Dependent Variable	*FAILED1*	*FAILED2*	*FAILED1*	*FAILED2*	*LN(ZSCORE)*	*σROA*	*LN(ZSCORE)*	*σROA*	*ROA*	*ROE*	*ROA*	*ROE*	*NPL/TL*	*LLA/GTA*
Independent Variables & Regression Method	LOGIT	LOGIT	LOGIT	LOGIT	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Key Independent Variables and Basic Characteristics														
COSTEFF	-1.215***	-3.562***	2.013	6.085	0.254***	-0.003***	0.436	-0.006	0.002***	0.024***	-0.007	-0.075	-0.002***	-0.0003**
	(-3.581)	(-6.928)	(0.593)	(1.139)	(4.962)	(-3.885)	(0.706)	(-0.593)	(3.800)	(4.220)	(-1.087)	(-1.377)	(-2.874)	(-2.017)
PROFITEFF	-0.366	-0.592*	0.775	0.673	-0.065*	-0.000	-0.343	0.001	-0.001*	-0.008*	-0.001	0.007	0.000	0.0001
	(-1.531)	(-1.714)	(0.404)	(0.252)	(-1.824)	(-0.884)	(-1.049)	(0.167)	(-1.891)	(-1.885)	(-0.182)	(0.200)	(0.570)	(1.256)
PROP OF COSTEFF INCREASES	-0.816***	-2.111***	1.315	4.499	0.155***	-0.001***	0.237	-0.002	0.002***	0.016***	-0.006	-0.070*	-0.001***	-0.0002***
	(-5.751)	(-10.006)	(0.494)	(1.287)	(10.314)	(-7.288)	(0.546)	(-0.348)	(9.221)	(10.106)	(-1.459)	(-1.685)	(-4.291)	(-4.918)
PROP OF PROFITEFF INCREASES	-0.283***	-0.572***	-0.340	-0.535	0.017	-0.000**	-0.361*	0.002	0.000**	0.003***	-0.001	-0.002	-0.000*	0.0000
	(-2.768)	(-3.192)	(-0.306)	(-0.355)	(1.550)	(-2.137)	(-1.705)	(0.563)	(2.226)	(2.626)	(-0.576)	(-0.095)	(-1.675)	(0.068)
OTHER BANK CHARACTERISTICS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
CRISIS FIXED EFFECTS	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
NUMBER OF OBSERVATIONS	47,654	39,477	856	576	34,291	34,292	859	859	47,654	47,654	878	878	48,532	48,532
PSEUDO R^2 / ADJ. R^2	0.297	0.303	0.283	0.343	0.212	0.101	0.222	0.151	0.127	0.181	0.092	0.147	0.246	0.526