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Capital ratios and financial distress: lessons from the crisis

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Overview

The most recent financial crisis has brought into question previous views that capital in the financial sector had been both adequate and adequately regulated. As a result, global regulators are in the process of imposing new capital requirements intended to result in both higher and better quality capital. However, there has been little evidence presented publicly to date on the impact of bank capital in mitigating financial distress reflecting what has been learned from the recent crisis itself. This paper attempts to contribute to the discussion by offering such evidence. Specifically, our analysis of bank distress during the credit and liquidity crisis of 2007 to 2009 suggests that the tangible common equity to risk-weighted assets ratio (or TCE to RWA) was the strongest predictor of future bank distress (with a Gini coefficient of 0.42) of the commonly measured capital ratios, and appears to be a significantly better predictor than other traditional risk-based measures of capital, including Tier 1 capital to RWA (Gini coefficient of 0.27) and Tier 1 capital plus Tier 2 capital to RWA (Gini coefficient of 0.26).

Further analysis suggests that while simple measures of leverage have some predictive power in isolation (Gini coefficients of 0.09 to 0.25, in all cases markedly lower than corresponding risk-based capital alternative), they do not appear to have any incremental predictive power in addition to the TCE to RWA ratio. That is, based on this analysis, imposing a leverage requirement on institutions already subject to a risk-based capital requirement appears to provide no further benefit.

Overall, an increase in the TCE / RWA ratio to 6.5 to 7.5 percent would have affected approximately 58 to 83 percent of banks that ultimately became distressed, at a cost of $280 billion to $540 billion in incremental capital raised and a reduction of 140 to 260 b.p. in ROE, all other things being equal. Setting higher minimum ratios than 7.5 percent has substantially diminished marginal benefits in terms of the incremental number of distressed banks that would have been affected and does so at sharply higher incremental costs.

Context and observations

Regulators and policymakers worldwide have proposed raising minimum capital requirements and limiting leverage for financial institutions in response to the 2007-2009 banking crisis. For example, the Group of Twenty (G-20) finance ministers and central bank governors, representing 85 percent of global GDP, 80 percent of world trade, and 65 percent of the world's population, articulated the intent in September 2009:

> We commit to developing by end-2010 . . . rules to improve both the quantity and quality of bank capital and to discourage excessive leverage . . . with the aim of implementation by end-2012. [These rules will include] national implementation of higher level and better quality capital requirements, counter-cyclical capital buffers, higher capital requirements for risky products and off-balance sheet activities. . . . We support the introduction of a leverage ratio as a supplementary measure . . . .

Agendas such as these raise several key questions in the path forward to reforming financial institution supervision:

1. To what extent have capital and leverage ratios been related to the banking crises and the distress of financial institutions?

2. What types of capital ratios (e.g., tangible common equity, Tier 1 capital, Tier 1 plus Tier 2 capital) are most likely to reduce the probability of financial distress?

3. Have higher leverage ratios (lower total assets to capital)[1] also been associated with a lower likelihood of financial distress, after accounting for the relationship between leverage ratios and capital ratios? Which ratio has been more predictive of distress – capital or leverage? What is the incremental benefit of imposing both requirements?

While increased capital ratios are widely believed to provide an additional margin of safety to the banking system, providing a larger capital cushion to absorb potential losses, some observers have noted that requiring higher capital and leverage ratios may have unintended consequences, ranging from higher borrowing costs for end users of credit, to reduced rates of return on equity for banks and, in the extreme, to a reduction in investor appetite as suppliers of that equity. In addition, while regulators and policymakers have been united in their desire to increase capital requirements and minimum leverage ratios, there have been few specifics about exactly "how high is high enough" for minimum ratios. There has also been near unanimous support for "higher quality" capital, but modest recent evidence favoring this view.

In this paper, we bring new evidence and data to bear on the question of whether higher capital and leverage ratios are related to the chances of bank distress, as well as what kind of capital and how much capital. We perform an analysis of what happened during the 2007-2009 global banking crisis, particularly how institutions fared over this period based upon how much and what type of capital they had at the beginning of the crisis. We draw implications from this evidence for the current situation.

Our analysis has its limitations – primarily it is an observational study based on historical data and not a controlled experiment (e.g., randomly requiring different financial institutions to hold different capital levels and then seeing what happens). As a result, the analysis does not definitively reveal how institutions could be expected to perform in the future if minimum capital ratios were changed. However, we believe the results from this paper provide valuable insights about the role of capital in banking distress.

Our analysis has enabled the following observations.

1. In the 2007-2009 crisis, institutions with higher capital and with higher leverage ratios pre-crisis have had less chance of becoming distressed during the crisis. Our findings on recent distress rates are also supported by previous work on U.S. bank distress during the banking crisis in 1989-93 (e.g., Estrella, Park, and Peristiani, 2000).

2. Capital ratios based on higher-quality forms of capital (e.g., TCE, Tier 1) have been more important predictors of bank distress than ratios based on broader measures of regulatory capital (Tier 1 plus Tier 2).

[1] For the purpose of this analysis, we defined the leverage ratio as the ratio of capital to total assets; higher ratios thus indicate more capital relative to total assets.

3. TCE to risk-weighted assets (RWA) is the most predictive of the ratios we examined, and the data suggests that this ratio is a significantly better predictor than the second best – the ratio of Tier 1 to RWA. Higher minimum TCE to RWA ratios, at levels near 6.5 to 7.5 percent, would have affected 58 to 83 percent of institutions that later became distressed. In order to increase capital ratios to these thresholds, $280 billion to $540 billion in incremental capital would have been required (measured relative to the capital position of banks as of December 31, 2007), reducing bank ROEs by 140 to 260 basis points, all other things being equal.

4. While leverage ratios on a stand-alone basis are related to the probability of distress, they do not appear to provide any additional information about the likelihood of future bank distress over and above what is already contained in the risk-based capital ratios.

Methodology and data

We analyzed the global banking crisis of 2007-2009 to identify the relationships that different types of capital and capital ratios have to bank distress. We have attempted to establish the link between banking distress and capital by looking at capital and capital ratios of financial institutions before the start of the crisis and examining what happened during the crisis.

Our approach was to examine individual bank balance sheets including their level and composition of capital as of December 31, 2007, and estimate the relationship between initial capital and leverage ratios with subsequent bank performance. Additionally, we focused our analysis on the largest global banks, whose entry into distress mattered most to the global economy.

In our analysis, we looked at the likelihood of the bank falling into distress (as defined below) in relation to the starting capital ratio and leverage ratios.[2] To compare ratios to one another, we used a statistical metric called the Gini coefficient,[3] which measures how accurate each capital metric is in distinguishing distressed banks from non-distressed banks.

With the ongoing debate on what type of capital ratios are most relevant, we considered a range of ratios that included different types of capital and assets:

1. Tier 1 / RWA
2. TCE / RWA

2 We used logistic regression to estimate the relationship between bank distress and starting capital and leverage ratios.

3 The Gini coefficient is a measure of statistical dispersion and based on the Lorenz curve; it is the ratio of the area that lies between the line of equality and the Lorenz curve over the total area under the line of equality. The Gini coefficient is bounded between zero and one, with zero indicating no better predictiveness than a random variable and one indicating a perfect predictor.

3. (Tier 1 + Tier 2) / RWA
4. Tier 1 / Total assets
5. TCE / Total assets
6. (Tier 1 + Tier 2) / Total assets

We performed the analysis using 115 large global banks (minimum asset size of $30 billion) representing $62.2 trillion in total assets – about 85 percent of developed-market banking assets, and 65 percent of total banking assets worldwide. Broker-dealers specifically were excluded from this analysis as data on risk-weighted assets for such institutions in December 2007 are unavailable.

Capital ratios for the banks in the sample set were determined as of December 31, 2007, to reflect bank capitalization before much of the crisis had occurred. In some cases, when data as of December 31, 2007, was not available, we used data for the point of time nearest to December 31, 2007. Performance of all the banks between January 1, 2008, and November 1, 2009, was used to identify banks that became distressed (as defined below).

Definition of distress

With the objective of determining relationships between capital ratios and bank performance during a financial crisis, we used a broader definition of bank distress than just liquidation or declaration of bankruptcy. During the recent financial crisis, governments intervened massively to support distressed banks. This support came in the form of conservatorships, direct capital infusions, and arranged mergers of distressed banks by healthier institutions. In the absence of such support, many banks may have faced a run on their liabilities and eventually failed. Hence, we deemed a bank to be in distress when one of the following four different conditions was met:

1. Declaration of bankruptcy
2. Government takeover or placement into government receivership
3. Merger under duress with another bank
4. Receipt of a substantial government bailout (defined as total bailout greater than 30 percent of Tier 1 capital as of December 31, 2007).[4]

Using the above definition, a total of 24 banks were considered distressed (21 percent of the sample). These banks had total assets of $18.5 trillion (30 percent of assets in the sample).

[4] We chose 30 percent as the threshold to reflect that, especially in the U.S. and in the initial rounds of TARP, bailouts were supplied to some institutions that were not close to failure, at least as indicated by market measures of distress (such as their CDS or debt spreads). It is arguable that some of these bailed-out institutions would not have reached a point of distress in the absence of a bailout. Thus we choose a threshold to limit our focus to institutions that were bailed out to a substantial degree relative to their starting capital position.

Core results

A relative comparison of the power of the six capital and leverage ratios to predict bank distress was conducted by comparing their respective Gini coefficients. Exhibit 1 shows the Gini coefficient for each of the three capital and three leverage ratios considered.

Exhibit 1

Gini coefficient results for capital and leverage ratio as indicator of bank distress rate

Type of capital	Capital ratio (based on RWA)	Leverage ratio (based on total assets)
TCE	0.42	0.25
Tier 1	0.27	0.19
Tier 1 plus Tier 2	0.26	0.09

Source: McKinsey analysis

Exhibits 2 and 3 (on the following page) show the “gains” chart, which plots the cumulative percentage of distressed banks captured from the banks rank-ordered by the capital ratios. The diagonal line in these exhibits indicates no predictive power (random ordering) and curves over the diagonal indicate higher predictive power.

Our analysis shows that while no capital or leverage ratio is a perfect or near-perfect predictor, stand-alone Gini on some ratios clearly outperformed others: TCE to RWA has the highest predictive power by a substantial margin, followed by Tier 1 and Tier 1 plus Tier 2. Capital and leverage ratios based on Tier 1 plus Tier 2, the broadest measure of capital, displayed the lowest predictive power.

Exhibit 2
Ratios based on RWA

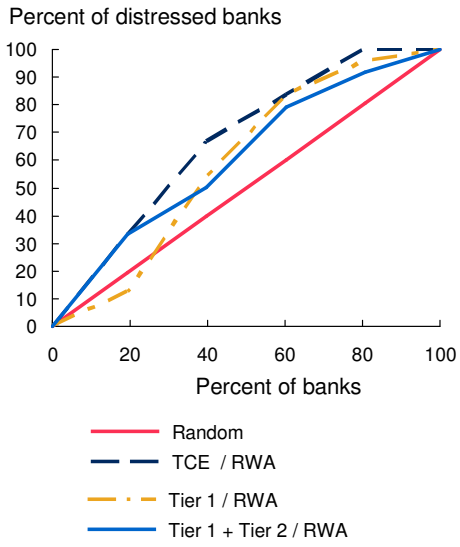
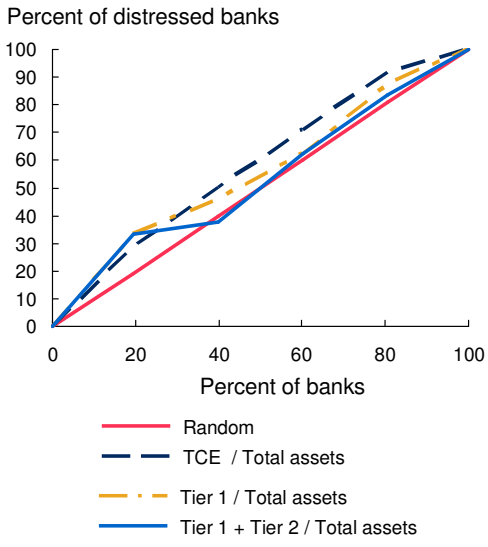


Exhibit 3
Ratios based on total assets



Source: McKinsey analysis

As between the risk-based capital ratios and the leverage ratios, the risk-based capital ratios have proven to be a stronger predictor of future bank distress, showing higher Gini coefficient results than the leverage ratios. This indicates the importance of risk-weighted assets in predicting future distress. Leverage ratios with higher-quality capital (TCE or Tier 1) do have some predictive power as well, but not as much as ratios based on RWA.

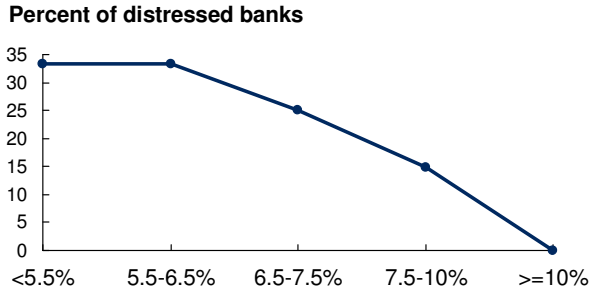
Looking at TCE/RWA as a possible target ratio and focus of regulatory attention, we examine the relationship between this ratio and the rate of bank distress.

Exhibit 4 on the following page plots the distress rates of banks as a function of initial capital ratio defined as TCE / RWA. Banks were grouped by their starting capital ratios, with the buckets determined based on similar number of banks in each bucket (i.e., each bucket has approximately 20-25 observations).[5]

5 The approach is robust to alternative bucketing of the data. Bucketing by equal number of observations gives equadistant intervals of 1 percent up until 7.5 percent. Beyond that, the observations are more dispersed, and so the intervals become wider (2.5 percent).

Exhibit 4

Distress rate among top global banks during credit crisis by different capital ratios



Cumulative % of banks	18%	37%	51%	81%	100%
Cumulative % of banks in distress	29%	58%	83%	100%	100%
Incremental capital required ($ billions)	110	280	540	1,450	1,450
Impact on ROE Basis points	-60	-140	-260	-560	-560

Source: McKinsey analysis

Exhibit 4 indicates that 33 percent of banks with a TCE/RWA ratio of less than 5.5 percent experienced distress, with a declining likelihood of distress as TCE/RWA levels increase above 6.5 percent (falling to 25 percent of banks experiencing distress with a TCE/RWA ratio of 6.5 to 7.5 percent, 15 percent of banks with a TCE/RWA ratio of 7.5 to 10 percent, and 0 percent of banks with a TCE/RWA ratio greater than 10 percent). It also describes the trade-off between lower distress rates from increased capital levels with the resulting reduction in ROE and incremental capital needed. For example, increasing capital requirements for the total global banking industry to a 5.5 percent minimum would have affected 29 percent of banks experiencing distress and would have required an incremental $110 billion in capital and would have reduced industry-wide average ROEs by 60 b.p., ceteris paribus. Increasing the TCE to RWA ratio to a 6.5 percent level would have affected 58 percent of banks experiencing distress; the incremental capital required[6] to increase capital to the 6.5 percent level would be roughly $280 billion, with a decrease in ROE[7] of 140 b.p., ceteris paribus. Increasing the minimum to 7.5 percent would have affected 83 percent of banks experiencing distress, and would have required $540 billion in incremental capital, with a decrease in ROE impact of 260 b.p., ceteris paribus. It is also interesting to note that no

6 Incremental capital required is the estimated amount of additional capital required for all global banks below the maximum capital ratio in the range to reach that level, measured based on the banks' capital position as of December 31, 2007.

7 Estimated impact on ROE is the reduction of ROE based on a higher capital ratio requirements for all banks below that minimum ratio, relative to average banking industry ROEs in 2006-2007, all other things being equal.

distress occurred among the 24 banks with capital ratios above 10 percent in TCE to RWA ratio, but the impact on capital required ($1.45 trillion) and ROEs (a decrease of 560 b.p.) at this level is extraordinarily high.

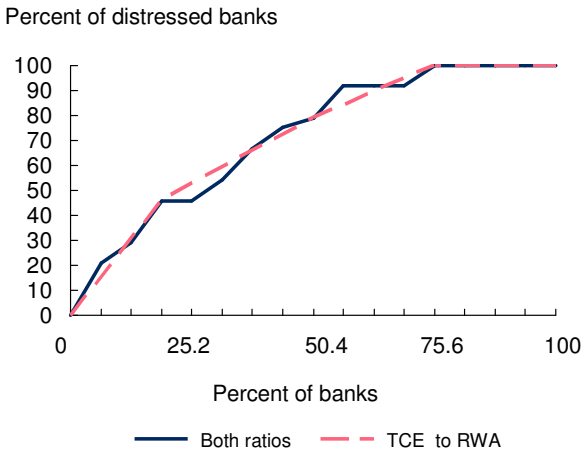
When considering the trade-off between required capital ratios and incremental capital requirements, it is important to consider the substantial capital raising already required to make up for the asset write-downs and credit losses banks have suffered to date and will continue to suffer as losses in asset classes such as commercial real estate loans and consumer credit continue to be realized, offset by pre-provision net revenues. Globally, financial institutions have already raised more than $1.5 trillion in incremental capital since the beginning of the crisis.

Finally, we looked at the results of combining different capital and leverage ratios. We estimated what would be the expected impact on distress rates of setting a combination of both minimum TCE to RWA and TCE to total assets ratios.

In fact, setting minimum ratios on both TCE to RWA and TCE to total assets did not prove to be more effective in reducing distress versus setting limits on TCE to RWA alone. Exhibit 5 shows the cumulative percent of distressed banks against cumulative percent of all banks, comparing the combination of TCE to RWA and TCE to total assets vs. only TCE to RWA.

Exhibit 5

Cumulative proportion of distress avoided



Source: McKinsey analysis

This shows that, among banks with higher TCE to RWA ratios, there is minimal reduction in the distress rate from also requiring a minimum TCE to total assets ratio. We also analyzed the Gini coefficient of a model that combines TCE to RWA with TCE to total assets. The Gini coefficient of this model was 0.42, which is not any better than the Gini coefficient of TCE to RWA alone.

Conclusions and implications

I. The TCE to RWA ratio is the best predictor of future distress

- Tangible common equity to RWA is the best predictor of future distress amount the ratios considered – Tier 1 to RWA and Tier 1 plus Tier 2 to RWA rate a distant second and third, respectively.

Empirically, these ratios have shown the strongest relationship to the onset of future bank distress, with TCE showing a stronger relationship than Tier 1, and in turn Tier 1 showing a marginally stronger relationship than total risk-capital (Tier 1 plus Tier 2). These capital ratios perform better empirically in predicting bank distress when computed as a function of RWA rather than total assets. This suggests that risk-weighting matters and is an important component of capital requirements, and that the current risk weights (although imperfect) add some value over a more brute-force leverage ratio approach.

Intuitively, TCE and Tier 1 capital provide greater potential for loss absorption, because they have greater contractual flexibility for the bank either to eliminate entirely or defer repayment for extended periods of time. In addition, TCE reflects loss-absorption capacity that is available whether the bank remains a going concern or not. In contrast, Tier 2 capital to RWA viewed on a stand-alone basis actually has a weakly positive relationship to future incidence of bank distress. Also intuitively, its loss-absorption benefits are limited if the institution is to be a going concern (i.e., deferral of interest payments on subordinated debt or cumulative dividends on preferred stock may raise concerns of future default and make raising additional common equity more challenging), and may be unavailable in times of severe economic stress (i.e., unrealized gains on securities).

The analysis suggests that the historical focus on combined Tier 1 plus Tier 2 capital has been misplaced due to inadequate loss-absorptiveness of Tier 2 capital (and some components of Tier 1). The analysis may also indicate that banks have successfully arbitraged the capital ratios watched by regulators, which has weakened the ability of the regulatory ratio to measure an institution's riskiness and loss-absorption capacity. In either case, this suggests the need to refocus on targeting capital ratios that are more loss absorbing and harder to arbitrage, and on refining risk weightings to align regulatory capital better with underlying risk.

II. TCE to RWA ratios of 6.5-7.5 percent would have affected most banks that became distressed; higher ratios impose additional costs with minimal benefit

- Maintaining TCE to RWA in the range of 6.5-7.5 percent would have affected 58 to 83 percent of those banks that ultimately became distressed. A minimum TCE to RWA capital ratio set at 6.5 to 7.5 percent would have required, as of December 31, 2007, an additional $280 billion to $540 billion in capital raised, and reduced bank ROEs by 140 to 260 b.p.

It is important to balance the incremental benefits of higher minimum capital requirements against the costs that these requirements impose on financial institutions and on society. A range of 6.5 to 7.5 percent captures a majority of the benefit.

At minimum levels of capital above 7.5 percent TCE to RWA, incremental benefits are relatively low (less than 17 percent of distressed institutions had starting capital ratios above 7.5 percent). But the negative impact on ROE with minimum levels above 7.5 percent is such that banks might have difficulty earning sufficiently high returns to attract the significant incremental capital required to reach these ratios, e.g., at a minimum TCE to RWA capital ratios of 10 percent, industry-wide ROEs would decline by 560 b.p., but an incremental $1.5 trillion in capital would be required. As the industry has already raised $1.5 trillion in capital since 3Q 2007, further capital raising required to reach TCE to RWA ratios well above the 6.5-7.5 percent range may at some point simply be impractical, potentially reducing the resiliency of the banking system.

In addition to the required capital raise and impact on ROEs, there would likely be broader macroeconomic costs. These would include the higher costs of borrowing to end users of capital, the effects of a short-term contraction in the availability of credit, and the potential long-term effects of reduced lending levels, which may result in lower GDP growth. According to several macroeconomic researchers, reduction in credit availability has a negative impact on GDP growth.[8] As articulated in *The Turner Review* (FSA, October 2009), "[t]he optimal level of capital and liquidity in the banking system should reflect an optimizing trade-off between the benefits of reduced financial instability and the costs which may arise from a higher price or reduced volume of credit extension and maturity transformation." This all suggests the need to balance benefits from the reduced likelihood of bank distress with the costs of making the system safer. There remains substantial uncertainty about the incidence of those costs and the extent to which they will be borne by borrowers, by current and future bank shareholders, or perhaps more broadly as a result of a less innovative and less resilient financial services sector.

III. Leverage ratios do not predict bank failures, once capital ratios are taken into account

- Based on the evidence from banks during the crisis, layering minimum leverage ratio on top of higher minimum capital ratio requirements would not provide any meaningful additional benefit in predicting the likelihood of future bank distress.

Based on our analysis, no additional predictive power is contained in the ratio of TCE to total assets that is not already reflected in the ratio of TCE to RWA. Looking at the distress rate as a function of both TCE to total assets and TCE to RWA suggests that imposing minimums on both ratios simultaneously makes little difference, relative to looking only at the TCE to RWA ratio.

8 According to Bayoumi and Melander 2008 (IMF Working Paper), the reduction of 1 percent in credit availability reduces GDP output by 0.36 percent per year based on 1.5 percent reduction over 12 quarters and returning to baseline in 24 quarters. One percentage point decline in domestic non-financial debt (DNFD) growth results in a decline of 0.34 percent of GDP growth in the short run and 0.47 percent in the long run (Greenlaw, 2008).

Thus, a minimum leverage ratio needs to be set based on its other potential advantages and disadvantages. For example, leverage ratios might be considered as a "backstop" for the liability side of the balance sheet to protect against excessively low haircuts in repo financing, which could precipitate a systemic crisis (even on very low-risk assets) if haircuts were increased in a financial panic. Leverage ratios also might be considered as an effective "backstop" to guard against the potential for errors or manipulations in assigning risk weights. The downside of the leverage ratio must also be considered. In the past, it has encouraged banks to conduct regulatory arbitrage – e.g., hold higher-risk assets, move toward off-balance sheet activities – and, when it is the binding constraint, can have the perverse effect of encouraging increased risk-taking.

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