A Primer on the Evolution and Complexity of Bank Regulatory Capital Standards

James R. Barth and Stephen Matteo Miller

February 2017

MERCATUS WORKING PAPER

MERCATUS CENTER
George Mason University

3434 Washington Blvd., 4th Floor, Arlington, Virginia 22201
www.mercatus.org

James R. Barth and Stephen Matteo Miller. "A Primer on the Evolution and Complexity of Bank Regulatory Capital Standards." Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, February 2017.

Abstract

Bank regulators consider minimum capital standards essential for promoting well-functioning banking systems. Despite their existence, however, such standards have been insufficient to prevent periodic disruptions in the banking sectors of various countries. The most recent disruption was the global banking crisis of 2007–2009. After the crisis, bank capital requirements have increased and become more complex. Clearly, capital requirements are important as a first line of defense in ensuring safer and sounder banking industries. Given the importance of capital requirements, this paper explains and documents (1) the extent to which capital requirements have evolved, becoming higher and more complex, and (2) how all the regulatory capital ratios that now exist to account for differences among banks, such as asset size and business model, do not provide equally valuable information about whether a bank is adequately capitalized. A simple minimum regulatory capital ratio will likely promote a more stable banking system.

JEL codes: D61, G28, K20, L51, N21, N22, N41, N42

Keywords: bank regulation, cost-benefit analysis, capital adequacy standards, US banking crises

Author Affiliation and Contact Information

James R. Barth
Lowder Eminent Scholar in Finance
Auburn University
barthjr@auburn.edu

Stephen Matteo Miller
Senior Research Fellow
Mercatus Center at George Mason University
smiller@mercatus.gmu.edu

A Primer on the Evolution and Complexity of Bank Regulatory Capital Standards

James R. Barth and Stephen Matteo Miller

Banks are vital in facilitating the exchange of goods and services by providing a payment system and in channeling savings to productive investment projects. When banks fulfill these functions efficiently and without any serious disruptions, everyone benefits. Banking systems, however, do not always work well. In various countries, banking crises have contributed to declines—rather than increases—in overall economic activity. The typical policy response in such situations has been implementation of a variety of banking reforms in an attempt to prevent the recurrence of such events.

Capital requirements can be an important tool that bank regulators use to promote a well-functioning banking system, presuming that requiring banks to fund themselves with sufficient levels of owner-contributed equity capital will eliminate any incentive for the banks to engage in excessive risk-taking. These requirements have evolved over recent decades, and the standards continue to become more complex. Fully understanding all their nuances is a challenge, even for those who have spent substantial time studying them. Further adding to the challenge is the existence of multiple capital requirements that are satisfied by different items. This guide to bank capital regulation summarizes the complexity of capital requirements, which adds to the difficulty of bank compliance, regulatory oversight, and academic and policy analysis.

This primer will show that despite the increased complexity of the regulatory capital ratios, they do not provide equally valuable information about whether a bank is adequately capitalized. The data presented clearly indicate that whether banks have too little capital or

excess capital depends on the specific capital ratio on which one focuses and whether the capital ratio is based on the riskiness of a bank's business model. Some ratios may indicate that a bank has sufficient capital while other ratios indicate the opposite. A higher regulatory capital ratio imposed on banks may or may not affect bank behavior. The specific ratio that regulators choose to increase is crucial. The market knows that not all ratios are equally revealing about a bank's actual capital adequacy, and thus it pays more attention to some ratios than others. Given this situation, we believe that the overwhelming regulatory emphasis should be placed on a straightforward and easily understood capital ratio that market participants have always paid attention to when they assess whether a bank is adequately capitalized.

The remainder of the paper proceeds as follows: After a discussion in section 1 about how the Basel Capital Accords have changed over time and about their specific guidelines, in section 2 we examine the implementation of these accords in the United States. We show that US capital requirements differ in some important respects from the Basel capital guidelines. Section 3 discusses the actions that banking regulators are legally required to take as a bank's capital declines below specified minimum levels. This is important because, based on publicly available information, researchers are able to determine whether the regulatory authorities actually take the actions required when banks encounter financial difficulties. Section 4 explains the comprehensive capital analyses and supervisory stress testing to which regulators now subject the bigger banks. These new requirements have generated considerable controversy because they require banks to hire more employees with quantitative skills, which results in an increase in costs without a corresponding increase in revenues. It is not clear, moreover, whether the more extensive analyses and testing contribute to a safer and sounder banking system. Section 5 explains what counts as capital and how capital requirements vary for different groups of banks.

Section 6 compares various actual capital ratios to the required ratios for a select and important group of banks. Importantly, the variation shown demonstrates the lack of any clear message about whether a bank is adequately capitalized. Section 7 concludes with a suggestion for a minimum required capital ratio that eliminates most of the confusion over determining whether a bank is adequately capitalized—one that market participants themselves relied on during the most recent banking crisis of 2007–2009.

1. Basel Capital Accords

The central bank governors of the G10 countries established a Committee on Banking Regulations and Supervisory Practices at the end of 1974 following disruptions in the international financial markets after the breakdown of the Bretton Woods system of managed exchange rates (Kapstein 1991, 1994). The committee was later renamed the Basel Committee on Banking Supervision (BCBS). The aim of that committee was and is to promote financial stability by improving banking supervision worldwide. The BCBS seeks to accomplish its aims by setting minimum standards and guidelines for the regulation and supervision of large, internationally active banks. Since its first meeting in February 1975 (Kapstein 1991, 1994), the BCBS has been meeting regularly three or four times a year. Membership was expanded beyond the G10 in 2009 and again in 2014, so that 28 jurisdictions—27 countries and the European Union—are now included in the BCBS.[1] BCBS decisions are recommendations and thus not legally binding on the member jurisdictions, but the BCBS "expects full implementation of its standards by its member jurisdictions and their internationally active banks."[2]

[1] See "Basel Committee Membership" page, Bank for International Settlements, last updated December 30, 2016, http://www.bis.org/bcbs/membership.htm.
[2] See "Policy Development and Implementation Review," Bank for International Settlements, last updated December 30, 2016, https://www.bis.org/bcbs/review_process.htm.

The Latin American debt crisis of the early 1980s generated concerns about the adequacy of the capital of the large international banks (Kapstein 1991, 1994). In response, Congress passed the International Lending and Supervision Act of 1983, in part to get US regulators to find a way to raise capital requirements in a multilateral way since differences existed in national capital requirements (Kapstein 1991, 1994).[3] Through the BCBS, these efforts culminated in the first Basel Capital Accord (Basel I) in July 1988. Basel I called for a minimum capital ratio, which was based on capital relative to risk-weighted assets (RWAs).

As shown in table 1, Basel I contained two tiers of capital, Tier 1 and Tier 2, that combined to form total capital, with these capital measures based on accounting or book values; the compositions of the different capital concepts are listed in table 2. Tier 1 capital was initially set at 3.625 percent of RWAs and then increased to 4 percent by the end of 1992, while total capital was increased from 7.25 percent to 8 percent of RWAs over the same period. The BCBS did not recommend a leverage ratio, or non-risk-based capital ratio, at the time.

The BCBS intended these capital ratios to evolve over time as events unfolded and new information became available. In January 1996, for example, the BCBS issued guidelines within Basel I to incorporate market risks in capital requirements, since initially only credit risks were addressed (BCBS 1996). This new capital requirement took into account the risk of losses in on-balance-sheet and off-balance-sheet positions arising from movements in market prices. At the same time, a third kind of regulatory capital, Tier 3, became part of total capital (BCBS 1996). These changes were to take effect at the end of 1997 and allowed banks, for the first time, to use internal models (value-at-risk models) as a basis for calculating their market-risk capital requirements.

[3] For the International Lending and Supervision Act of 1983, see Title IX of Public Law No. 98-181, 97 Stat. 1278.

Table 1. A Timeline of Basel Capital Accords

Regulatory capital standards	Basel I[a] (%) 1991–1992	Basel I[a] (%) 1993–2010	Basel II[b] (%) 2011	Basel II.5[c] (%) 2012	Basel III[d] (%) 2013	2014	2015	2016	2017	2018	as of 1 Jan 2019
Minimum Tier 1 capital (CET1 plus additional Tier 1)	3.625	4.0	4.0	4.0	4.5	5.5	6.0	6.0	6.0	6.0	6.0
Minimum total capital (Tier 1 plus Tier 2 capital)	7.25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Common equity leverage ratio[e] (viewed as a backstop to risk-based ratios)	n/a	n/a	supervisory monitoring		---------- test period and disclosure starts 1 Jan 2015 ----------					3.0	3.0
Minimum CET1 capital ratio	n/a	n/a	2.0	2.0	3.5	4.0	4.5	4.5	4.5	4.5	4.5
Phase-in of deductions from CET1 (including amounts exceeding the limit for deferred tax assets, mortgage servicing rights, and financials)	n/a	n/a	n/a	n/a	n/a	20	40	60	80	100	100
Capital conservation buffer	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.625	1.25	1.875	2.50
Countercyclical capital buffer (discretionary, 0.0% to 2.5%), to be filled with Tier 1 capital	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.625	1.25	1.875	2.50
Capital surcharge for global systemically important banks	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.25 to 3.5	0.5 to 3.5	0.75 to 3.5	1 to 3.5
Capital instruments that no longer qualify as noncommon equity Tier 1 capital or Tier 2 capital	n/a	n/a	n/a	n/a	---------- 10% per year phaseout over 10-year horizon beginning 1 Jan 2013[f] ----------						

Note: CET1 = common equity Tier 1, n/a = not applicable.

[a] Basel I was finalized in July 1988 and implemented over the period 1988–1992.
[b] Basel II was finalized in June 2004 and implemented over the period 2007–2010.
[c] Basel II.5 was finalized in July 2009 and meant to be implemented no later than December 31, 2011. Basel II.5 enhanced the measurements of risks related to securitization and trading book exposures.
[d] Basel III was finalized in December 2010 and meant to be implemented over the period 2013–2018.
[e] The leverage ratio is calculated as the ratio of Tier 1 capital to balance-sheet exposures plus certain off-balance-sheet exposures.
[f] The phasing works by capping the amount that can be included in capital from 90 percent on January 1, 2013, and reducing this cap by 10 percent in each subsequent year.

Sources: Documents by the Basel Committee on Banking Supervision at the Bank for International Settlements in Basel, Switzerland: "International Convergence of Capital Measurement and Capital Standards," July 1988; "Amendment to the Capital Accord to Incorporate Market Risks," January 1996; "Amendment to the Capital Accord to Incorporate Market Risks," June 2004; "Revisions to the Basel II Market Risk Framework—Final Version," July 2009; "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems—Revised Version June 2011," June 2011; "The G-SIB Assessment Methodology—Score Calculation," November 2014; "Implementation of Basel Standards: A Report to G20 Leaders on Implementation of the Basel III Regulatory Reforms," November 2014; also James R. Barth, Gerard Caprio Jr., and Ross Levine, *Guardians of Finance: Making Regulators Work for Us* (Cambridge, MA: MIT Press, 2012).

Table 2. Components of Total Capital

Tier 1 capital	Largely shareholder equity and disclosed reserves minus goodwill
Tier 2 capital	Some long-term debt instruments, some loan loss reserves, and some unrealized capital gains on shareholdings
Tier 3 capital	Largely short-term subordinated debt

Note: Tier 1 capital did not include goodwill, which is the present value of conjectural future profits arising from an acquisition when the amount paid is in excess of the target firm's value, because its ability to absorb losses is unclear. Goodwill shows up on the balance sheet, but is recognized as not being easily converted into cash.

Sources: Documents by the Basel Committee on Banking Supervision at the Bank for International Settlements in Basel, Switzerland: "International Convergence of Capital Measurement and Capital Standards," July 1988; "Amendment to the Capital Accord to Incorporate Market Risks," January 1996.

In June 2004, the BCBS replaced the Basel Capital Accord (Basel I) with the Revised Capital Framework (Basel II) (BCBS 2004). Basel II was made up of three pillars: Pillar I, which was designed to develop and expand the minimum capital requirements in Basel I; Pillar II, which provided for supervisory review of a bank's capital adequacy and internal assessment process; and Pillar III, which called for the effective use of disclosure as a lever to strengthen market discipline and encourage sound banking practices. The minimum required risk-based capital ratios for Tier 1 and total capital were left unchanged at 4 percent and 8 percent, respectively, as shown in table 1. The BCBS member countries and several non-member countries agreed to adopt the new guidelines, but on varying national timescales.[4]

The BCBS agreed to Basel II.5 in July 2009 as a revision of Basel II, which BCBS members believed had failed to properly address market risk that banks took on their trading books. Basel II.5 introduced an incremental risk charge (IRC) to estimate and capture default and credit migration risk (i.e., the risk when customers move their loans from one bank to another bank). Basel II.5 also introduced an additional charge to compensate for an increase in one risk

[4] By 2014, all 27 BCBS member countries had implemented or were in the process on implementing Basel II (meaning at least one subsection had been implemented), while another 94 non-BCBS jurisdictions had done the same (see BCBS 2014b).

that leads to an increase in another risk (i.e., correlated risk). In addition, BCBS introduced stressed value-at-risk to require banks to calculate capital requirements under stress conditions. Lastly, standardized charges were introduced for securitization and re-securitization positions.

BCBS issued Basel III in December 2010 and revised it in June 2011, after the global banking crisis. BCBS made the revisions to enhance the Basel framework and strengthen the three pillars established by Basel II (BCBS 2011). The new framework (Basel III) also introduced several regulatory capital innovations. Basel III established new minimum common equity and Tier 1 requirements and added an additional layer of common equity (the capital conservation buffer), a countercyclical buffer, a leverage ratio (based on both a bank's on-balance-sheet assets and off-balance-sheet exposures regardless of risk weighting), and supplementary capital requirements for systemically important banks. Also introduced were a liquidity coverage ratio (intended to provide enough cash to cover funding needs over a 30-day period of stress) to be phased in from January 1, 2015, to January 1, 2019, and a longer-term net stable funding ratio (intended to address maturity mismatches over the entire balance sheet) to take effect as a minimum standard by January 1, 2018.

The final capital requirements introduced by Basel III were to be phased in over time, as shown in table 1. The recommended leverage ratio will be 3 percent in 2019. The recommended risk-based capital requirement will be as high as 13 percent for some banks, and even as high as 16.5 percent for global systemically important banks (GSIBs).

The Financial Stability Board (FSB), which makes policy recommendations to G20 members, has proposed further increasing requirements on GSIBs through a total loss-absorbing capacity (TLAC) requirement. On top of the required minimum common equity Tier 1 (CET1) ratio of 4.5 percent, GSIBs would have to hold an additional 11.5 percent of "loss absorbency" in

the form of Tier 1 and Tier 2 capital relative to risk-weighted assets. This requirement would rise to 13.5 percent by 2022. The FSB expects GSIBs to meet this requirement in part through long-term, unsecured debt that can be converted into equity when a bank fails. The emphasis on convertible debt is meant to put an end to "too big to fail" by forcing bondholders rather than taxpayers to inject capital into a big bank that fails.[5]

2. US Capital Requirements

The US banking regulators issued a final rule regarding the implementation of Basel III in July 2013.[6] The new capital rule strengthens the definition of regulatory capital, increases the minimum risk-based capital requirements for all banks, and modifies the requirements for how banks calculate risk-weighted assets. The revised capital rule also retains the generally applicable leverage ratio requirement that banking regulators believe to be a simple and transparent measure of capital adequacy that is credible to market participants and ensures that a meaningful amount of capital is available to absorb losses. The rule includes both the advanced approaches for determining the risk weight of assets for the largest internationally active banking organizations and a standardized approach that will apply to all banking organizations except small bank holding companies (BHCs) with less than $500 million in assets. The rule became effective for advanced-approaches banks on January 1, 2014, while for the non-advanced-approaches banks it became effective on January 1, 2015. Also, advanced-approaches banks have to calculate standardized-approach RWAs in addition to advanced-approaches RWAs for purposes of

[5] For a discussion of TLAC, including its implications for US banks, see Killian (2016).
[6] See Comptroller of the Currency, Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Risk-weighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Federal Register 62018, October 11, 2013.

applying the "Collins Floor," which is a part of the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act that establishes a bank's minimum capital ratios as the lower of its standardized-approach and advanced-approaches ratios.[7]

Table 3 shows the various capital requirements the United States has implemented and will be implementing over the next several years according to Basel I, Basel II, Basel II.5 and Basel III.[8] The leverage capital requirement is still there, as are a few risk-based capital requirements that apply to every bank, though they differ in magnitude based on the bank's asset size. The risk-based capital requirements provide an incentive for banks to focus more on assets with lower risk weights, which can lead banks to change their business models. Under Basel III, there are several new and more stringent capital requirements, as well as different capital requirements for banks of different sizes and systemic importance. In particular, there is a new CET1 capital ratio set at 4.5 percent of risk-based assets. The Tier 1 capital ratio is set at 6 percent (an increase from 4 percent), while the total capital ratio remains at 8 percent. The capital requirements are more stringent for the advanced-approaches banks and a subset of those banks identified as GSIBs. Indeed, for GSIBs the capital requirements can be as high as 17.5 percent of risk-based assets, as shown in table 3. The Federal Reserve Board (FRB) in July 2015 established the methods that US GSIBs will use to calculate a risk-based capital surcharge, which is calibrated to each firm's overall systemic risk.[9] In particular, the GSIBs are required to calculate their surcharges under two methods and use the higher of the two. The first method is

[7] See Section 171 of the "Dodd-Frank Wall Street Reform and Consumer Protection Act," Public Law No. 111-203, 124 Stat. 1376.
[8] The table also reflects the effect of the implementation of the Dodd-Frank Act on capital requirements.
[9] The FSB and BCBS provide the list of GSIBs, using the assessment methodology published by BCBS. See Financial Stability Board, "2015 update of list of global systemically important banks (G-SIBs)," November 3, 2015. See also Board of Governors of the Federal Reserve System, Regulatory Capital Rules: Implementation of Risk-Based Capital Surcharges for Global Systemically Important Bank Holding Companies, 80 Federal Register 49081, August 14, 2015.

based on the framework agreed to by BCBS and considers a GSIB's size, interconnectedness, cross-jurisdictional activity, substitutability, and complexity. The second method uses similar inputs, but is calibrated to result in significantly higher surcharges and replaces substitutability with a measure of the bank's reliance on short-term wholesale funding. The surcharges are being phased in—implementation began on January 1, 2016, and will become fully effective on January 1, 2019.

3. US Prompt Corrective Action Requirements

In addition to the implementation of the Basel Capital Accords, US banks are subject to Prompt Corrective Action (PCA) requirements. The PCA regulatory regime was established pursuant to the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of December 1991 and became effective in December 1992.[10] The FDICIA Act requires insured depository institutions (IDIs) and federal banking regulators to take "prompt corrective action" to resolve capital deficiencies at IDIs. As table 4 indicates, banks are placed into one of five categories depending on their leverage and risk-based capital (RBC) ratios. Well-capitalized banks are those banks that meet all five thresholds and are not subject to formal action to maintain a specific capital level. Banks that are less than well-capitalized are subject to increasingly stringent provisions to resolve capital deficiencies as their capital ratios decline. The regulatory authorities of banks that become critically undercapitalized must within 90 days appoint a receiver or take other such actions that would better serve the purposes of PCA (and review such actions every 90 days). Lastly, the standards for determining whether a BHC is well-capitalized are not established.

[10] For the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991, see Public Law 102-242, 105 Stat. 2236.

Table 3. A Timeline of US Capital Requirements

	US minimum capital standards based on Basel I[a] (%)		Basel II[b] (%)	Basel II.5[c] (%)	Basel III[d] (%)						
Regulatory capital requirements	1991–1992	1993–2010	2011	2012	2013	2014	2015	2016	2017	2018	as of 1 Jan 2019
Minimum Tier 1 capital (CET1 + additional Tier 1)	3.625	4.0	4.0	4.0	4.5	5.5	6.0	6.0	6.0	6.0	6.0
Minimum total capital (Tier 1 + Tier 2 capital)	7.25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Tier 1 leverage ratio and supplementary leverage ratio[e] (viewed as a complement to risk-based ratios)[f]	---------- 4 (3 for banks that are CAMELS 1-rated) ----------						4	4	4	3 (AA) 5 (GSIBs and 6 for their IDIs) 4 (NAA)	3 (AA) 5 (GSIBs and 6 for their IDIs) 4 (NAA)
Minimum CET1 capital ratio (introduced in 2009 in the United States)	n/a	n/a	n/a	n/a	3.5	4.0	4.5	4.5	4.5	4.5	4.5
Phase-in of deductions from CET1 (including amounts exceeding the limit for deferred tax assets, mortgage servicing rights, and financials)	n/a	n/a	n/a	n/a	n/a	20.0	40.0	60.0	80.0	100.0	100.0
Capital conservation buffer[g]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.625	1.25	1.875	2.5
Countercyclical capital buffer for AA banks (discretionary, 0.0% to 2.5%)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.625	1.25	1.875	2.5
Capital surcharge for GSIBs[h]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.25 to 4.5	0.50 to 4.5	0.75 to 4.5	1 to 4.5
Capital instruments that no longer qualify as CET1 or Tier 1 capital[i]	n/a	n/a	n/a	n/a	n/a	80	60	40	20	0	0

Note: AA = advanced approaches, CET1 = common equity Tier 1, GSIB = global systemically important bank, IDI = insured depository institution, n/a = not applicable, NAA = non-advanced approaches.

[a] Basel I was finalized in July 1988 and phased in over the period 1988–1992; it became fully effective in 1992 for all US banks. For the 1988–2010 period, see Capital; Risk-Based Capital Guidelines, 54 Federal Regsiter 4186, January 27, 1989.

[b] US banking regulators published a final Basel II rule in December 2007 with a phase-in and it did not become effective until April 1, 2008. See Risk-Based Capital Standards: Advanced Capital Adequacy Framework—Basel II, 72 Federal Regsiter 69288, December 7, 2007. US federal banking agencies chose not to apply Basel II to all US banks, but only to the very largest, internationally active "core" US banks.

[c] US banking regulators published the final rule in June 2012 that became effective January 1, 2013, with revisions to certain capital requirements for trading positions and securitizations. See Risk-Based Capital Guidelines: Market Risk, 77 Federal Regsiter 53060, August 30, 2012.

[d] US banking regulators issued a final rule in July 2013 implementing Basel III; the rule became effective for AA banks, those with more than $250 billion in assets or more than $10 billion of on-balance-sheet foreign exposures, on January 1, 2014, and for NAA banks on January 1, 2015. See Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Riskweighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Federal Register 62018, October 11, 2013. The Collins Floor, required by the Dodd-Frank Act, established a firm's minimum capital ratio as the lower of its standardized-approach and advanced-approaches ratios, which include both minimum capital standards and the capital conservation buffer.

[e] The Tier 1 leverage ratio is the ratio of Tier 1 capital to on-balance-sheet assets less items deducted from Tier 1 capital. The leverage ratio applies to all banks, and must be at least 4 percent for an institution to be adequately capitalized and 5 percent to be well capitalized. The supplementary leverage ratio only applies to AA banks and is the ratio of Tier 1 capital to both on-balance-sheet and selected off-balance-sheet assets, or leverage exposure.

[f] Leverage ratio for AA bank holding companies is based on both on-balance-sheet and off-balance-sheet items, while only on-balance-sheet items are included for NAA bank holding companies.

[g] A bank's capital conservation buffer of 2.5 percent (on top of each risk-based ratio) will equal the lowest of the following three amounts: (1) a bank's CET1 ratio minus 4.5 percent; (2) a bank's Tier 1 risk-based capital ratio minus 6 percent; (3) a bank's total risk-based capital ratio minus 8 percent. Failure to meet these requirements results in restrictions on payouts of capital distributions and discretionary bonus payments to executives.

[h] GSIBs calculate their surcharges using two methods and use the higher of the two surcharges. The first method is based on the framework agreed to by the Basel Committee on Banking Supervision and considers a GSIB's size, interconnectedness, cross-jurisdictional activity, substitutability, and complexity. The second method uses similar inputs, but is calibrated to result in significantly higher surcharges and replaces substitutability with a measure of the firm's reliance on short-term wholesale funding.

[i] Basel III revised the regulatory capital treatment for Trust Securities, requiring them to be partially transitioned from Tier 1 capital into Tier 2 capital in 2014 and 2015, until fully excluded from Tier 1 capital in 2016, and partially transitioned and excluded from Tier 2 capital beginning in 2016. The exclusion from Tier 2 capital starts at 40 percent on January 1, 2016, increasing 10 percent each year until the full amount is excluded from Tier 2 capital beginning on January 1, 2022.

Additional sources: James R. Barth, Gerard Caprio Jr., and Ross Levine, 2012, *Guardians of Finance: Making Regulators Work for Us*, Cambridge, MA: MIT Press; Bank for International Settlements, Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems (December 2010, rev. June 2011); European Parliament, US Implementation of Basel II: Final Rules Issued, but No Supervisory Approvals to Date (October 2011).

Table 4. US Prompt Corrective Action (PCA), Old and New

	Old PCA categories (IDIs)[a]			New PCA categories (IDIs)[b]				
PCA threshold	Tier 1 leverage (%)	Tier 1 RBC (%)	Total RBC (%)	Tier 1 leverage (%)	Tier 1 capital (%)	Common equity Tier 1 RBC (%)	Total RBC (%)	Supplementary leverage ratio (AA/IDIs only)
Well capitalized	≥ 5.0	≥ 6.0	≥ 10.0	≥ 5.0	≥ 8	≥ 6.5	≥ 10.0	n/a
Adequately capitalized	≥ 4.0	≥ 4.0	≥ 8.0	≥ 4.0	≥ 6	≥ 4.5	≥ 8.0	≥ 3
Undercapitalized	< 4.0	< 4.0	< 8.0	< 4.0	< 6	< 4.5	< 8.0	< 3
Significantly undercapitalized	< 3.0	< 3.0	< 6.0	< 3.0	< 4	< 3.0	< 6.0	n/a
Critically undercapitalized	---------- tangible equity / total assets ≤ 2% ----------							n/a

Note: AA = advanced approaches, IDI = insured depository institution, n/a = not applicable, RBC = risk-based capital. Tangible equity is Tier 1 capital plus non-Tier 1 perpetual preferred stock. Also, the supplementary leverage ratio becomes effective January 1, 2018.

[a] See Prompt Corrective Action; Rules of Practice for Hearings, 57 Federal Register 44866, September 29, 1992.

[b] See Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Riskweighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Federal Register 62018, October 11, 2013.

Additional source: Federal Deposit Insurance Corporation, Regulatory Capital Interim Final Rule, https://fdic.gov/regulations/resources/director/RegCapIntFinalRule.pdf.

Table 4 shows the old and new capital ratios associated with the different categories calling for the various regulatory actions to resolve capital deficiencies. The major change is that a stricter measure of capital (CET1) than the previous Tier 1 capital ratio was introduced by eliminating some components that had previously counted as capital. In addition, the associated ratios for the new measure as compared to the previous measure have been increased. The new PCA ratios became effective on January 1, 2015, for all banks.

4. US Capital Planning and Stress Tests

Supervisory stress testing by banking regulators gained prominence during the banking crisis of 2007–2009. In particular, in 2009, banking supervisors conducted the Supervisory Capital Assessment Program (SCAP) to assess the largest bank holding companies' capital positions. SCAP presented two hypothetical macroeconomic scenarios, including one that was more adverse than what was expected for the US economy, for BHCs to use in estimating the impact on capital. The Federal Reserve publicly reported that 10 of the 19 BHCs that were included in SCAP did not meet the capital adequacy requirements under the adverse macroeconomic scenario. As a result, these BHCs were collectively required to add $185 billion in capital by the end of 2010 (Office of the Inspector General, 2015).

Section 165(i) of the Dodd-Frank Act mandated an annual assessment by the Federal Reserve of BHCs with $50 billion or more in total consolidated assets, as well as smaller BHCs and nonbank financial institutions regulated by the Federal Reserve. This annual assessment includes two related programs: the Comprehensive Capital Analysis and Review (CCAR) and

supervisory stress testing (DFAST).[11] These annual stress tests look at whether the BHCs have effective capital adequacy processes and sufficient capital to absorb losses during stressful conditions, while meeting obligations to creditors and counterparties and continuing to serve as credit intermediaries.

In late 2010, the Federal Reserve—acting in part in response to the statute—initiated the CCAR exercise. As part of the exercise, the Federal Reserve evaluates institutions' capital adequacy, their internal capital adequacy assessment processes, and their individual plans to make capital distributions, such as dividend payments or stock repurchases. More specifically, CCAR specifies four mandatory elements of a capital plan: (1) an assessment of the expected uses and sources of capital over the planning horizon that reflects the BHC's size, complexity, risk profile, and scope of operations, assuming both expected and stressful conditions; (2) a detailed description of the BHC's process for assessing capital adequacy; (3) the BHC's capital policy; and (4) a discussion of any baseline changes to the BHC's business plan that are likely to have a material impact on the BHC's capital adequacy or liquidity.[12]

The Federal Reserve has conducted CCAR annually since its inception in 2010 for the largest BHCs. For the CCAR 2015 exercise, the Federal Reserve issued instructions on October 17, 2014, and received capital plans from 31 BHCs on January 5, 2015. Table 5 shows the banks participating in CCAR in 2015 as well as the required capital ratios. The 31 BHCs that are part

[11] For the final rule for supervisory guidance on banking organizations with greater than $10 billion in total consolidated assets, see the joint supervisory guidance from the Office of the Comptroller of the Currency (OCC), the Federal Reserve (Fed), and Federal Deposit Insurance Corporation (FDIC), 77 Federal Register 29458, May 17, 2012. For the OCC's annual stress test final rule, see 77 Federal Register 61238, October 9, 2012. For the FDIC's annual stress test final rule, see 77 Federal Register 62417, October 15, 2012. For the Fed's final rule for supervisory and company-run stress tests, see 77 Federal Register 62378, October 12, 2012. For the Fed's final rule for company-run stress tests for banking organizations with greater than $10 billion in total consolidated assets, see 77 Federal Register 62396, October 12, 2012.

[12] See Board of Governors of the Federal Reserve System, *Comprehensive Capital Analysis and Review 2012: Methodology and Results for Stress Scenario Projections*, March 13, 2012, 5.

Table 5. Comprehensive Capital Analysis and Review (CCAR) 2015 Bank Holding Companies (BHCs) and Applicable Minimum Capital Ratios

Advanced-approaches BHCs in CCAR 2015			
American Express Company	Bank of America Corporation	Bank of New York Mellon Corporation	Capital One Financial Corporation
Citigroup Inc.	Goldman Sachs Group Inc.	HSBC North America Holdings Inc.	JPMorgan Chase & Co.
Morgan Stanley	Northern Trust Corporation	PNC Financial Services Group Inc.	State Street Corporation
U.S. Bancorp	Wells Fargo & Co.		
Other BHCs for CCAR 2015			
Ally Financial Inc.	BB&T Corporation	BBVA Compass Bancshares Inc.	BMO Financial Corp.
Citizens Financial Group Inc.	Comerica Incorporated	Deutsche Bank Trust Corporation	Discover Financial Services
Fifth Third Bancorp	Huntington Bancshares Incorporated	KeyCorp	M&T Bank Corporation
MUFG Americas Holdings Corporation	Regions Financial Corporation	Santander Holdings USA Inc.	SunTrust Banks Inc.
Zions Bancorporation			

Minimum capital ratios in CCAR 2015 (%)			
	2014:Q4 advanced-approaches BHCs	2014:Q4 other BHCs	2015–2016 all BHCs
Tier 1 common ratio	5	5	5
Common equity Tier 1 ratio	4	not applicable	4.5
Tier 1 risk-based capital ratio	5.5	4	6
Total risk-based capital ratio	8	8	8
Tier 1 leverage ratio	4	3 or 4	4

Source: Board of Governors of the Federal Reserve System, "Comprehensive Capital Analysis and Review 2015: Assessment Framework and Results," March 2015, available from https://www.federalreserve.gov/newsevents/press/bcreg/bcreg20150311a1.pdf.

of this CCAR held more than 80 percent of the total assets of all US BHCs, or $14 trillion as of the fourth quarter of 2014. The Federal Reserve reported that in 2015, for the first time, no participating bank fell below the quantitative benchmarks that must be met in CCAR after some BHCs made onetime downward adjustments to their planned capital distributions or redemptions. However, the Federal Reserve did object to Santander's CCAR 2015 capital plan on qualitative grounds because of widespread and critical deficiencies across the BHC's capital planning processes. The Federal Reserve also objected on qualitative grounds to the capital plan of Deutsche Bank Trust Corporation because of numerous and significant deficiencies across its risk-identification, measurement, and aggregation processes; approaches to loss and revenue projection; and internal controls (Board of Governors of the Federal Reserve System, 2015).

DFAST—a complementary exercise to CCAR—is a forward-looking quantitative evaluation of the effect of stressful economic and financial market conditions on a bank's capital. In 2012, the Federal Reserve finalized the rules that implement the stress test requirements under the Dodd-Frank Act.[13] All BHCs and IDIs with $10 billion or more in total consolidated assets are required to conduct an annual company-run stress test.[14] BHCs with assets greater than $50 billion must conduct semiannual company-run stress tests and also are subject to stress tests conducted by the Federal Reserve. The company-run tests must include three scenarios, and the institutions must publish a summary of the results. The estimated losses resulting from these tests are then subtracted from a bank's capital to determine the financial buffer that a bank has to

[13] See Federal Reserve System, Supervisory and Company-Run Stress Test Requirements for Covered Companies, 77 Federal Register 62377, October 12, 2012.

[14] As of June 30, 2016, there were 112 IDIs (1.9% of all IDIs) with $10 billion or more in assets and they accounted for $13,540 billion in assets (81.9% of the assets of all IDIs) (see FDIC Quarterly Banking Profile, Second Quarter 2016). At the same time, there were 97 BHCs (2.3% of all BHCs) with $10 billion or more in assets and they accounted for $15,386 billion in assets (93% of the assets of all BHCs).

insulate itself from shocks and losses. A bank effectively fails the tests if its capital falls below a required minimum level after the theoretical losses.

While DFAST is complementary to CCAR, both efforts are distinct testing exercises that rely on similar processes, data, supervisory exercises, and requirements. However, there are important differences between the two exercises. For CCAR, the Federal Reserve uses BHCs' planned capital actions and assesses whether a BHC would be capable of meeting supervisory expectations for minimum capital levels even if stressful conditions emerged and the BHC did not reduce planned capital distributions. By contrast, for DFAST, the Federal Reserve uses a standardized set of assumptions that are specified in the Dodd-Frank Act stress test rules. DFAST is therefore far less detailed and less tailored to a specific BHC.

The requirements, expectations, and activities relating to DFAST and CCAR do not apply to any banking organizations with assets of $10 billion or less. In particular, community banks are not required or expected to conduct the enterprise-wide stress tests required of larger organizations under the capital plan rule, the rules implementing the Dodd-Frank Act stress testing requirements, or the procedures described in the stress testing guidance for organizations with more than $10 billion in total consolidated assets. As noted, BHCs with $10 to $50 billion in assets are only subject to firm-run stress tests for DFAST.

Stress testing requirements are a risk-assessment supervisory tool. The goal of stress tests conducted under the Dodd-Frank Act is to provide forward-looking information to supervisors to assist in their overall assessments of a bank's capital adequacy and to aid in identifying downside risks and the potential impact of adverse outcomes on the covered bank. Further, these stress tests support ongoing improvement in a bank's internal assessments of capital adequacy and overall capital planning. Yet, according to the Office of Inspector General

of the Federal Reserve, "the Federal Reverse's Model Validation Unit does not currently conduct a formal assessment of the expertise required to validate each model or maintain an inventory to track the skills and expertise of reviewers."[15] Furthermore, as evidence of additional problems at the Federal Reserve, "[T]he governance review findings include . . . a shortcoming in policies and procedures, insufficient model testing, insufficient planning and procedures to address the risks posed by potential key-personnel departures, and incomplete structures and information flows to ensure proper oversight of model risk management." These and other types of problems, such as a lack of transparency and forced homogeneity, call the usefulness of DFAST into question.

On the positive side, CCAR and DFAST may induce banks to have more capital than they would if they were subject only to the traditional capital requirements. As a result of the stress tests, banks may have become less susceptible to financial distress, but at the same time more reluctant to lend as much as they otherwise would.

5. US Regulatory Capital: Components and Risk Weighting

What Counts as Capital?

Table 6 provides information on the various components of regulatory capital that are associated with the different required capital ratios under the US implementation of the Basel Capital Adequacy Standards. Basel III implementation brought major changes in the components of capital. In particular, banking regulators now consider the new capital measure, CET1 capital, to be the most loss-absorbing form of capital.

[15] See Office of the Inspector General 2015, pp. 9 and 11.

Table 6. A Timeline of US Regulatory Capital Components

	Basel I[a]		Basel II[b]	Basel II.5[c]	Basel III[d]
Regulatory capital components	1991–1992	1993–2010	2011	2012	2013 to as of 1 Jan 2019
Tier 1 capital (old)	Common equity + preferred stock + qualifying hybrids + minority interests − (goodwill + other intangibles, except for MSRs, PCCR, and DTAs)				n/a
Tier 2 capital (old)	Undisclosed reserves + assets revaluation reserves + general provisions/general loan loss reserves + preferred stock + qualifying hybrids + subordinated debt				n/a
Tier 3 capital (old)	n/a	n/a	Short-term subordinated debt, solely to support the market risks in the trading book[e]		n/a
CET1, going-concern capital (new)	n/a	n/a	n/a	n/a	Common stock and retained earnings ± limited accumulated other comprehensive income items for opt-out banks (or accumulated other comprehensive income for non-opt-out and advanced-approaches banks) ± deductions and adjustments + qualifying CET1 minority interest − (goodwill + deferred tax assets + other intangibles)
Additional Tier 1 capital (AT1), going-concern capital (new)	n/a	n/a	n/a	n/a	Noncumulative perpetual preferred stock, including surplus + SBLF& TARP (bank issued) + qualifying Tier 1 minority interest − certain investments in financial institutions
Tier 2 capital, gone-concern capital (new)	n/a	n/a	n/a	n/a	Limited allowance for loan and lease losses + preferred stock and subordinated debt + qualifying Tier 2 minority interest − Tier 2 investments in financial institutions
Total capital (CET1 capital + AT1, or Tier 1 capital, + Tier 2 capital)	n/a	n/a	n/a	n/a	All of the above items with limits eliminated on subordinated debt and limited-life preferred stock in Tier 2 capital and no limit on Tier 2 capital
Capital conservation buffer (CCB) (new)	n/a	n/a	n/a	n/a	CET1 (CCB ratio must be in excess of CET1, Tier 1 and total capital ratios by at least 2.5% to avoid limits on capital distributions and certain discretionary bonus payments)
Countercyclical capital buffer (new)	n/a	n/a	n/a	n/a	CET1
Capital surcharge for global systemically important banks (new)	n/a	n/a	n/a	n/a	CET1
Leverage capital	Tier 1 (old)	Tier 1 (old)	Tier 1 (old)	Tier 1 (old)	CET1 + AT1 (new Tier 1)

Note: CET1 = common equity Tier 1, DTA = deferred tax assets, MSR = mortgage servicing rights, n/a = not applicable, PCCR = purchased credit card receivables.

[a] See Capital; Risk-Based Capital Guidelines, 54 Federal Regsiter 4186, January 27, 1989.
[b] See Risk-Based Capital Standards: Advanced Capital Adequacy Framework—Basel II, 72 Federal Register 69288, December 7, 2007.
[c] See Risk-Based Capital Guidelines: Market Risk, 77 Federal Regsiter 53060, August 30, 2012.
[d] See Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Riskweighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Federal Register 62018, October 11, 2013.
[e] For the rule introducing Tier 3 capital, see Risk-Based Capital Standards: Market Risk, 61 Federal Regsiter 4186, September 6, 1996.

The new emphasis on CET1 no doubt reflects the fact that as the banking crisis emerged, market participants chose to focus more on capital measures that reflected loss-absorbing capital than on the official regulatory measures. CET1 includes qualifying common stock, retained earnings, certain accumulated other comprehensive income (AOCI) elements (if the bank does not make an AOCI opt-out election) plus or minus regulatory deductions or adjustments as appropriate, and qualifying CET1 minority interests. The banking regulators expect the majority of CET1 capital to be in the form of common voting shares. Non-advanced-approaches banks were allowed on their March 31, 2015, Call Report to make a permanent, onetime opt-out election, enabling them to calculate regulatory capital without AOCI. Such an election neutralizes the impact of unrealized gains or losses on available-for-sale bond portfolios in the context of regulatory capital levels. For banks that did not opt out, the AOCI adjustment to CET1 capital could have a significant impact on regulatory capital ratios if significant bond portfolio appreciation or depreciation occurs.

Unfortunately, this is not the end of the story. Fully describing what counts as regulatory capital requires an even more detailed explanation. The next two paragraphs provide this detail to finish the story, and in the process they demonstrate the complexity associated with calculating capital that complies with the regulatory requirements. These paragraphs also highlight the difficulties that researchers must confront when they assess how changes in capital requirements affect bank behavior. For example, banks may respond differently to capital requirements depending on differences in both the level of existing capital and the composition of the existing components of that capital. Of course, readers who are not familiar with the meaning of all the terms may skip these two paragraphs without missing the bigger story.

Banks must fully deduct several items from CET1 capital, such as goodwill, deferred tax assets that arise from a net operating loss and tax credit carry-forwards, other intangible assets (except for mortgage servicing assets), gains on sale of securitization exposures, and certain investments in another financial institution's capital instruments. Banks also must consider threshold deductions for three specific types of assets: mortgage servicing assets, deferred tax assets related to temporary timing differences, and significant investments in another unconsolidated financial institution's common stock. Generally, banks must deduct, by category, the amount of exposure to these types of assets that exceeds 10 percent of a base CET1 capital calculation. In addition, there is a 15 percent aggregate limit on these three threshold deduction items in CET1.

Additional non-CET1 capital includes qualifying noncumulative perpetual preferred stock, bank-issued Small Business Lending Fund and Troubled Asset Relief Program instruments that previously qualified for Tier 1 capital, and qualifying Tier 1 minority interests, less certain investments in other unconsolidated financial institutions' instruments that would otherwise qualify as additional Tier 1 capital. Tier 2 capital includes the allowance for loan and lease losses up to 1.25 percent of risk-weighted assets, qualifying preferred stock, subordinated debt, and qualifying Tier 2 minority interests, less any deductions in the Tier 2 instruments of an unconsolidated financial institution. Previous limits on term subordinated debt, limited-life preferred stock, and the amount of Tier 2 capital that can be included in total capital no longer apply. Non-qualifying capital instruments issued before May 9, 2010, by banks with less than $15 billion in assets (as of December 31, 2009) are grandfathered, with the exception that grandfathered capital instruments cannot exceed 25 percent of Tier 1 capital.

How Much Capital Is Needed?

Nearly all the capital adequacy guidelines set by BCBS are based on a bank's risk-weighted assets. In assessing the financial condition of a bank, the denominator in the risk-based capital ratio is as important as the numerator, if not more so. As noted earlier, Basel I was the first capital standard based on RWAs. Then, in response to the growing importance of trading activities of large banks, Basel I was amended in 1996 to expand capital requirements to include capital charges for market risk. Then again, Basel II.5 added capital charges for certain types of trading activities by changing the calculation of risk weights for the trading book. More generally, as compared to Basel I, Basel II and II.5 provided for more detailed calculations of the risk-sensitivity of banks. Indeed, according to Andrew Haldane, "[For] a large, representative bank using an advanced internal set of models to calibrate capital . . . [its] number of risk buckets has increased from around seven under Basel I to, on a conservative estimate, over 200,000 under Basel II."[16]

In Basel III, there are two general approaches to RWAs. The standardized approach is generally designed for community banks, while the advanced approach is used by larger, more complex banks. The standardized approach applies to BHCs with $500 million or more in consolidated assets. Risk-weighted assets consist of credit-risk RWAs plus market-risk RWAs (if applicable). Credit-risk RWAs include risk-weighted assets for general credit risk, cleared transactions, default fund contributions, unsettled transactions, securitization exposures, and equity exposures. General credit risk involves consideration of general risk weights, off-balance-sheet exposures, over-the-counter derivative contracts, cleared transactions, guarantees, credit derivatives, and collateralized transactions. Since the introduction of the risk-weighting system

[16] See Haldane (2011), p. 2.

in the United States in the early 1990s, the general process of risk weighting assets has not changed. However, the movement from Basel I to Basel III has brought several specific changes in risk weights.

Table 7 shows that the standardized approach for Basel III involves risk weights other than the 0, 20, 50, and 100 percent categories that were initially implemented for Basel I. The Basel III risk-weighting categories allow for more detailed risk weights, and the weights now range from a low of 0 to a high of 150 percent. The risk weight for exposures to, and portions of exposures that are directly and unconditionally guaranteed by, the US government, its agencies, and the Federal Reserve is zero percent. The risk weight for high-volatility commercial real estate loans is 150 percent, up from 100 percent under Basel I.

Section 939 of the Dodd-Frank Act directs the banking regulators to remove regulatory references to external credit ratings from regulations.[17] This provision was a legislative response to the failure of the ratings to adequately indicate the riskiness of various securities. That failure affected the ability to assess the riskiness of banks and other entities leading up to the 2007–2009 financial crisis.

[17] By contrast, the Federal Reserve, Federal Deposit Insurance Corporation, and Office of the Comptroller of the Currency finalized a joint rulemaking known as the Recourse Rule on November 29, 2001. See Office of the Comptroller of the Currency, Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation, and Office of Thrift Supervision, Risk-Based Capital Guidelines; Capital Adequacy Guidelines; Capital Maintenance: Capital Treatment of Recourse, Direct Credit Substitutes and Residual Interests in Asset Securitization, 66 Federal Register 59614, November 29, 2001. The Recourse Rule set capital requirements for private label asset- and mortgage-backed securities and other positions in securitization transactions (except for credit-enhancing interest-only strips) according to their relative risk using credit ratings from rating agencies to measure the level of risk. As Erel, Nadauld, and Stulz (2013, p. 8) note, after this change "a bank that made subprime loans was better off holding them on its books as securities backed by these loans than holding the loans directly." As they point out, the regulatory capital charge became a function of the securities' credit ratings rather than their asset class. Miller (Forthcoming) shows that the largest securitization-active banks began increasing their holdings of the highly-rated securitization tranches once the rule went into effect.

Table 7. Basel I and Basel III: US Risk Weights for On-Balance-Sheet and Off-Balance-Sheet Items for the Standardized Approach

Selected items	Existing Basel I–based risk weights[a]	US Basel III final rule standardized risk weights[b]
Cash	0%	0%
Exposures to, and portions of exposures that are directly and unconditionally guaranteed by, the US government, its agencies, and the Federal Reserve	0%	0%
Exposures to foreign governments and their central banks	0% for direct and unconditional claims on Organisation for Economic Co-operation and Development (OECD) governments 20% for conditional claims on OECD governments 100% for claims on non-OECD governments that entail some degree of transfer risk	Risk weight depends on the sovereign's OECD country risk classification (CRC) Sovereign CRC 0–1: 0%; 2: 20%; 3: 50%; 4–6: 100%; 7: 150% OECD member with no CRC: 0% Non-OECD member with no CRC: 100% Sovereign default: 150%
Exposures to US government-sponsored enterprises	20%	20%
Exposures to US public-sector entities, including US states and municipalities	20% for general obligations 50% for revenue obligations	20% for general obligations 50% for revenue obligations
Exposures to foreign public-sector entities	20% for general obligations of states and political subdivisions of OECD countries 50% for revenue obligations of states and political subdivisions of OECD countries 100% for all obligations of states and political subdivisions of non-OECD countries	Risk weight depends on the home country's CRC Risk weight for general obligations: Sovereign CRC 0–1: 20%; 2: 50%; 3: 100%; 4–7: 150%; OECD member with no CRC: 20%; Non-OECD member with no CRC: 100%; Sovereign default: 150% Risk weight for revenue obligations: Sovereign CRC 0–1: 50%; 2–3: 100%; 4–7: 150%; OECD member with no CRC: 50%; Non-OECD member with no CRC: 100%; Sovereign default: 150%
Exposures to US depository institutions and credit unions	20%	20%

continued on next page

Selected items	Existing Basel I–based risk weights[a]	US Basel III final rule standardized risk weights[b]
Exposures to foreign banks	20% for all claims on banks in OECD countries 20% for short-term claims on banks in non-OECD countries 100% for long-term claims on banks in non-OECD countries	Risk weight depends on the home country's CRC Sovereign CRC 0–1: 20%; 2: 50%; 3: 100%; 4–7: 150% OECD member with no CRC: 20% Non-OECD member with no CRC: 100% Sovereign default: 150%
Exposures to nonbank corporations	100%	100%
Exposures to residential mortgages	50% for a first-lien residential mortgage exposure that is: secured by a property that is either owner-occupied or rented; made in accordance with prudent underwriting standards; not 90 days or more past due or carried in nonaccrual status; and not restructured or modified (unless restructured or modified solely pursuant to the US Treasury's Home Affordable Mortgage Program) 100% for all other residential mortgage exposures	Retains existing capital treatment: 50% for a first-lien residential mortgage exposure that is: secured by a property that is either owner-occupied or rented; made in accordance with prudent underwriting standards; not 90 days or more past due or carried in nonaccrual status; and not restructured or modified (unless restructured or modified solely pursuant to the US Treasury's Home Affordable Modification Program) 100% for all other residential mortgage exposures
Exposures to high-volatility commercial real estate loans	100%	150% (the definition of high-volatility commercial real estate only captures a specific subset of acquisition, development, and construction loans; not all commercial real estate loans)
Exposures to over-the-counter derivatives	Risk weight depends on counterparty category (e.g., bank, securities firm, or general corporation), subject to a 50% risk-weight ceiling	Removes the 50% risk-weight ceiling for over-the-counter derivatives
Exposures to securitizations	Ratings-based approach: risk weight depends on the external credit rating assigned to the securitization exposure	General 20% risk-weight floor for securitization exposures
Default risk weight for items not specifically assigned to a risk-weight category	100%	100%
Conversion factors that are used to measure the risk of off-balance-sheet items	0%–100%	0%–100%

[a] See Capital; Risk-Based Capital Guidelines, 54 Federal Regsiter 4186, January 27, 1989.
[b] See Regulatory Capital Rules: Regulatory Capital, Implementation of Basel III, Capital Adequacy, Transition Provisions, Prompt Corrective Action, Standardized Approach for Riskweighted Assets, Market Discipline and Disclosure Requirements, Advanced Approaches Risk-Based Capital Rule, and Market Risk Capital Rule, 78 Federal Register 62018, October 11, 2013.

Additional source: Davis Polk, U.S. Basel III Final Rule: Standardized Risk Weights Tool, accessed January 23, 2017, http://www.usbasel3.com/tool/.

The advanced approach under Basel III applies to BHCs with consolidated assets greater than $250 billion or balance-sheet foreign exposures greater than $10 billion. These banks are required to determine compliance with minimum capital requirements based on the lower of the capital ratios calculated under the standardized and advanced approaches. Using the advanced approach, risk-weighted assets are the sum of credit-risk RWAs, market-risk RWAs (if applicable), and operational RWAs. Credit-risk RWAs include risk-weighted assets for general credit risk, securitization exposures, and equity exposures. General credit risk refers to wholesale and retail RWAs, as well as the counterparty credit risk of repo-style transactions, eligible margin loans, over-the-counter derivative contracts, cleared transactions, unsettled transactions, guarantees, and credit derivatives.[18] Market-risk RWAs—which apply only to BHCs that have aggregate trading assets and liabilities equal to either 10 percent or more of total assets or at least $1 billion—are based on the following risk categories: interest rate, credit spread, equity price, foreign exchange, and commodity price. Operational-risk RWAs have the same basic RWA formula as that of market risk.

Although the risk weights have become much more complex since the introduction of Basel I, the basic framework—setting minimum capital requirements as a fraction of RWAs with risk weights assigned to asset categories—has remained the same. Yet Acharya, Engle, and Pierret (2014, p. 38) argue that "risk weights are flawed measures of bank risks cross-sectionally as banks game their risk-weighted assets (cherry-pick on risky but low risk-weight assets) to meet regulatory capital requirements, which does not necessarily reduce economic leverage."

[18] Under US generally accepted accounting principles (GAAP), banks are allowed to report their derivatives on a net basis. Under international financial reporting standards (IFRS), European banks are generally required to report their derivatives on a gross basis. This leads to a substantial decrease in the size of the balance sheet for big US banks as compared to big European banks.

6. Not All Capital Ratios Are Equally Informative:

Actual Capital Ratios Compared to Required Minimum Capital Ratios

In this section, we provide evidence that the various capital ratios imposed on banks are not equally informative about whether a bank is adequately capitalized. The analysis proceeds by comparing the actual capital ratios to the required minimum capital ratios for some of the biggest banks in the United States for every year over the period 2000–2015. There are four such capital ratio comparisons: (1) the actual risk-based Tier 1 capital ratio is compared to the required minimum ratio of 4 percent; (2) the actual risk-based total capital ratio is compared to the required minimum ratio of 8 percent; (3) the actual non-risk-based leverage ratio is compared to the minimum required ratio of 4 percent; and (4) the actual non-risk-based tangible common equity ratio is compared to a (hypothetical) required minimum tangible common equity ratio of 4 percent. We also provide two other ratios that furnish an additional perspective on the four ratios just mentioned. These are the ratio of RWAs to total assets and the ratio of market capitalization to tangible common equity. The lower the former ratio, the less risk-based capital required, and in the latter case a ratio greater than 1 indicates the market values a bank more than the book values indicate.

The calculations are made for six of the eight GSIBs and twelve other large banks with total assets greater than $50 billion. Table A1 in the appendix shows the percentage by which the actual risk-weighted Tier 1 capital ratio exceeds the required minimum Tier 1 capital ratios for the eighteen banks from 2000 to the third quarter of 2015. All the percentages are positive, which means that all the banks had capital buffers, or actual capital ratios, that exceeded the required minimum ratios. It is noteworthy that every bank's minimum capital buffer occurs in 2007 or earlier, while the maximum ratio occurs in 2009 or later. For nine of the eighteen banks, the

minimum capital buffer occurs in 2007, which was in the midst of the banking crisis and the year before the bailout of the biggest banks. Small banks were also bailed out, mainly in 2009. On the eve of the bailout, these banks more than satisfied their required minimum capital ratios. By 2015, moreover, all the banks had more than met the new and higher capital requirement of 8.5 percent—6 percent plus the capital conservation buffer of 2.5 percent—applicable beginning in 2019.

The situation is quite similar for the risk-weighted total capital ratio, as shown in table A2 in the appendix. For every bank, the actual ratio exceeds the required minimum ratio, and by more than a trivial percentage, in each year. Importantly, just as in the case of Tier 1 capital, every bank had a positive capital buffer during 2007–2008, even though the United States was suffering the worst financial crisis since the Great Depression and was in the midst of a severe recession. In 2015, moreover, all the banks had sufficient capital to satisfy the minimum total capital ratio plus the capital conservation buffer of 10.5 percent.

To better understand how these banks' capital positions were changing over time, it is useful to look at the ratio of RWAs to total assets. Table A3 in the appendix presents this ration in percentage terms for the eighteen banks for the years 2000–2015. Risk weighting makes it easier to exceed minimum capital ratios by lowering the total assets against which capital requirements are applied. The vast majority of the percentages in table A3 are less than 100 percent because of the type of assets the banks have chosen to hold. After the risk-weighting formula is applied, almost all the banks' asset totals are less than the actual amount of assets. For example, for Citigroup the ratio was 72 percent in 2000, but it then declined to 57 percent in 2007. In other words, Citigroup did not need to have capital to back 43 percent of its assets in 2007. The decline in RWAs relative to total assets enabled the Tier 1 and total capital ratios to be higher with the same amount of capital then otherwise.

Table A4 in the appendix shows the actual non-risk-based leverage ratio minus the required minimum leverage ratio. All the capital buffers are positive. However, in contrast to tables A1 and A2, the percentages for most of the banks' capital buffers are smaller. In particular, the three biggest banks had the smallest capital buffers in any year over the entire period, with the exception of BNY Mellon, State Street, and BB&T. In 2007, the figures were 2.00 percent for JPMorgan Chase, 1.04 percent for Bank of America, and 0.03 percent for Citigroup.

Another non-risk-based capital ratio is the tangible common equity ratio. Table A5 in the appendix shows the actual tangible common equity ratio minus a (hypothetical) required minimum tangible common equity ratio of 4 percent. This particular ratio is based on the actual owner-contributed common equity and the actual tangible assets of a bank, based on generally accepted accounting principles (GAAP). The benefits of this measure lie in the fact that (1) it is less susceptible to guesswork or questionable manipulation, (2) market participants paid more attention to it than to other measures during the recent banking crisis, and (3) it is highly correlated to a market-value measure of capital. Unlike tables A1, A2, A3, and A4, table A5 contains quite a few negative percentages, as denoted by the cells with numerical values in parentheses. In 2008, if tangible common equity had been the required capital measure for the minimum leverage ratio, nine banks would not have had enough capital to meet this minimum ratio. In 2007, one year before the bank bailout, neither Bank of America nor Citigroup would have met such a ratio. All these banks received capital injections from the federal government.

Table A6 in the appendix presents the market capitalization to actual tangible common equity ratios for the eighteen banks. A ratio greater than 1 means the market value of a bank is greater than indicated by its book value. The table shows that every bank had a ratio greater than 1 in every year from 2000 to 2006. In 2008 and 2009, during the midst of the banking crisis, nine

banks had ratios less than 1. The three biggest banks had ratios less than 1 in 2008, while two of these banks also have ratios less than 1 in 2009. In the latter year, JPMorgan had a ratio of 1.04. During the period 2009 to 2015, only six banks had ratios greater than 1 every year, and those same banks also had ratios greater than 1 throughout the entire period from 2000 to 2015. Moreover, three of the banks—Bank of America, Citigroup, and Regions—had ratios less than 1 every year from 2008 to 2015.

As noted earlier, the data regarding capital ratios clearly indicate that whether banks have too little or excess capital depends on the specific capital ratio on which one focuses and whether the capital ratio is risk-based or not. Some of the ratios may indicate that a bank has sufficient capital to satisfy regulatory requirements, whereas other ratios may indicate that there is a deficiency in capital. This means that a higher regulatory capital ratio imposed on banks may or may not affect bank behavior. To determine the outcome, one must know the specific ratio that regulators choose to increase. Importantly, the market knows that all ratios are not equally revealing about a bank's actual capital adequacy, and thus pays more attention to some ratios than others when assessing whether a bank is adequately capitalized.

7. Conclusion

Bank regulatory standards have been a work in progress in countries around the world. They have changed several times in recent decades, and most significantly in response to the last banking crisis. They have become ever more stringent and complex for banks of all sizes, but especially for the biggest banks. This is certainly the case in the United States. In addition to the legally mandated actions that banking regulators are required to take as a bank's capital declines below specified minimum levels, regulators now subject the bigger banks to new comprehensive

capital analyses and supervisory stress. Yet it is not clear whether regulators took appropriate actions in a timely manner to lessen the severity of the most recent banking crisis, nor whether the more extensive analyses and testing contribute to a safer and sounder banking system.

What is clear is that understanding what counts as capital and how capital requirements vary for banks of different asset sizes and business models has become mind-boggling, to say the least. Most importantly, our comparison of various actual capital ratios to the required minimum ratios for a select and important group of banks is quite revealing. The differences found demonstrate the lack of any clear message about whether a bank is or is not adequately capitalized.

Whether banks have too little capital or excess capital depends on the specific required capital ratio on which one focuses and whether the required capital ratio is risk-based or non-risk-based. Some ratios indicate a bank has sufficient capital; other ratios indicate the opposite. This means that a higher regulatory capital ratio imposed on banks may or may not affect bank behavior. The specific ratio that regulators choose to increase matters for the outcome.

Given this confusing situation, simply adding more capital requirements is not the way to promote a safer and sounder banking system. Indeed, in 2000, only three different regulatory capital requirements were imposed on banks, two of which were risk-based. However, today there are seven such requirements, six of which are risk-based. While beyond the scope of this discussion, instead of the existing complexity in the regulatory capital requirements, a simpler, non-risk-based equity leverage ratio would better address the issue of an appropriate capital requirement.[19] This ratio is fairly straightforward and easily understood by market participants. In contrast, risk-based capital ratios have all too often been misleading with respect to whether banks were adequately capitalized.

[19] For a discussion of the appropriate level of the regulatory capital ratio, see Barth and Miller (2017).

Appendix: Data Tables

Table A1. Actual Tier 1 Capital Ratio Minus Required Minimum Tier 1 Capital Ratio of 4 Percent

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
JPMorgan	4.50	4.29	4.24	4.50	4.70	4.50	4.70	4.40	6.90	7.10	8.10	8.30	8.60	7.40	6.10	7.30
Bank of America	3.50	4.30	4.22	3.85	4.20	4.25	4.64	2.87	5.15	6.40	7.24	8.40	8.89	7.94	7.60	6.50
Citigroup	4.38	4.42	4.47	4.91	4.74	4.79	4.59	3.12	7.92	7.67	8.91	9.55	10.06	9.20	7.60	6.91
Wells Fargo	3.29	2.99	3.60	4.42	4.41	4.26	4.95	3.59	3.84	5.25	7.16	7.33	7.75	7.83	6.95	6.42
U.S. Bancorp	3.20	3.70	4.00	5.20	4.60	4.20	4.80	4.30	6.60	5.60	6.50	6.80	6.80	6.70	5.80	5.10
BNY Mellon	4.60	4.11	3.58	3.44	4.31	4.38	4.19	5.32	9.30	8.10	9.40	11.00	11.10	11.70	6.70	5.90
PNC	4.60	3.80	4.80	5.50	5.00	4.30	6.40	2.80	5.70	7.40	8.10	8.60	7.60	7.90	7.10	6.00
State Street	10.50	9.60	13.10	10.00	9.30	7.70	9.70	7.20	16.30	13.70	16.50	14.80	15.10	12.80	9.20	8.70
BB&T	5.70	5.80	5.20	5.33	5.20	5.30	5.00	5.10	8.30	7.50	7.80	8.50	6.50	7.30	6.90	6.00
SunTrust	3.09	4.02	3.47	3.85	3.16	3.01	3.72	2.93	6.87	8.96	9.67	6.90	7.13	6.31	5.30	4.90
Fifth Third	9.02	8.36	7.70	6.94	6.31	4.38	4.39	4.50	6.59	9.31	9.94	7.91	6.65	5.86	5.33	4.49
Regions	5.14	5.66	4.98	5.72	5.04	4.60	4.00	3.29	6.38	7.54	8.40	9.28	8.00	7.10	7.04	6.54
Northern Trust	5.79	6.88	7.13	7.10	7.00	5.70	5.80	5.70	9.10	9.40	9.60	8.50	8.80	8.90	7.70	7.00
M&T	3.49	3.37	4.02	3.30	3.31	3.56	3.74	2.84	4.83	4.59	5.47	5.67	6.22	7.50	6.97	5.94
KeyCorp	3.72	3.43	3.74	4.35	3.22	3.59	4.24	3.44	6.92	8.75	11.16	8.99	8.15	7.46	6.40	4.87
Comerica	3.52	3.98	4.08	4.72	4.77	4.46	4.02	3.51	6.66	8.46	6.13	6.37	6.14	6.14	5.00	4.58
Huntington	3.19	3.24	4.69	4.53	5.08	5.13	4.93	3.51	6.72	8.03	7.55	8.11	8.01	7.78	6.00	4.49
Zions	4.53	4.25	5.26	5.42	5.35	3.52	3.98	3.57	6.22	6.53	10.78	12.13	9.38	8.27	8.97	8.41

Note: The required minimum Tier 1 capital ratio is 4.5 percent in 2013, 5.5 percent in 2014, and 6 percent in 2015. Also, the data are for the third quarter of 2015 or for the most recent quarter for which data are available.

Table A2. Actual Total Capital Ratio Minus Required Minimum Total Capital Ratio of 8 Percent

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
JPMorgan	4.00	3.88	3.95	3.80	4.20	4.00	4.30	4.60	6.80	6.80	7.50	7.40	7.30	6.30	5.10	6.90
Bank of America	3.04	4.67	4.43	3.87	3.73	3.08	3.88	3.02	5.00	6.66	7.77	8.75	8.31	7.44	6.60	5.80
Citigroup	3.23	2.92	3.25	4.04	3.85	4.02	3.65	2.70	7.70	7.25	8.59	8.99	9.26	8.68	6.53	–
Wells Fargo	2.43	2.45	3.31	4.21	4.07	3.64	4.50	2.68	3.83	5.26	7.01	6.76	6.63	7.43	7.53	7.44
U.S. Bancorp	2.60	3.70	4.40	5.60	5.10	4.50	4.60	4.20	6.30	4.90	5.30	5.30	5.10	5.20	5.60	5.10
BNY Mellon	4.92	3.57	3.96	3.49	4.21	4.48	4.49	5.25	9.10	8.00	8.30	9.00	8.40	9.00	4.50	4.20
PNC	4.57	3.80	4.50	5.80	5.00	4.10	5.50	2.30	5.20	7.00	7.60	7.80	6.70	7.80	7.90	6.80
State Street	7.60	6.50	10.00	7.80	6.70	6.00	7.90	4.70	13.60	11.10	14.00	12.50	12.60	11.70	8.60	8.80
BB&T	4.20	5.30	5.40	4.43	6.50	6.40	6.30	6.20	9.40	7.80	7.50	7.70	5.40	6.30	6.90	6.10
SunTrust	2.85	4.18	3.62	3.75	2.36	2.57	3.11	2.30	6.04	8.43	8.54	5.67	5.48	4.81	4.51	4.72
Fifth Third	6.76	6.42	5.51	5.38	4.31	2.45	3.07	2.16	6.78	9.48	10.14	8.09	6.42	6.08	6.33	5.68
Regions	3.40	5.23	5.84	6.46	5.51	4.76	3.54	3.25	6.64	7.78	8.35	8.99	7.38	6.70	7.26	7.26
Northern Trust	4.85	6.25	6.13	6.00	5.30	4.30	3.90	3.90	7.40	7.80	7.60	6.20	6.30	7.80	7.00	6.80
M&T	3.19	2.72	3.20	3.20	2.91	2.85	3.78	3.18	4.83	4.30	5.08	5.26	5.39	7.07	7.21	6.70
KeyCorp	3.48	3.41	4.11	4.57	3.47	3.47	4.43	3.38	6.82	8.95	11.12	8.51	7.13	6.33	5.89	4.47
Comerica	3.58	3.70	3.76	4.71	4.75	3.75	3.63	3.20	6.72	8.93	6.54	6.25	2.10	5.05	4.54	4.91
Huntington	2.46	2.29	3.60	3.95	4.48	4.42	4.79	2.85	5.91	6.41	6.46	6.77	6.51	6.57	5.56	4.70
Zions	2.83	4.20	4.94	5.52	6.05	4.23	4.29	3.68	6.32	5.28	9.15	10.06	2.96	6.67	8.27	8.46

Note: The data are for the third quarter of 2015 or for the most recent quarter for which data are available.

Table A3. Risk-Weighted Assets as a Percentage of Total Assets

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
JPMorgan	62	66	60	66	68	71	69	67	57	59	55	54	54	58	63	63
Bank of America	84	81	79	78	71	70	72	71	73	69	64	60	55	62	60	65
Citigroup	72	66	63	59	57	59	56	57	51	59	51	52	52	58	70	70
WellsFargo	81	85	81	79	81	80	85	84	84	82	78	77	76	75	74	75
U.S. Bancorp	97	95	90	84	87	88	89	89	87	84	80	80	81	82	79	81
BNY Mellon	–	36	34	30	78	78	75	61	49	50	41	31	31	30	44	44
PNC	89	85	87	84	81	83	84	83	86	86	82	85	85	85	82	82
State Street	36	40	32	39	42	48	44	45	40	43	37	33	32	33	39	42
BB&T	71	72	72	73	73	74	75	75	72	71	75	69	74	75	77	80
SunTrust	93	96	92	91	86	88	89	92	86	80	77	75	78	85	85	87
Fifth Third	80	84	81	82	88	93	102	104	94	89	90	90	90	89	85	87
Regions	75	74	75	76	77	81	81	82	79	73	72	72	76	83	83	84
Northern Trust	70	65	69	67	67	64	65	66	62	59	61	57	60	57	57	–
M&T	84	85	84	88	86	86	87	86	56	61	57	92	92	86	80	–
KeyCorp	96	103	101	100	106	109	110	111	102	92	85	87	89	90	91	97
Comerica	85	116	113	113	117	121	122	120	108	104	111	104	102	99	99	97
Huntington	94	98	99	92	91	90	88	84	86	84	81	84	85	84	82	82
Zions	73	79	80	84	87	88	92	90	94	100	84	81	79	81	80	79

Note: The ratios for Fifth Third, KeyCorp, and Comerica exceed 100 percent because of off-balance-sheet items. Also, the data are for the third quarter of 2015 or for the most recent quarter for which data are available.

Table A4. Actual Leverage Ratio Minus Required Minimum Leverage Ratio of 4 Percent

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
JPMorgan	1.40	1.17	1.06	1.60	2.20	2.30	2.20	2.00	2.90	2.90	3.00	2.80	3.10	3.10	3.60	4.40
Bank of America	2.12	2.56	2.29	1.73	1.89	1.91	2.36	1.04	2.44	2.91	3.21	3.53	3.37	3.86	5.60	5.30
Citigroup	1.97	1.64	1.49	1.56	1.20	1.35	1.16	0.03	2.08	2.89	2.60	3.19	3.48	4.20	5.03	5.86
Wells Fargo	2.49	2.25	2.58	2.93	3.08	2.99	3.89	2.83	10.52	3.87	5.19	5.03	5.47	5.60	5.45	5.51
U.S. Bancorp	3.70	3.70	3.70	4.00	3.90	3.60	4.20	3.90	5.80	4.50	5.10	5.10	5.20	5.60	5.30	5.30
BNY Mellon	3.49	2.70	2.48	1.82	2.41	2.60	2.67	2.53	2.90	2.50	1.80	1.20	1.30	1.40	1.60	1.90
PNC	4.03	2.80	4.10	4.20	3.60	3.20	5.30	2.20	13.50	6.10	6.20	7.10	6.40	7.10	6.80	6.20
State Street	1.40	1.40	1.60	1.60	1.50	1.60	1.80	1.30	3.80	4.50	4.20	3.30	3.10	2.90	2.40	2.30
BB&T	3.30	3.20	2.90	3.15	3.10	3.20	3.20	3.20	5.90	4.50	5.10	5.00	4.20	5.30	5.90	3.00
SunTrust	2.98	3.94	3.30	3.37	2.64	2.65	3.23	2.90	6.45	6.90	6.94	4.75	4.91	5.58	5.64	5.68
Fifth Third	6.77	6.53	5.73	5.11	4.89	4.08	4.44	3.72	6.27	8.43	8.79	7.10	6.05	5.64	5.66	5.38
Regions	2.90	3.41	2.92	3.49	3.47	3.42	4.30	2.66	4.47	4.90	5.30	5.91	5.65	6.10	6.86	6.86
Northern Trust	2.91	3.93	3.76	3.60	3.60	3.10	2.70	2.80	4.50	4.80	4.80	3.30	4.20	3.90	3.80	3.80
M&T	2.66	2.55	3.05	2.98	2.73	2.94	3.20	2.59	4.35	4.43	5.33	5.28	6.07	6.78	6.17	6.31
KeyCorp	3.71	3.65	4.16	4.55	3.96	4.53	4.98	4.39	7.05	7.72	9.02	7.79	7.41	7.11	7.26	6.68
Comerica	4.90	5.36	5.30	6.13	6.37	5.99	5.76	5.26	7.77	9.25	7.26	6.92	6.52	6.82	6.44	6.29
Huntington	2.93	3.41	4.89	3.98	4.42	4.34	4.00	2.77	5.82	6.09	5.41	6.28	6.47	6.67	5.74	4.85
Zions	2.38	2.56	3.56	4.06	4.31	4.16	3.86	3.37	5.99	6.38	8.56	9.40	6.96	6.48	7.82	7.63

Note: The data are for the third quarter of 2015 or for the most recent quarter for which data are available.

Table A5. Actual Tangible Common Equity Ratio Minus Assumed Required Minimum Tangible Common Equity Ratio of 4 Percent

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
JPMorgan	(0.43)	(0.35)	0.22	0.59	1.09	0.82	0.87	0.76	(0.17)	1.27	1.59	1.62	2.26	2.35	2.46	3.23
Bank of America	1.47	1.96	1.83	1.03	0.79	0.24	0.14	(0.65)	(1.17)	0.51	1.86	2.52	2.63	3.10	3.38	3.69
Citigroup	1.52	0.98	0.70	0.53	0.51	0.68	(0.21)	(1.28)	(2.44)	2.49	2.89	3.90	4.46	5.05	5.47	6.06
Wells Fargo	2.01	1.59	1.71	2.11	2.25	2.12	3.15	1.93	(1.67)	1.44	2.72	3.40	4.04	4.13	4.08	4.21
U.S. Bancorp	2.18	1.52	1.71	2.12	2.45	2.29	1.17	0.74	(0.81)	1.10	1.22	2.00	2.54	2.72	2.67	2.84
BNY Mellon	1.78	1.36	–	0.91	1.56	1.68	1.14	(0.19)	(2.37)	(0.25)	(0.15)	(0.57)	(0.29)	(0.19)	(0.18)	(0.07)
PNC	1.75	1.13	2.59	2.30	1.68	1.05	3.34	0.61	(1.26)	(0.47)	3.43	4.53	4.34	4.77	4.88	5.40
State Street	0.71	0.67	0.93	0.55	0.53	0.75	1.15	(0.51)	(1.03)	1.36	2.30	1.17	1.54	0.89	0.38	0.70
BB&T	3.07	3.53	3.04	2.84	2.78	2.39	1.54	1.47	0.75	1.97	2.59	2.48	2.50	3.23	3.96	3.69
SunTrust	3.23	3.26	2.53	2.82	1.68	1.56	1.75	1.99	1.08	1.77	2.24	3.33	3.79	3.75	3.78	4.27
Fifth Third	5.42	–	5.42	4.44	4.34	2.86	3.78	2.03	0.31	2.64	3.30	5.04	5.10	4.69	4.71	5.60
Regions	2.91	2.77	2.64	3.08	2.86	2.64	2.53	1.88	1.23	2.03	1.86	2.42	4.62	5.09	5.61	5.07
Northern Trust	2.14	2.39	3.02	2.83	2.79	1.80	1.64	1.93	1.42	3.16	3.65	2.49	3.11	3.12	2.83	2.55
M&T	1.41	1.54	2.23	1.51	1.41	1.49	1.79	0.95	0.55	1.09	2.16	2.34	3.17	4.37	4.10	5.13
KeyCorp	2.12	2.33	2.73	2.94	2.35	2.68	3.01	2.58	1.95	3.56	4.19	5.88	6.02	5.70	5.80	6.04
Comerica	–	4.81	4.85	5.29	5.43	5.20	4.65	3.99	3.23	3.99	6.53	6.28	5.76	6.06	5.85	5.91
Huntington	–	2.12	3.62	2.80	3.18	3.19	2.87	0.81	(0.20)	1.74	3.42	4.20	4.69	4.77	4.13	3.84
Zions	1.34	1.98	2.06	2.53	2.80	1.37	1.98	1.70	1.85	2.12	2.99	2.77	3.09	4.02	5.48	5.76

Note: Negative values denoted by parentheses. Tangible common equity divided by tangible assets. Also, the data are for the third quarter of 2015 or for the most recent quarter for which data are available.

Table A6. Market Capitalization to Book Value Ratio

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
JPMorgan	2.15	1.79	1.16	1.66	1.32	1.29	1.44	1.19	0.87	1.04	0.99	0.71	0.86	1.10	1.10	1.02
Bank of America	1.56	2.03	2.08	2.46	1.90	1.82	1.80	1.29	0.51	0.67	0.64	0.28	0.57	0.75	0.84	0.70
Citigroup	3.98	3.26	2.12	2.58	2.31	2.17	2.30	1.30	0.52	0.62	0.84	0.43	0.64	0.80	0.82	0.72
Wells Fargo	3.64	2.71	2.63	2.92	2.80	2.61	2.64	2.11	1.84	1.35	1.39	1.13	1.24	1.55	1.72	1.53
U.S. Bancorp	2.92	2.48	2.21	2.98	2.98	2.70	3.16	2.74	2.39	1.76	1.88	1.65	1.74	2.03	2.08	1.79
BNY Mellon	6.77	4.71	2.60	3.05	2.80	2.49	2.46	1.90	1.29	1.17	1.16	0.72	0.85	1.11	1.26	1.20
PNC	3.34	2.73	1.74	2.28	2.18	2.12	2.01	1.51	1.24	1.11	1.08	0.94	0.87	1.08	1.18	1.07
State Street	6.16	4.40	2.65	3.03	2.66	2.91	3.09	2.78	1.56	1.49	1.31	1.04	1.06	1.60	1.67	1.44
BB&T	3.12	2.68	2.36	2.11	2.13	2.05	2.03	1.31	1.19	1.08	1.11	1.01	1.07	1.31	1.29	1.13
SunTrust	2.27	2.16	1.83	2.07	1.67	1.56	1.73	1.24	0.61	0.58	0.81	0.48	0.75	0.95	1.01	0.88
Fifth Third	5.69	4.68	3.97	3.93	2.96	2.22	2.27	1.46	0.61	0.78	1.12	0.91	1.01	1.33	1.17	0.95
Regions	1.74	1.71	1.77	1.85	1.54	1.47	1.32	0.83	0.41	0.44	0.66	0.41	0.67	0.89	0.89	0.74
Northern Trust	7.74	5.03	2.69	3.33	3.23	3.14	3.37	3.75	2.38	2.01	1.97	1.34	1.59	1.86	1.95	1.88
M&T	2.35	2.33	2.28	2.07	2.17	2.08	2.15	1.38	1.02	1.13	1.37	1.14	1.35	1.46	1.50	1.34
KeyCorp	1.54	1.79	1.68	1.56	1.75	1.94	1.76	1.97	1.18	0.57	0.61	0.93	0.76	0.78	1.19	1.17
Comerica	2.48	2.11	1.53	1.92	2.04	1.82	1.79	1.28	0.59	0.89	1.29	0.74	0.82	1.21	1.13	0.96
Huntington	1.72	1.79	1.89	2.26	2.26	2.08	1.86	0.91	0.52	0.72	1.28	0.94	1.00	1.41	1.44	1.37
Zions	3.06	2.13	1.50	2.17	2.19	1.88	1.85	0.99	0.57	0.46	0.96	0.65	0.80	1.01	0.91	0.85

Note: The data are for the third quarter of 2015 or for the most recent quarter for which data are available.

References

Acharya, Viral, Robert Engle, and Diane Pierret. 2014. "Testing Macroprudential Stress Tests: The Risk of Regulatory Risk Weights." *Journal of Monetary Economics* 65: 36–53.

Barth, James R., Gerard Caprio, Jr., and Ross Levine. 2012. *Guardians of Finance: Making Regulators Work for Us*. Cambridge, MA: MIT Press.

Barth, James R., and Stephen Miller. 2017. "Benefits and Costs of a Higher Bank Leverage Ratio." Arlington, VA: Mercatus Center at George Mason University.

Basel Committee on Banking Supervision (BCBS). July 1988. "International convergence of capital measurement and capital standards." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/publ/bcbs04a.htm.

———. January 1996. "Amendment to the Capital Accord to Incorporate Market Risks." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/publ/bcbs24.htm.

———. June 2004. "Amendment to the Capital Accord to Incorporate Market Risks." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/publ/bcbs107.htm.

———. July 2009. "Revisions to the Basel II Market Risk Framework—Final Version." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/publ/bcbs158.htm.

———. June 2011. "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems—Revised Version June 2011." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/publ/bcbs189.htm.

———. November 2014a. "The G-SIB Assessment Methodology—Score Calculation." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/bcbs/publ/d296.htm.

———. November 2014b. "Implementation of Basel Standards: A Report to G20 Leaders on Implementation of the Basel III Regulatory Reforms." Basel, Switzerland: Bank for International Settlements. http://www.bis.org/bcbs/publ/d299.htm.

Board of Governors of the Federal Reserve System. 2015. "Comprehensive Capital Analysis and Review 2015: Assessment Framework and Results." Washington, DC. http://www.federalreserve.gov/newsevents/press/bcreg/bcreg20150311a1.pdf.

Erel, Isil, Taylor Nadauld, and René M. Stulz. 2013. "Why Did Holdings of Highly Rated Securitization Tranches Differ So Much across Banks?" *Review of Financial Studies* 27 (2): 404–53.

Federal Deposit Insurance Corporation. 2014. "Regulatory Capital Interim Final Rule."

Haldane, Andrew G. 2011. "Capital Discipline." BIS Central Bankers' Speeches. http://www.bis.org/review/r110325a.pdf.

Kapstein, Ethan. 1991. “Supervising International Banks: Origins and Implications of the Basle Accord.” Essays in International Finance, No. 185. International Finance Section, Princeton University.

———. *Governing the Global Economy*. 1994. Cambridge, MA: Harvard University Press.

Killian, Thomas W. 2016. “Total Loss Absorbing Capacity (TLAC).” New York: Sandler O’Neill and Partners.

Miller, Stephen Matteo. Forthcoming. “The Recourse Rule, Regulatory Arbitrage and the Crisis.” Unpublished manuscript.

Office of the Inspector General. 2015. “The Board Identified Areas of Improvement for Its Supervisory Stress Testing Model Validation Activities, and Opportunities Exist for Further Enhancement.” https://oig.federalreserve.gov/reports/board-supervisory-stress-testing-model-validation-oct2015.pdf.