Risk Practice

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Capital ratios and financial distress: lessons from the crisis

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Contents

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Overview

The recent credit and liquidity crisis has brought into question once prevailing views that capital in the financial sector was both adequate and adequately regulated. As a result, global regulators are in the process of imposing new standards that require both a higher amount and a better quality of capital. However, little recent evidence has been presented of the role that bank capital plays in mitigating financial distress. This paper attempts to contribute to the discussion by offering such evidence based on what has been learned from the crisis.

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 (TCE to RWA) at the onset of the crisis was the strongest predictor of future bank distress (with a Gini coeffient of 0.42) among the commonly measured capital ratios. It appears to be a significantly better predictor than other traditional risk-based measures of capital, including Tier 1 capital to RWA (Gini coeffient of 0.27) and Tier 1 capital plus Tier 2 capital to RWA (Gini coeffient of 0.26).

Banks with a TCE to RWA ratio of less than 6.5% to 7.5% accounted for a disproportionate share and the vast majority of distressed banks. Approximately 21% of the largest global banks became distressed during the crisis. Banks with a TCE to RWA ratio of less than 6.5% prior to the depths of the crisis had a distress rate of 33% and made up 58% of distressed banks. Banks with a TCE to RWA ratio of 6.5% to 7.5% had a distress rate of 25% and, together with those with a lower ratio, made up 83% of all distressed banks. In order for banks to have increased their TCE to RWA ratios to no less than 6.5% to 7.5%, $280 billion to $540 billion in incremental capital would have been required, reducing industry-wide ROEs by 140 to 260 basis points, all other things being equal.

There does not seem to be a strong case for requiring an effective TCE to RWA ratio above 6.5 to 7.5 percent (or, assuming that banks maintain a capital buffer of no less than 200 basis points, a minimum TCE to RWA ratio of 4.5% to 5.5%). Distress rates fell sharply for banks with TCE to RWA ratios greater than 7.5%. Requiring a higher ratio 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, not only for the financial sector but also potentially for borrowers and for the overall economy.

Finally, while simple measures of leverage have some predictive power in isolation (Gini coeffients of 0.09 to 0.25, in all cases markedly lower than the corresponding risk-based capital alternative), they do not appear to have any incremental predictive power in addition to the TCE to RWA ratio. In other terms, based on this analysis, imposing a leverage requirement on banks already subject to a risk-based capital requirement appears to provide little or no further benefit.

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 following 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 regarding the optimal path 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 (as they provide a larger capital cushion to absorb potential losses), some observers have noted that requiring higher capital and leverage ratios is likely to have second-order 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. First, 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). Secondly, it is only based on the most recent crisis, and it is quite likely that the next crisis would occur under a different set of conditions. As a result, the analysis does not definitively reveal how institutions could be expected to perform in the future if required capital ratios were changed. However, we believe

[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.

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 a smaller likelihood 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) have been more important predictors of bank distress than ratios based on broader measures of regulatory capital (e.g., Tier 1 plus Tier 2).

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 capital to RWA. Banks with a capital ratio of less than 6.5 to 7.5 percent made up 58 to 83 percent of those 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 industry-wide 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. 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,

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

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.

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

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

[3] The Gini coefficient is a measure of statistical dispersion 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. 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 the assets in the sample).

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 their capital ratios.

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.

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

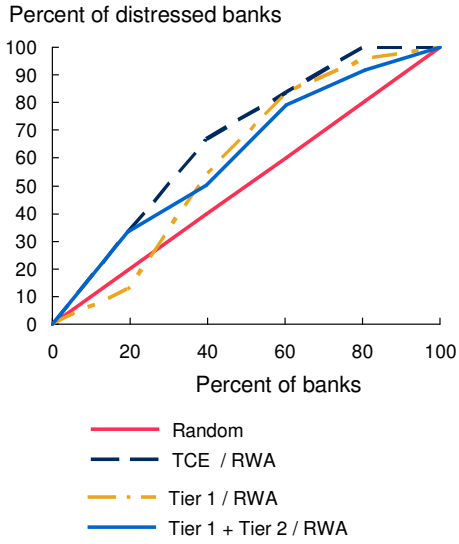
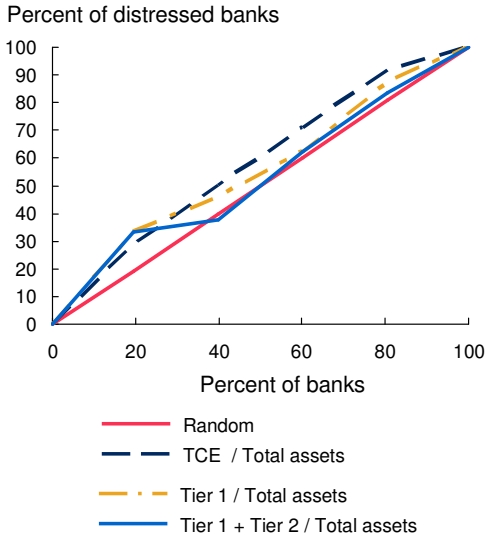


Exhibit 3
Ratios based on total assets



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.

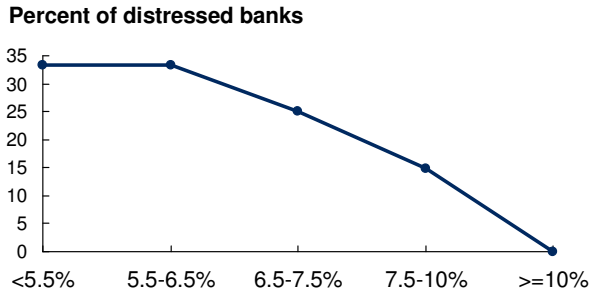
Looking at TCE/RWA as a possible target ratio and focus of regulatory attention, we also examined the relationship between this ratio and the rate of bank distress.

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]

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 6.5 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 the TCE to RWA ratio for the global banking industry to no less than 5.5 percent would have affected 29 percent of banks experiencing distress, would have required an incremental $110 billion in capital and would have reduced industry-wide average ROEs by 60 bps, *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

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).

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.

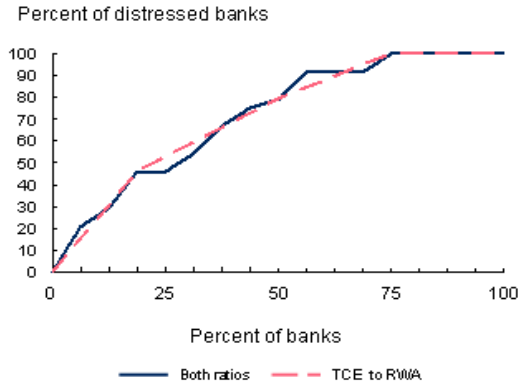
be roughly $280 billion, with a decrease in industry-wide average ROE[7] of 140 bps, *ceteris paribus*. Increasing the TCE to RWA ratio to 7.5 percent would have affected 83 percent of banks experiencing distress, and would have required $540 billion in incremental capital, with a decrease in ROE impact of 260 bps, *ceteris paribus*. It is also interesting to note that no 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 bps) at this level is extraordinarily high.

When considering the trade-off between required capital ratios and incremental capital requirements, it is important to note 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 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 percentage 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

7 Estimated impact on ROE is the reduction of industry-wide 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.

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 was the best predictor of future distress

- Tangible common equity to RWA was 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 the broadest measure of 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. A refinement of these risk weights has the potential to further increase this value.

Tangible Common Equity is intended to reflect the common equity of the institution and its retained earnings, excluding intangible components such as goodwill, and is available to absorb losses whether the bank remains a going concern or not. At the other end of the capital spectrum, Tier 2 capital to RWA viewed on a stand-alone basis actually has a weakly positive relationship to future incidence of bank distress. The loss-absorption benefits of Tier 2 capital and components of Tier 1 capital are limited if the institution is to be a going concern (e.g., deferral of interest payments on subordinated debt or 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 (e.g., unrealized gains on securities).

The analysis suggests that the historical focus on combined Tier 1 plus Tier 2 capital has been misplaced due to the inadequate loss-absorptiveness of Tier 2 capital (and some components of Tier 1). Some in fact have argued 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 true 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 so as to better align regulatory capital with the underlying risk.

II. Banks with a TCE to RWA ratio of less than 6.5 to 7.5 percent accounted for the vast majority of distressed banks

- Banks with a TCE to RWA ratio of less than 6.5 to 7.5 percent represented 58 to 83 percent of those banks that ultimately became distressed. Maintaining a TCE to RWA capital ratio at no less than 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 industry-wide ROEs by 140 to 260 bps.

It is important to balance the incremental benefits of higher capital requirements against the costs that these requirements may impose on financial institutions, borrowers and on society more broadly. An effective range of 6.5 to 7.5 percent captures a majority of the benefit.

In considering the potential implications, it is important to consider the effects of minimum capital requirements, the capital buffers that banks choose to or may be required to maintain and the point in the economic cycle. *The Turner Review* and the accompanying *FSA Discussion Paper* suggest that requiring buffers of 200 to 300 bps at the peak of the cycle may be appropriate. In the U.S., banks have maintained average capital buffers (in excess of risk-based capital requirements in order to be well-capitalized of 6% Tier 1 to RWA and 10% Tier 1 plus Tier 2 capital to RWA) of 240 to 290 bps. If banks maintain a capital buffer of, for example, no less than 200 basis points, then a minimum required TCE to RWA ratio of 4.5% to 5.5% will result in an effective TCE to RWA ratio of no less than 6.5% to 7.5%.

At effective 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). However, the negative impact on ROE with minimum levels above 7.5 percent is significant. At effective TCE to RWA capital ratios of 10 percent, industry-wide ROEs would decline by 560 bps, but an incremental $1.45 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 to 7.5 percent range may at some point simply be challenging, potentially reducing the resiliency of the banking system.

In addition to the required capital raising 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]

[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).

As articulated in *The Turner Review*, "[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 did not predict bank distress, once risk-based capital ratios are taken into account

- Based on the evidence from banks during the crisis, layering a 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 ratio. 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.

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 may also 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 seems to have encouraged certain banks to engage in regulatory arbitrage (e.g., hold higher-risk assets, move toward off-balance sheet activities) and when the leverage ratio is the binding constraint, it can have the perverse effect of encouraging increased risk-taking.

* * *

Our analysis in this working paper has focused on evidence from the financial crisis on capital adequacy and risk-based capital requirements. However, as policymakers craft the future standards governing the financial services industry, care should be taken not to rely to too heavily on any single tool. The objective should not be to set minimum capital requirements under the first pillar of the Basel Accord in a way that completely eliminates the possibility of financial distress, but rather to balance the benefits and costs of alternative policies, to leverage other tools at regulators' disposal including supervisory review of individual institutions under the second pillar, and to develop tools to mitigate the costs of bank distress when it does occur.

Indeed, there are multiple regulatory changes planned, including higher risk-weighted assets on the trading book and for securitization and off-balance sheet assets, countercyclical capital buffers, periodic stress testing, higher capital requirements for systemically important financial institutions, and the imposition of quantitative liquidity requirements. Each of these changes is individually well-intentioned, but in the aggregate might have an impact that needs to be considered carefully in order to assure that the industry can earn returns adequate to attract providers of equity, which is the ultimate foundation for the resilience of the industry.

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