Introduction

Scene Setting, Preliminaries, Outline, and Main Findings

Setting the Scene

Bank stress tests—exercises designed to assess whether a bank or group of banks will be adequately capitalized even in an adverse economic scenario—have been conducted by the International Monetary Fund (IMF) since the late 1990s. National central banks and other regulatory authorities ran them even before that, and commercial and investment banks have stress tested their trading books for extreme movements in market prices for even longer.[1]

What put bank stress tests on the front page of major newspapers around the world, however, is of more recent origin. Specifically, a bank stress test (known as the Supervisory Capital Assessment Program, or SCAP) was used as an important tool of crisis management by US authorities in February–May 2009. The SCAP was announced on February 10, 2009, and the test results were released on May 7, 2009, only a few quarters after the fall of Lehman Brothers and at a juncture when anxiety about the viability of some large US financial institutions was still high and there was considerable uncertainty about US macroeconomic prospects.[2] To bolster the credibility of the test, bank-by-bank results were published, a new more stringent definition of high-quality bank capital was introduced (tier 1 common), and a severe loss rate on bank loans (over 9 percent—even higher than during the Great Depression) was employed in the adverse scenario.

Because the US crisis management effort had many important elements beyond bank stress tests, it is difficult to assess the impact of a single reform.[3] Nevertheless, there is by now a consensus that the 2009 US

stress test "worked." By "worked," I mean that the test results seemed to persuade market participants—both that 9 of the 19 largest US banks had sufficient capital to weather the storm and that the remaining 10 banks that fell short of the regulatory standard would be promptly recapitalized. Interbank lending spreads, credit default swap (CDS) spreads for pressured banks, and the volatility fear index in the broader US stock market all improved dramatically in the immediate aftermath of the SCAP, and the 10 banks identified as needing additional capital were able to raise, within a month of the test results, almost all ($66 billion of $75 billion) of the aggregate shortfall without additional government funds.

Former Federal Reserve Chair Ben Bernanke (2013, 1) offers the following assessment of the SCAP: "In retrospect, [it] stands out for me as one of the critical turning points in the financial crisis. It provided anxious investors with something they craved: credible information about losses at banks. Supervisors' public disclosure of the stress test results helped restore confidence in the banking system and enabled its successful recapitalization." In his recent memoir, Bernanke (2015, 397) confirms his earlier assessment: "The [SCAP] stress test was a decisive turning point. From then on, the US banking system would strengthen steadily—and eventually, the economy would follow." Alan Blinder (2013, 260) reaches a similar positive verdict on the impact of the SCAP: "Few people realized it at the time, but the successful (May 2009) stress tests were a turning point. The tests marked the end of the acute stage of the financial crisis and the beginning of the return to normalcy—albeit just the beginning. It wouldn't be long before everyone stopped worrying about the survival of the big American banks. Not long after that, these institutions started generating profits again."

Spurred by the enormous cost of the 2007–09 financial crisis and buoyed by the apparent success of the initial stress test, further rounds of US bank stress tests were conducted annually between 2011 and 2016.[4,5] Indeed, such stress tests have now been made a mandatory and permanent part of the US regulatory and supervisory framework.

Senior US regulatory officials—including New York Federal Reserve Bank President William Dudley (2012); Chairman Bernanke (2013); Federal Reserve Vice Chair Stanley Fischer (2014b); and Board of Governors member Daniel Tarullo (2014c, 2016)—have argued that US stress tests made an important contribution to financial stability. They point to the key role stress tests have played in strengthening the capital position of the industry, with the 33 bank holding companies participating in the 2016 Comprehensive Capital Analysis and Review (CCAR) stress test having more than doubled their (risk-based) common equity tier 1 (CET1) capital

(ratios) since the first quarter of 2009.[6] Similarly, banks' liquidity position has improved markedly relative to precrisis levels.[7]

US supervisors maintain that the process of looking at the group of large banks together in the stress tests facilitated a more "macroprudential" approach to supervision—that is, an approach focusing on the health of the entire banking system and the whole economy as opposed to that of an individual bank. The "horizontal" nature of the tests—that is, examining a number of banks simultaneously—is said to facilitate the identification of banks that are risk outliers in terms of their valuation practices or portfolios. Forward-looking stress testing is also regarded as better than static Basel-type regulatory approaches at evaluating complex exposures to derivative positions and to funding risks.

Going farther, it is argued that the transparency of the stress tests and the publication of results for individual banks have contributed to market discipline by making it easier for investors, counterparties, analysts, and markets to make more informed judgments about the financial condition of banks. Stress tests are also seen as having upped the ante for sound risk management, as failure to either meet the regulatory capital benchmark or demonstrate that the capital planning process is otherwise up to snuff carries nontrivial reputational cost. And last but not least, stress testing is credited with providing a helpful counterweight to the pressures sometimes facing banks to use capital distributions to signal financial strength, even when stressful conditions point to a need to conserve capital.

A second moment in the sun for bank stress tests has been their application in the European Union, first during the crisis of 2007–09 and later during the debt crisis of 2010–13 and the ongoing effort to create a banking union. The results of the first EU-wide bank stress test were released in October 2009. Additional EU-wide tests were completed in 2010 (July), 2011 (July), 2014 (October), and most recently in 2016 (July).

EU policymakers have regarded the EU-wide stress tests as necessary and helpful for obtaining a more objective assessment of the condition of the banking system. They also argue that concerns about failing the test have prompted banks to raise more capital than would be the case in the tests' absence. They point out that in recent years the (weighted) average risk-based capital ratios for the group of large and complex banks in the euro area were very close to or above those of their global peers (including large and complex US banks), even if this has not (in their view) been adequately reflected in equity prices for European banks.[8]

Release of the first EU-wide stress test results in 2009 was not immediately followed by a sharp improvement in confidence in EU or euro area banks. The market response to the 2010, 2011, 2014, and 2016 tests also seemed lackluster. Indeed, if one looks at market indicators of EU banking

stress/confidence immediately after the release of the five EU-wide stress tests results it is difficult to discern an independent, positive impact of the tests.[9,10] Appendix I at the end of this introductory chapter summarizes the "event studies" of the market impact of the US and EU-wide stress tests. It shows that the market received the US tests, especially the 2009 SCAP, more favorably than the EU-wide tests.

Preliminaries: Measurement of Bank Capital, the US Comprehensive Capital Analysis and Review, and the Dodd-Frank Act Stress Tests

Some definitions will be useful for readers unfamiliar with the arcane subject of the measurement of bank capital or the distinctions between the two main US stress testing exercises.

Measurement of Bank Capital

This volume makes reference to two types of bank capital ratios. The first—risk-based measures of capital—uses risk-weighted assets in the denominator. The second—leverage ratios—uses either unweighted total assets or total leverage exposure in the denominator. About 85 percent of risk weights reflect credit risk differences across assets; market and operational risk are also taken into account. Risk weights typically fall between 0 and 100 percent but can far exceed 100 percent for some very risky assets.

A simple numerical example illustrates the difference between a risk-based and a non-risk-weighted capital ratio. Suppose that a bank has total assets of $100 and equity capital of $5. Assume that the bank's total assets are composed of cash ($10), federal government bonds ($10), municipal bonds ($10), residential mortgage loans ($35), and commercial and industrial loans ($35). For simplicity, assume that bank regulators set the following risk weights on those assets: cash and federal government bonds (0 percent), municipal bonds (20 percent), residential mortgages (50 percent), and commercial and industrial loans (100 percent).[11] The bank's risk-weighted assets (RWA) are then the weighted average of the bank's assets, that is, RWA = ($10 times 0 percent, plus $10 times 0 percent, plus $10 times 20 percent, plus $35 times 50 percent, plus $35 times 100 percent) = $54.5. The risk-based capital ratio is the ratio of equity capital to RWA; that is $5/$54.5, or 9.2 percent. In contrast, the leverage ratio takes no account of these risk weights; it weights all assets equally. The leverage ratio is then simply the ratio of equity capital (E) to total assets (TA), or $5/$100, or 5 percent. A bank that has a leverage ratio of 5 percent is sometimes said to be "leveraged" twenty times (the reciprocal of the leverage ratio), while one that has a leverage ratio of 10 percent would be "leveraged" ten times.

The ratio of risk-weighted assets to total assets (sometimes called risk-weight density) differs significantly across countries and regions, across different size classes of banks, and over time. A few examples convey the flavor. At end-2015 the average risk-weight density for the eight US "global systemically important banks" (G-SIBs) was 63 percent; the figure for the 12 EU G-SIBs was 34 percent.[12] Among a sample of small EU banks (banks with total assets of less than €30 billion), the average risk-weight density was 62 percent—almost twice the level of the EU G-SIBs (Berger, Hüttl, and Merler 2016). In 1993 the average risk-weight density for a group of 17 major international banks stood at 70 percent; by end-2011 it had fallen to below 40 percent (Haldane 2013). With differences this large, it is easy to understand why regulatory and stress testing issues that deal with the application of risk-weighted capital ratios elicit such strong reaction from banks and their supervisors.

The other main source of differences among capital ratios derives from differences in the quality of bank capital, captured in the numerator of the capital ratio. The highest quality of capital is usually regarded to be common equity because it doesn't need to be repaid, it doesn't require payments of dividends or interest, and it stands last in the seniority line in bankruptcy or insolvency proceedings (Elliott 2010). Tangible common equity—defined as common equity minus intangible assets (goodwill, deferred tax assets, minority interest, etc.)—is of even higher quality than common equity because it has greater loss absorbency. In descending order of quality, this book makes reference to the following risk-based measures of capital:

- common equity tier 1, the equity measure at the center of Basel III,
- tier 1 common, the equity measure used in the earlier US stress tests,
- core tier 1, the equity measure used in the 2011 EU-wide stress test (usually defined as common equity plus government hybrid instruments),
- tier 1 capital, the high-quality capital measure used in the first two EU-wide stress tests,
- tier 2 capital, a lower-quality component of bank capital, and
- total capital adequacy ratio (CAR), the broadest measure of bank capital, consisting of tier 1 plus tier 2 capital.

The Basel Committee on Banking Supervision defines common equity tier 1 as consisting of the following components: (1) common shares issued by the bank that meet the criteria for classification as common shares for regulatory purposes; (2) stock surplus (share premium); (3) retained earnings; (4) accumulated other comprehensive income and other disclosed

reserves; (5) minority interest that meets the criteria for inclusion in CET1; and (6) regulatory adjustments.

The noncommon stock elements of tier 1 capital are mainly the kinds of preferred stock that are more like common stock. Tier 2 capital consists mainly of the kinds of preferred stock that are more like debt; it also includes subordinated debt.

This volume examines three leverage ratios (listed in descending order of quality):

- the tangible leverage ratio, defined as the ratio of adjusted tangible equity to adjusted tangible assets (see Hoenig 2016b)
- the Basel III tier 1 leverage ratio, defined as the ratio of tier 1 capital to total leverage exposure
- the tier 1 leverage ratio, defined as the ratio of tier 1 capital to total assets.[13]

Some researchers also employ a more generic set of leverage ratios, defined as the ratio of the book value of equity to the book value of total assets (using various definitions of equity). Total leverage exposure includes both on-balance-sheet assets and off-balance-sheet exposures, such as over-the-counter derivatives, cleared derivatives, repo-style transactions, and other off-balance-sheet exposures.[14] For banks that have large derivative books and that use US Generally Accepted Accounting Principles (GAAP), total leverage exposure is always larger than total assets (see Allahrakha, Glasserman, and Young 2015). For banks in countries that use International Financial Reporting Standards (IFRS), total leverage exposure can be close to or even below total leverage exposure (see Berger, Hüttl, and Merler 2016 and Dowd 2016a).

The supplementary leverage ratio and the enhanced supplementary leverage ratio are the US banking agencies' implementation of the Basel III leverage ratio. The enhanced supplementary leverage applies to the eight largest US bank holding companies that are designated as G-SIBs. The supplementary leverage ratio applies to other large US banks that meet certain size criteria (greater than or equal to $250 billion in total assets, or greater than or equal to $10 billion of on-balance-sheet foreign exposures). Banks that meet these criteria are classified as "advanced-approach" banks. All US banks, regardless of size, have long been required to meet a 4 percent tier 1 leverage ratio. The tier 1 leverage ratio is the leverage ratio used in the US CCAR tests and the Dodd-Frank Act Stress Tests (DFAST).

When comparing capital ratios across banking systems in different countries, it is important to recognize that different treatment of the netting of derivative positions under GAAP and IFRS accounting stan-

dards can have sizable effects on all leverage ratios that use either total assets or tangible assets in the denominator (see Goldstein 2016). GAAP allows a much more generous treatment of the netting of derivatives than does IFRS. As a result, total assets of US banks look much smaller under GAAP than under IFRS.[15] As total assets are in the denominator of certain leverage ratios (such as the tier 1 leverage ratio used in the CCAR), tangible leverage ratios and tier 1 leverage ratios for US banks look better under GAAP than under IFRS.

A few numbers convey the flavor. At end-2015, the weighted average tangible leverage ratio for the 8 US G-SIBs under US GAAP was 8.1 percent versus 6.0 percent under IFRS—a difference of over 200 basis points. We can do those conversions because the Federal Deposit Insurance Corporation (FDIC) regularly publishes a Global Capital Index that translates one into the other. Not surprisingly, the netting rule makes a big difference for banks with large derivative positions but not for others. JPMorgan Chase, with its huge derivative book, has a US GAAP tangible leverage ratio of 8.3 percent versus an IFRS one of 6.0 percent—a difference of roughly 230 basis points. In contrast, Wells Fargo, with a much smaller derivative book, has a difference between its GAAP and IFRS tangible leverage ratios of only 30 basis points. And for smaller US banks, the GAAP/IFRS difference does not matter at all.

The Basel III leverage ratio—and other leverage ratios based on it (like the supplementary leverage and the enhanced supplementary leverage) that use total leverage exposure in the denominator—are not subject to this apples versus oranges comparability problem, because Basel III has adopted a uniform netting formula that is a compromise between the GAAP and IFRS treatments. This rule is less generous on netting than US GAAP but more generous than IFRS. The compromise makes Basel III leverage ratios comparable across countries.[16]

Because the stricter minimum capital and liquidity requirements specified under Basel III are to be implemented during a transition period that runs through 2019 (but is different for different elements of the Basel III reform package; see table 4.1 in chapter 4), it has become standard to differentiate between "transitional" Basel III capital ratios and "fully loaded" Basel III ratios. "Transitional" means that the capital ratio in question is measured under Basel III's (more generous) transitional arrangements. "Fully loaded" means that the capital ratio is measured under the assumption that Basel III's final requirements were already in force.

Basel III is frequently described as having three pillars. Pillar 1 sets out minimum regulatory capital requirements, Pillar 2 deals with risk management and supervision, and Pillar 3 addresses market discipline, including disclosure requirements. A Pillar 1 capital requirement is rule based and

affords less discretion to supervisors than Pillar 2 measures. After an observation period, Pillar 2 measures can sometimes be upgraded to become Pillar 1 requirements.

The Comprehensive Capital Analysis and Review and the Dodd-Frank Act Stress Tests

Large US banks are now required to participate in two supervisory programs in which stress tests are a key component. The first is the stress testing required by the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act (known as DFAST). The second is the stress testing included in the wider annual capital plan assessment, the CCAR.

The CCAR covers only large complex US bank holding companies with total consolidated assets of $50 billion or more. It includes not only stress test methodology and results but also a more qualitative assessment of the risk management and capital planning process, including policies covering dividends, common stock issuance, and share repurchases. Such large bank holding companies are subject to both supervisor-led and company-run stress tests. In contrast, DFAST applies to a broader range of financial institutions, encompassing bank holding companies with total consolidated assets greater than $10 billion, state member banks with total consolidated assets greater than $10 billion, and savings and loan holding companies with total consolidated assets greater than $10 billion. All of these institutions are subject to company-run stress tests, but only the subset of bank holding companies with $50 billion or more in total consolidated assets is subject to supervisor-led tests. The focus of DFAST is exclusively on the quantitative outcomes of the stress tests. It does not set any capital hurdle rates or limit any capital actions by the firms; those functions are handled through the CCAR.

The two stress test exercises incorporate the same projections of losses, revenues, balances, and risk-weighted assets, but they use somewhat different capital action assumptions. The DFAST uses a set of capital action assumptions specified in the DFAST rules, whereas the CCAR uses a bank's planned capital actions under the bank's baseline scenario (see Board of Governors press release, October 30, 2015; Lehnert 2015; and Tarullo 2016). The Federal Reserve coordinates the two stress test exercises while seeking to reduce duplication and minimize the burden on banks (see Bernanke 2103, Board of Governors 2014a, and Tarullo 2014c). This study focuses on the CCAR tests because the quantitative results are very similar to those of the DFAST, because the CCAR provides information on capital hurdle rates, and because the qualitative part of the CCAR tests is also of interest.

Outline of the Study

This volume takes a critical look at the bank stress tests conducted by bank supervisors in the United States and the European Union between 2009 and 2016. It seeks to draw the lessons that would be most helpful for the design and conduct of future stress tests, not only in the United States and Europe but elsewhere as well.

A central thesis of the study is that the enormous costs of systemic banking crises, combined with the advantages that stress tests possess over other supervisory tools, make it likely that stress testing will become the central pillar of bank supervision worldwide. At the same time, unless several fundamental weaknesses of bank stress tests are corrected, the tests may fail to distinguish healthy banks from sick ones and produce false reassurance about the safety and soundness of the banking system as a whole.

Some important existing weaknesses in bank stress tests can be remedied within the current stress test and bank regulatory framework. Others cannot. Fixing them will require significant reform of the bank capital regime, first in the United States and ultimately at the global level. This is where the second part of this book, on bank capital reform, comes in. Three elements of the current bank capital regime are most in need of change. First, minimum capital requirements are much too low, despite the advances made under Basel III and the Dodd-Frank Act. Theory and empirical evidence suggest that for the eight US G-SIBs, the minimum capital ratio, expressed as an unweighted leverage ratio, ought to be 14 to 18 percent. The minimums for smaller US banks should be lower, in the 10 to 13 percent range. Current regulatory minimums (for leverage ratios) in the United States are in the 3 to 6 percent range, and the eight US G-SIBs currently have an actual average tangible leverage ratio of about 8 percent (in GAAP terms). For the largest US banks, minimum bank capital requirements are thus only about a third and actual leverage ratios only about half of what they should be.

Second, the existing bank capital regime has made risk-based measures of bank capital the primary regulatory standard and unweighted leverage ratios the supplementary backup standard. But a large body of empirical evidence shows that in terms of ability to distinguish sick from healthy (large) banks, vulnerability to manipulation (by banks), the cost of implementation, and ease of understanding, the leverage ratio is far superior to the risk-based measures. We have it backwards. The leverage ratio should thus be the primary capital standard, and the risk-based measures should serve as a backup. This volume shows how this can be done, at low cost and without giving banks a large incentive to shift into high-risk activities.

Third, although the bank capital regime recognizes that failure of a G-SIB imposes larger losses on society than failure of a smaller bank, the capital surcharges (i.e., the additional capital requirements) G-SIBs face are too low. In terms of risk-based capital measures, the minimum capital ratio requirement for the largest bank in the United States is just 450 basis points more than for a small bank; in terms of a leverage ratio, the maximum surcharge is about 200 to 300 basis points. In addition, on average US G-SIBs maintain lower leverage ratios than non-G-SIBs. To right this imbalance and make expected losses at G-SIBs no higher than for non-too-big-to-fail banks, the difference in minimum leverage requirements between G-SIBs and small banks (banks with less than $50 billion in total assets) should be in the neighborhood of 400 to 800 basis points, not 200 to 300 basis points.

With these shortcomings of the current bank regulatory regime in mind, consider what it means to "pass" a stress test. A bank is deemed to pass the quantitative part of the CCAR test if its capital ratio does not fall below the prespecified hurdle rates not only in the baseline scenario but also in the adverse and severely adverse scenarios. As noted earlier, these capital hurdle rates are typically set at the minimum regulatory standard. In the 2016 CCAR test, for example, two of the key hurdle rates were 4.5 percent for the risk-weighted common equity tier 1 capital ratio and 4 percent for the (unweighted) tier 1 leverage ratio. Both hurdle rates were the same for all 33 of the bank holding companies participating in the test.

But what if this 4 percent hurdle rate for the tier 1 leverage ratio is way below the ratio that would maximize net social benefits for the US economy? What if the risk-weighted common equity tier 1 measure of capital is not the measure that best distinguishes sick from healthy banks? And what if the social consequences stemming from the insolvency of JPMorgan Chase (with its almost $2.5 trillion in total consolidated assets as of end-June 2016) during a severe financial crisis are much more damaging than the insolvency of Zions Bancorporation (with less than $60 billion in total consolidated assets)? If these suppositions are correct, the fact that all 33 bank holding companies passed the quantitative part of the test has less economic significance than it would if more appropriate hurdle rates were set. As in other walks of life, a pass or fail verdict is not necessarily a sufficient statistic for drawing valid inferences about the test takers.

The primary purpose of bank capital reform is broader than improving the quality and credibility of bank stress tests. It is to reduce the probability and severity of banking crises and to reduce the day-to-day distortions that come about if banks—especially the largest too big to fail banks—are permitted to operate with a fragile, debt-heavy, equity-light funding structure that is unlike that in most other nonfinancial corporations

(Admati and Hellwig 2013a, Admati 2016a, 2016b). In this sense bank capital reform, writ large, is more important than the narrower objective of improving stress testing. Bank-capital reform would not only increase the credibility of stress testing, it would also generate large, wider-ranging benefits in terms of bolstering financial stability.

Going in the other direction, effective stress testing can likewise improve the prospects for bank-capital reform. The stigma attached to publicly failing a stress test and having bank supervisors reject a bank's capital plan—including approval for dividend payments and share buybacks—appears to generate more and faster bank capital raising than would occur in the absence of stress testing. A CEO whose large bank fails the Federal Reserve's annual supervisor-led stress test twice in a row may find his job in jeopardy.

As hinted at earlier, stress tests also have other attributes that help compensate for some of the weaknesses of regulatory capital ratios alone. Whereas Basel capital requirements are backward-looking and rigid in design, stress tests address tail risk in forward-looking scenarios and those scenarios can be custom-tailored to meet the specifics of a given country or region's risk profile. Whereas regulatory capital ratios usually lean heavily on aggregate banking data, stress tests, with their bank-by-bank results and greater granularity, provide the horizontal comparisons that market participants value, especially in a crisis. And whereas the setting of regulatory capital ratios has been heavily dependent on the (low) historical probability of banking crises, stress tests employ the less demanding but often more revealing standard that their adverse risk scenarios have to be "severe but plausible." This standard permits stress tests to consider a wider set of crisis vulnerabilities. Finally, if the hurdle rates are appropriately defined and set at the right level, stress tests also provide a simple and understandable metric with which to evaluate the capital adequacy of banks—namely, a comparison of what the capital ratio would be under adverse conditions with the capital hurdle rate.

In short, more credible stress testing and serious bank-capital reform are complements. Achieving both would represent a quantum jump in crisis resistance at low social cost.

This volume is organized as follows. Chapter 1 explores why many analysts (including me) were not impressed with the outcomes of the five EU-wide stress tests. It highlights several important differences between the designs of the EU-wide tests and those of the US tests.

Chapter 2 reviews the main operational features of the US and EU tests: the coordinating supervisor, coverage, frequency, time horizons, design of the baseline and adverse scenarios, models used, definition and height of hurdle rates for bank capital, outcome metrics, disclosure practices, and

remedial actions required or recommended for banks that fail the test.[17] It also summarizes the ways in which bank stress tests have evolved since 2009.

Chapter 3 turns to three fundamental criticisms that have been leveled at stress testing methodology and measurement:

- Whatever their helpful role in crisis management, stress tests were a dismal failure as early warning indicators of systemic banking crises in the global economic and financial crisis of 2007–09.
- Stress tests are too "orderly" and do not capture adequately the chaos, contagion, and adverse feedback and amplification effects from the financial sector to the real sector, all of which make financial crises much more costly than normal recessions.
- Stress tests (following the Basel framework) have relied on risk-based measures of bank capital to measure capital adequacy, at just the time when an increasing share of analysts are concluding that risk-based measures of capital should be deemphasized relative to a simpler but more reliable unweighted measure (a leverage ratio).

Chapter 4 lays out the case for thinking that stress tests should be more ambitious than Basel III in setting out bank capital minimums. Three complementary approaches to assessing socially optimal capital ratios are analyzed: an approach that looks at bank losses during a country's most severe banking crisis, a macroprudential approach that focuses on the banking system's ability to support lending and economic growth and highlights runs by wholesale creditors and fire sales by banks under stress, and a benefit-cost approach that weighs the effects of heightened capital requirements on the availability and cost of bank credit against its contribution to reducing the probability of banking crises. Based on my review of theory and empirical evidence, I conclude that the socially optimal bank capital ratio is likely far above both current levels and the Basel III minimums. An immediate policy implication of this finding is that future stress tests should, over the next decade, gradually increase capital hurdle rates until they closely approximate the socially optimal capital ratio.

Chapter 5 examines three frameworks for estimated appropriate capital surcharges for G-SIBs: an approach that compares systemic importance scores to leverage ratios; the Bank of England's "symmetry and proportionality approach," which derives G-SIB leverage surcharges as a proportion of G-SIB surcharges for risk-based capital measures; and the Federal Reserve's "estimated impact" approach, which compares expected systemic losses for G-SIBs and non-G-SIBs. I conclude that the current capital surcharges for G-SIBs in the United States (and elsewhere) are too low. Future stress tests should therefore increase, over time, the amount of differentiation across

different banks, with higher hurdle rates set for banks with the highest expected systemic loss (should they fail).

Chapter 6 draws seven lessons for future bank stress tests, based mainly on the US and EU-wide stress testing experiences of 2009–16.

Chapter 7 sketches the outlines of an improved bank capital regime for the United States. It puts forward a plan for a three-level bank capital structure, with a minimum leverage ratio of 10 percent for small banks (with total assets less than $50 billion), 11 to 13 percent for large banks, and 14 to 18 percent for G-SIBs. Under the plan, banks would have 10 years to meet the final capital targets, and interim targets would be incorporated in stress tests. The plan also includes a recommendation for using a set of risk indicators to construct a risk surcharge. This risk surcharge is meant to compensate for some of the weaknesses of current stress tests and to discourage banks from gaming the unweighted leverage ratio by loading up on unduly on risky assets. I also lay out the advantages of such a plan.

Chapter 8 addresses four potential criticisms of the plan: (1) that such a schedule of much heightened minimum leverage ratio requirements is a step too far for banking reform, with little chance of being implemented; (2) that a much higher capital requirement cum larger G-SIB capital surcharges would generate a marked shrinkage in the sizes of large banks, of the banking system, and of the financial sector as a whole—all with adverse effects on efficiency and economic growth; (3) that such high capital requirements for banks would cause financial activity to migrate to less regulated shadow banks, thereby putting financial stability at risk; and (4) that a much higher equity requirement for bank capital is no longer needed, now that the G-20 economies have reached agreement on a total loss-absorbing capacity (TLAC) initiative, which requires G-SIBs to hold 18 percent of their risk-weighted assets in TLAC instruments (equity plus debt that converts to equity under prespecified conditions) (G-20 2014).

In chapter 8, I also argue that objections 1, 2, and 4 (above) are not persuasive. Objection 3 is more weighty. That risk, however, could be combatted, if necessary, by adopting Mervyn King's (2016) "pawnbroker for all seasons" proposal, aimed at "run-proofing" the financial system. Under this scheme, all financial institutions (banks and shadow banks) that chose to issue liabilities with a maturity of one year or less would have to limit the amount of those short-term liabilities to the sum of reserves at the central bank and the haircut-adjusted value of their assets, as estimated by the central bank (the pawnbroker). The scheme would be phased in over 10 to 15 years. Chapter 8 also includes some brief concluding remarks.

Chapter 9 is a postscript. Shortly after most of the writing for this book was being completed, two developments took place that are particularly relevant for bank-capital reform and stress testing. First and most

important, Donald Trump, the newly elected president of the United States, announced that he was in favor of major deregulation of the financial system, including banks. And second, following a review of its stress test program, the Federal Reserve announced a set of reforms to its stress testing procedures (Tarullo 2016). Chapter 9 briefly discusses the likely and/or proposed policy changes and provides my preliminary reactions to them.

Readers whose main interest is in stress testing may want to focus on chapters 1 to 3 and chapters 6 and 9. Readers whose bailiwick is bank-capital reform will find chapters 4 to 5 and 7 to 9 to be of primary interest. Given the importance of both topics for the current debate on whether large US banks are now safe enough, I hope most readers will go for the Full Monty.

Main Findings

This is a long book. I therefore provide a summary of the volume's main findings. Those for stress tests are covered first, followed by those for bank-capital reform.

On Stress Tests

1. Stress tests are here to say. If certain current weaknesses can be remedied, their influence is likely to increase even further relative to other bank supervisory tools.

2. The most successful single stress test over the 2009–16 period was the 2009 SCAP in the United States. So far stress testing has been more successful as a crisis management instrument than as an early warning or crisis prevention mechanism.

3. On the whole, the set of EU-wide stress tests received poorer reception by markets and officials (away from home) than the US tests.

4. There are good reasons for the poor reception of the EU-wide tests. They include lack of authority (in the 2009–11 tests) to compel (rather than just recommend) recapitalization for undercapitalized banks; a weak supporting crisis management cast for stress tests (which produced an anemic recovery from the 2007–09 crisis); outside estimates of capital shortfalls that were consistently higher than those emanating from the stress tests; likely overstatement of capital ratios as a result of low loan-loss provisioning and low credit write-downs; and a failure (in the 2011 EU-wide capital exercise) to specify capital targets in terms of absolute amounts rather than as a ratio. In addition, a leverage ratio test was not introduced until the 2016

test, thereby allowing large German, French, and Dutch banks with high risk-weighted capital ratios but low leverage ratios to fare much better on the tests than they should have. Although the 2014 and 2016 EU-wide tests contained some notable improvements relative to their predecessors, they had major shortcomings of their own. The 2014 test contained neither a leverage ratio test nor an adverse deflation scenario, and it allowed participating banks in some EU countries to inflate their capital ratios by being too lenient on tax-deferred assets and credits. The 2016 test made a major step forward by including data on fully loaded Basel III leverage ratios, but it then took a major step backward by suspending the use of hurdle rates, choosing instead to treat the stress test results as merely an input into the Supervisory Review and Evaluation Process (SREP). This decision is likely to retard future capital raising—just when it is badly needed and when there are justified concerns about a potential Italian banking crisis and the viability of Deutsche Bank.

5. Banks participating in stress tests should account for a substantial part of the banking system's assets. If the country's financial system is not bank dominated, a way needs to be found to assess how fragilities in the nonbank sector and in systemically important nonbanks could affect the banking system. This guideline is particularly relevant in the United States, where the nonbank sector is dominant and played an important role in the 2007–09 crisis.

6. The supervisor coordinating the tests should have not only the resources and authority to obtain the necessary private data inputs from the banks but also the capacity to evaluate independently the quality of those inputs as well as the impact of the shocks assumed in the scenarios on bank capital. Over time supervisors should seek to develop their own suites of models, both to guard against model risk from a particular model or two and to validate the reasonableness of models used by the banks in any bank-run tests.

7. Test coordinators must have the political independence to be able to call the results of the tests as they see them. If instead markets perceive that the tests are "rigged" to produce an overly optimistic and politically convenient pattern of outcomes for bank failures and the aggregate capital shortfall, publication is likely to do little to bolster confidence. This caveat applies with particular force to the EU-wide stress tests, where too many national discretions in the definition of bank capital have weakened its quality and outmoded provisioning and credit write-down practices (in some EU economies) have allowed a large stock of nonperforming loans (now estimated at €950 billion) to languish on banks' books for far too long.

8. Since stress test scenarios are meant to be "what if" exercises, it is not helpful to rule out certain scenarios just because they run counter to current policy objectives. Likewise, it detracts from their credibility if the scenarios cover only a minor part of the relevant risk exposures or the look-back periods used to estimate the impact of the shocks are not long enough to encompass some of the most severe banking crises in the country's history. In short, stress tests are not likely to be reassuring if they do not contain much stress.

9. The quality of the capital contained in the hurdle rate matters, especially in a crisis, when there are more losses to absorb. During the worst of the global financial crisis, the only capital ratios that market participants were interested in were those that had tangible equity in the numerator (see Tarullo 2011). Trying to make stress test results look better by inflating artificially the headline capital ratio—by choosing a low-quality capital measure for the hurdle rate—is a mug's game.

10. Disclosure of bank-by-bank results is essential for obtaining the market discipline effects of stress tests. All US tests except the 2011 CCAR and all EU-wide tests except the initial 2009 test have included bank-by-bank results. There is little indication that stress test disclosure has led to reduced production of information by private firms. The decision by US supervisors not to publish the models they use to translate the impact of shocks on bank capital is the right one. Disclosure of these models would weaken banks' incentives to improve their own models and increase the risk that banks would game their portfolios to fit the properties of the supervisors' models.

11. Linking the results of the stress test with remedial actions to correct undercapitalization is crucial. The innovation of the US CCAR exercises—to embed the stress tests in the capital planning process of banks—is a good one that merits serious consideration in other jurisdictions. Bank supervisors need a mandate to temporarily suspend dividend payments, share buybacks, and parts of executive compensation when capita hurdle rates in stress tests are not achieved as well as the will to enforce that mandate.

12. If severely undercapitalized banks are unable to raise enough capital from private markets and the decision is made not to close them, enough public funds need to be available to make public recapitalization feasible. If there is considerable doubt about their availability, it will be difficult to make stress test results credible, because market participants may well reason that the stress test architects are lowballing the capital shortfalls to match the small amount of recapitalization resources.

13. Bank stress tests do not operate in a vacuum. If the supporting crisis management cast is weak and there is a nontrivial probability that banks will face very large losses, it will be tough to sell reassuring stress test outcomes, no matter how skillful the design of the tests.

14. Official stress test estimates of capital shortfalls will be less credible when outside estimates of these shortfalls are consistently much larger. When the gap between official and private shortfall estimates is large, officials should address the main reasons for this discrepancy.

15. It is troubling that stress tests performed so poorly in the run-up to the worst economic and financial crisis since the Great Depression, failing to provide early warning of the banking system's vulnerability not just in the United States but in almost all the economies that subsequently experienced systemic banking crises in 2007–09. Two corrective actions are called for.

16. First, the authorities need to draw more heavily on early warning models of banking crises and integrate them into the stress testing exercise. These top-down, dual threshold models find that banking system vulnerability is greatest when there is both an abnormally rapid rate of growth in credit to the nonfinancial private sector and an abnormally rapid rise in real property prices. These models performed well in forecasting most of the major systemic banking crises of the past several decades, including the 2007–09 episodes. Fortunately, parsimonious models can be estimated and evaluated in any economy with decent time series data on credit aggregates and property prices.

17. Second, the modeling of the financial sector during a crisis needs to include enough feedback, contagion, and amplification effects that a seemingly moderate shock to the banking system can produce the kind of real economy and bank-capital effects observed in an actual severe crisis. Current stress test models do not incorporate enough elements of the leverage cycle, enough shifts in expectations, enough funding problems, enough fire sales of assets, enough nonlinearities and fat tails, enough interaction between the bank and nonbank financial sectors, and enough adaptation by agents. In addition, there are signs that the outcomes of the past few CCAR tests are becoming too predictable for comfort. These analytical issues are not a technical sideshow. In stress test modeling, they are the main event. Even the most advanced stress testing programs admit that they are in the early stages of dealing with this difficult challenge. Until they get farther, true capital shortfalls are likely to be underestimated.

18. Taking a cue from the macroprudential approach to bank supervision, when stress tests indicate that a bank is undercapitalized, the capital target should be expressed in terms of the absolute amount of capital that should be raised. If instead supervisors allow banks to choose how they will achieve the higher capital ratio, there is a good chance the banks will opt to make much of the adjustment by cutting back on loans, engaging in fire sales of assets, and derisking (i.e., rearranging their portfolio or redoing their internal risk-weight models), all with the aim of reducing their risk-weighted assets. The problem is that these methods of lowering the denominator of the capital ratio will not be the lowest-cost option for the macroeconomy. They will be contractionary.

19. All stress tests should contain a leverage ratio test. Almost all of the largest US banks that ran into trouble during the global financial crisis had risk-weighted capital measures that allowed them to be classified as "well capitalized" on their last reports while low leverage ratios were simultaneously pointing to very thin capital cushions (Hoenig 2012, 2013). The story was similar in Europe. This situation could be avoided in the future by requiring a leverage ratio test. US stress tests have contained a leverage ratio test since 2011. The EU-wide tests added one only in 2016.

20. Since the weight of the evidence points to optimal capital ratios being far above the minimum ratios set under Basel III (as well as under current US regulatory requirements), the message for stress test architects is that they need to be raising capital hurdle rates over time until this gap is eliminated.

On Bank-Capital Reform

1. None of the approaches to estimating optimal capital ratios—be it the bank losses approach, the macroprudential approach, or the benefit-cost approach—is comprehensive enough on its own to provide a good guide. In addition, there is no sense in pretending that estimates of optimal capital carry a high degree of precision. Better therefore to combine the insights from all of these approaches to reach a sensible judgment call on the preferred answer. My call is that the optimal (weighted-average) leverage ratio for US banks should be in the neighborhood of 15 percent—with the eight G-SIBs in the 14 to 18 percent range, other large banks (banks with $50 billion or more in total assets) in the 11 to 13 percent range, and small banks at 10 percent.

2. The consensus in official circles is for a much lower leverage ratio. For US banks, minimum leverage ratios are in the 4 to 6 percent range. The

minimum for the Basel III leverage ratio is 3 percent. Actual leverage ratios (be it tangible equity ratios or tier 1 leverage ratios) for the eight US G-SIBs (in US GAAP terms) currently stand at (a weighted average of) about 8 to 9 percent. The official consensus is wrong: It underestimates the benefits of higher capital ratios and overestimates the costs.

3. When implementing the "losses approach" to bank capital, the consensus relies exclusively on observed losses incurred by banks, with particular attention (rightly) devoted to the 2007–09 global financial crisis. The consensus ignores "counterfactual" losses. By counterfactual losses, I mean the losses that banks would have suffered in the global crisis had there not been such a massive and multifaceted array of government interventions. Without those interventions—including widespread government guarantees, public capital injections into banks and measures to aid the asset-backed securities markets, not just super-easy monetary policy and large fiscal expansion—bank losses would surely have been much higher. Note too that a proper treatment of the counterfactual (for US banks) would include not only the effect of US crisis intervention measures but also those of other G-20 governments since those foreign interventions also helped reduce US bank losses. IMF (2009, 2010b) data indicate that observed (peak) credit write-downs by US banks during the global financial crisis amounted to more than 8 percent of their total assets; counterfactual losses would have been much bigger. The counterfactual is highly relevant because G-20 leaders have pledged publicly not to repeat this extraordinary set of government interventions during any future crisis. Ignoring the counterfactual is a major methodological error and seriously biases downward the consensus' estimate of optimal capital.

4. Another common procedure in implementing the losses approach is to assume that after suffering losses during the upswing of the business cycle, banks can run their capital down very close to zero. This assumption ignores the fact that banks typically maintain capital ratios (for both risk-weighted capital and leverage ratios) considerably above the regulatory minimum at the bottom of the credit/financial cycle (reflecting market pressures to do so). The right question is therefore how much capital would banks need to sustain the losses experienced during the upswing of the credit cycle and still have enough capital left to meet market pressures at the bottom of the cycle (Hanson, Kashyap, and Stein 2011). Correcting this omission of market pressure to hold adequate capital leads to a higher optimal capital ratio than when assuming unrealistically that banks can operate (after credit losses) with near-zero capital ratios.

5. The consensus chooses to measure bank losses during the global financial crisis using an income statement approach rather than a balance sheet approach. Using net income as the preferred measure of losses leads to a lower estimate of the optimal capital ratio because credit losses are offset against bank revenues and those revenues usually do not stay negative for long in a surviving bank, even in a severe crisis. But in severe crisis conditions, when many banks are failing or close to failing, market participants will find it difficult to know which banks will survive long enough to earn those positive revenues over the next year or two. Put in other words, they won't know which banks are "going concerns" and which are "gone concerns." What market participants think about potential bank losses and bank survival matters because that perception is important for bank runs and subsequent fire sales. The better assumption for measuring losses during the worst financial crisis since the Great Depression is to use the balance sheet approach, which yields a higher optimal capital ratio.

6. The consensus also takes little account of either earnings management or survivorship bias in measuring bank losses during the 2007–09 crisis. By earnings management, I mean using discretionary measures—such as taking lower loan-loss provisions and showing lower realization of losses on securities—to smooth net earnings during a crisis and to avoid reporting large(r) losses. By survivorship bias, I mean dropping from the sample some banks that did not survive the crisis. Suffice to say that the studies reviewed in chapter 5 indicate that both of these distortions to observed bank losses were present during the global financial crisis. Even though we don't as yet have a good estimate of their combined effect, there is no question that earnings management and survivorship bias have biased down the consensus estimate of the optimal capital ratio.

7. When looking at peak losses during earlier systemic banking crises, there is a choice between focusing on the average/median in the sample or paying more attention to (relevant) extreme observations. The consensus almost always sticks to the average, even though the worst crises can involve losses many times larger than the mean loss. In a similar vein, the consensus typically measures losses on an annual or semiannual basis, which smooths peak losses relative to quarterly data. While reasonable people could differ on which crisis observations are the most relevant for a future US crisis, the consensus tendency to downplay the extremes leads it to a lower optimal capital ratio.

8. The consensus usually fails to incorporate a key insight from the macroprudential approach to bank supervision—namely, that the capital ratio that the economy needs both to sustain a healthy rate of bank lending and

to remain solvent against bank losses in a crisis is higher than the capital ratio needed just to absorb losses (BCBS 2010d).

9. Yet another sin of omission committed by the consensus is to see bank capital solely as "solvency" protection and not to take account of the "liquidity" benefits of higher capital. Recent empirical studies (for example, Pierret 2015) show that a bank's capital shortfall under stress influences how much debt it can raise. Similarly, the macroprudential approach highlights that where there is substantial reliance on uninsured wholesale financing, the "run point" for a systemic bank is at a higher capital rate than the solvency point. The message here is that while higher bank capital may not be the main supervisory tool for discouraging runs and fire sales, it helps a good deal—and this benefit needs to be accounted for in estimating the optimal capital ratio.

10. The consensus usually assumes that output losses in systemic banking crises are mostly temporary and do not have a large negative impact on potential output. Recent research has put this assumption in doubt. It finds that during the global financial crisis, the negative effect on potential output in advanced economies was about as large as the effect on actual output (e.g., Ball 2014a, 2014b). This raises the output cost of a systemic bank crisis from the 60 percent of GDP level commonly employed in the consensus to as much as 200 percent of GDP. Ceteris paribus, the higher the output cost of a banking crisis, the higher the optimal capital ratio.

11. The consensus uses historical databases on the unconditional annual probability of a systemic banking crisis (in a large group of advanced and developing countries) to drive its estimate of the benefits of higher capital ratios. This probability is typically assumed to be in the range of 2 to 5 percent. With such a low probability, it does not take much capital before the reduction in the probability of a crisis induced by higher capital ratios hits zero. At that point the marginal benefit from higher capital ratios also hits zero, because that benefit is the product of the change in the crisis probability and the output cost of a crisis.

The rub is that the historical probability of a crisis may not be a good guide to future crisis probabilities. This probability fluctuated sharply across subperiods in the international sample, and it was higher in the United States in 1892–1933 than it was in 1934–2007.[18] The historical probability of large losses at large US banks during the 1986–2005 period provided a very poor forecast (way too optimistic) of the losses experienced by those banks during the 2007–09 crisis (Kuritzkes and Schuermann 2007). Nor does the (average) historical crisis probability fully capture the

rise of the US shadow banking system, with its large stock of uninsured, runnable, short-term liabilities and the potential adverse spillover effects on the banking system of another run on these shadow banks. Setbacks to the crisis management arsenal that have taken place in the wake of the 2007–09 crisis also count—for both future crisis severity and probability. Here, former US Treasury Secretary Timothy Geithner (2016) underlines that of 21 financial crisis tools used during the 2007–09 crisis (spanning lending, guarantee, and bank-capital programs), 12 of them could not be activated if needed today. Likewise, monetary and fiscal policy tools are more constrained today than they were in 2007.

A sensible guideline for crisis prevention is to hope for the best but prepare for the worst. A poor substitute is to hope for the best but prepare for the global average.

12. At the heart of the banking industry's opposition to much higher capital requirements is the assertion that higher bank capital requirements will depress bank lending and thereby reduce output and employment in the economy. This assertion is increasingly at odds with the empirical evidence—as well as with the appraisals of senior bank supervisors. I cannot emphasize this enough: Better-capitalized banks lend more, not less, than weakly capitalized ones. One impressive recent study, which looked at 105 large banks from advanced economies over the 1994–2012 period, finds that after holding other factors constant, a 1 percentage point increase in the equity to total assets ratio (i.e., leverage ratio) is associated with a 0.6 percent increase in total lending growth (Gambacorta and Shin 2016; see also Cohen and Scatigna 2014 and Cecchetti 2014 for similar findings). With this empirical finding, a key pillar of the case against much higher capital requirements is taken away.

13. In a parallel fashion, the consensus view of the effect of higher capital requirements on banks' overall funding cost sits on shaky ground. Most estimates either fail to allow for any Modigliani-Miller (M&M) offset or, if they do, focus too much on the cost of new equity and not enough on the cost of raising new debt financing. The M&M theorem (1958) shows that under certain assumptions, shifting a firm's capital structure away from debt toward equity leaves the firm's total funding cost unchanged. Because of favorable tax treatment of debt (relative to dividends), subsidies granted to too big to fail banks, deposit insurance, bankruptcy costs, and principal-agent problems, the M&M theorem does not hold strictly in the real world. Still, its fundamental insight—that higher equity reduces the riskiness of both equity and debt and therefore lowers the required rate of return, blunting any sizable increase in overall financing costs—is a much better approximation than the doomsday claims of the banking industry.

Focusing on the effect of higher capital on debt funding costs makes sense because debt is the dominant form of financing for banks. Gambacorta and Shin (2016) report important new empirical evidence on the effect of higher bank capital on bank funding costs. They use a comprehensive database on 105 large banks in 14 advanced economies over the 1994–2012 period. They find that, all else equal, a 1 percentage point increase in the equity to total assets (leverage) ratio was associated with approximately a 4-basis-point reduction in the average cost of debt funding. They then use this estimate, along with data on the "average" bank in their sample, to calculate the overall change in the cost of bank funding from a 1 percentage point increase in the leverage ratio. Their answer is 3 basis points. They argue that even this modest estimate probably overstates the true effect, because it does not allow the cost of equity funding to fall as the funding mix shifts toward equity.

Using the estimates of Gambacorta and Shin (2016) and Hanson, Kashyap, and Stein (2011) and assuming that 80 percent of the increase in bank funding costs were passed on to bank customers would imply that an 800-basis-point increase in the G-SIB leverage ratio—from its current (weighted-average) level of about 8 to 16 percent—would yield an increase in G-SIB bank lending rates of only 20 basis points.[19] Since G-SIBs represent a little above 60 percent of total consolidated US bank holding company assets, the increase in overall bank lending rates would be lower still—about 12 basis points.[20] And as I show in chapter 7, even when this large increase in minimum leverage requirements for G-SIBs is paired with more modest increases in minimum leverage ratios for large non-G-SIB banks and for smaller banks, the increase in overall bank lending rates is only 14 basis points. The consensus typically assumes an increase in bank lending rates considerably higher than that. All else equal, the lower the increase in bank lending spreads, the higher the optimal capital ratio.

14. It is useful to compare my estimated 20-basis-point increase in G-SIB bank funding costs (linked to much higher capital requirements) to the estimated bank funding effects of too big to fail subsidies for systemically important banks (SIBs). In the IMF (2014a) estimates, the annual too big to fail subsidy was lowest for US SIBs, at roughly 15 basis points in normal periods, but rising to 75 basis points for a distressed SIB. Too big to fail subsidies were higher for Japanese, UK, and euro area banks. As these subsidies are funded by the government, elimination of them should not count as a social cost. The bottom line is that a 20-basis-point-plus increase in G-SIB bank lending rates represents a negligible social cost. And the lower the social costs of higher capital ratios, the higher the optimal capital ratio.

15. To translate any increase in bank funding costs into increases in bank lending rates, the consensus almost always assumes full pass-through. The argument for doing so is that failure to pass on fully the increase in funding costs would induce resources to leave the banking industry, with adverse consequences for economic growth. However, as chapter 8 shows, beyond a certain threshold (which US and EU financial systems have already passed), a larger banking and a large financial system become a drag on economic growth, not a spur to it.

16. The recent empirical evidence is not kind to the full pass-through assumption. Cecchetti (2014) examines the effects of the Basel III capital increases using data for 15 large economies. Comparing indicators of bank performance in 2013 and the average for 2000–07, he finds that profitability, net interest margins, and operating costs were all lower in 2013. His interpretation is that to the extent that capital increases imposed costs, these costs were borne by equity holders in the form of lower dividends and managers in the form of lower compensation (which is included in operating costs). He stresses that contrary to the predictions of pessimists, there was no ballooning of interest margins. In light of Cecchetti's finding of essentially zero pass-through of Basel III increases in funding costs to lending rates, my assumption (below) of 80 percent pass-through—that is, that a 24-basis-point increase in G-SIB bank funding costs would lead to a 20-basis-point increase in G-SIB lending rates—seems conservative.

17. Increases in minimum capital requirements that are phased in gradually and can be funded largely by retained earnings are less costly than increases implemented more quickly and funded largely by new equity issuance. On this I agree with the consensus. But if capital increases are going to be funded mainly from retained earnings, it is crucial to tightly control dividend payments and share buybacks, because those discretionary actions drain bank capital. If US bank supervisors were tougher on controlling dividends and share buybacks in the run-up to the global financial crisis, the needed public bank recapitalization during the crisis would have been much lower.

18. Based on the evidence and considerations outlined above, I see an 800-basis-point increase in leverage ratios for US G-SIBs, phased in gradually over 10 years, as consistent with roughly a 20-basis-point increase in G-SIB bank lending rates. Equivalently, G-SIB lending rates would increase by about 2 basis points a year during the phase-in period.

19. As indicated above, a 20-basis-point increase in G-SIB lending rates translates into only a 12-basis-point increase in overall bank lending rates (because G-SIBs account for 62 percent of total consolidated bank holding

company assets). There is no reason to believe that a 12-basis-point increase in overall bank lending rates would have a large negative impact on the level of US real GDP. It is useful to reference the rule of thumb that says a 100-basis-point increase in the US federal funds rate (which boosts the entire term structure of interest rates) lowers the level of real GDP by about 100 basis points over eight quarters.[21] A similar size increase in the overall bank lending rate should produce just a fraction of that effect given its narrower impact. Banks are responsible for only about a third of the credit extended to the private nonfinancial sector in the United States (Fischer 2015b). On the basis of this rule of thumb, the macroeconomic impact of a 12-basis-point increase in overall bank lending rates spread over 10 years—induced by a cumulative 800-basis-point increase in minimum leverage ratios for G-SIBs—is likely to be so small as to be barely detectable in the macro data.[22] Moreover, such a tiny macro effect could be easily offset by the Fed lowering the path (infinitesimally) for the federal funds rate. The consensus assumes larger output effects. The smaller the (negative) output effects of higher capital ratios, the higher the optimal capital ratio.

20. The primary capital standard for bank regulation should have three properties: It should be better than the alternatives in distinguishing sick from healthy banks; be easy to understand, inexpensive to compute, and difficult to manipulate; and possess superior loss absorbency. By no stretch of the imagination do the existing risk-based measures of capital fit this job description. Indeed, the deficiencies of risk-based capital measures—especially of the internal models approach to setting risk weights—are so serious that the leverage ratio should become the primary measuring rod for capital adequacy, not only in bank stress tests but also more broadly in supervision.

21. Making the leverage ratio king of the hill need not mean that there would be no risk sensitivity in bank supervision or stress tests. To incentivize banks not to load up on risky assets and to compensate for some of the weaknesses of existing stress tests, I propose that large banks be subject to a risk surcharge. This surcharge would be based on a set of indicators, in much the same way that G-SIB capital surcharges are based on a set of systemic risk indicators. One might think of six types of indicators:

- a measure of tail risk dependence,
- the rate of loan growth cum a measure of the overvaluation of property prices,
- market-based measures of bank health (e.g., contingent claims analysis of distance to default, leverage ratios that depend on market value of equity rather than book values),

- risk derived from reverse scenarios, in which one solves for the shocks that will produce a given decline in the capital ratio,
- areas of risk where the supervisors have special concerns (e.g., leveraged loans, commercial real estate, etc.), and
- the ratio of risk-weighted assets to total assets, where risk-weighted assets come from a revised standardized approach to risk weighting.

Banks with high risk scores would be subject to a capital shortage; banks with normal or low scores would not.

22. Each of these risk indicators has strengths and weaknesses. When used in combination, they should do better at identifying dangerous levels of asset risk than a single indicator alone. Tail dependence indicators pick up the crucial difference between a solitary bank failure and simultaneous bank failures. The rate of loan growth has been shown to be a useful early warning indicator of deteriorating credit quality and, when paired with a measure of the overvaluation of property prices, subsequent banking crises. Market-based indicators of bank health often do better at diagnosing bank vulnerability than slower-moving accounting (book value) measures. Reverse scenarios are useful because they are portfolio specific in a way that traditional stress test scenarios are not. Allowing supervisors to assign a relatively high risk weight to asset concentrations that are of particular current concern guards against the risk that the nature of risk changes over time. Finally, the ratio of risk-weighted assets to total assets—if obtained from a revised "standardized" approach to risk weights—combines credit, market, and operational risk, without the "noise" created by manipulation from banks' internal models.

23. The Bank of England's approach to setting G-SIB leverage surcharges as a proportion of G-SIB surcharges for risk-based capital measures—what I call the "symmetry and proportionality" approach—is a highly artificial construct that ought not be replicated. It is based on the faulty assumption that the bank-capital regime must retain both the risk-based capital standard and the leverage ratio as Pillar 1 requirements and that there is only one way of getting both the risk-based standard and the leverage ratio to be binding simultaneously. This approach would prevent authorities from moving the leverage ratio (way) up to its optimal level. It also yields unduly low capital surcharges for UK G-SIBs. On top of that, the Bank of England has concluded that the optimal common equity tier 1 and Basel III leverage ratios (exclusive of G-SIB surcharges) need be only 8.5 and 3.0 percent, respectively, under the dubious argument that the regulatory minimums should not be designed for the riskiest banks in unusually risky situations (Brazier 2015).

24. In contrast, the Federal Reserve's "estimated impact" approach is an appealing way to think about what it means to eliminate too big to fail and how to go about estimating G-SIB capital surcharges (Board of Governors 2015b). Unfortunately, its conclusion that the top surcharge for the largest G-SIB needs to be no higher than 450 basis points is seriously flawed.[23] Once one employs a $50 billion bank as the appropriate non-G-SIB reference bank instead of a $250 billion one; factors in the likelihood that G-SIBs have a higher probability of default than non-G-SIB; and recognizes that the historical data are likely to give too optimistic a picture of future crisis probabilities, the appropriate capital surcharge for the largest G-SIB rises to the neighborhood of 800 basis points. The Fed's current G-SIB surcharge range for risk-based capital measures of 100 to 450 basis points is too low and too flat.

25. The problem is even more pronounced for leverage ratios, where G-SIBs face a minimum leverage ratio (under the enhanced supplementary leverage ratio) of 5 to 6 percent (versus a minimum of 3 to 4 percent for other banks).[24] It is likewise regrettable that US regulatory and supervisory officials have applied essentially the same capital hurdle rate to all bank holding companies participating in the CCAR stress tests, without regard to the large variations in their systemic importance.

26. To remedy the most glaring deficiencies in the existing bank capital regime in the United States, I propose a reform plan. The four existing Pillar 1 bank-capital standards would be replaced with a single (Pillar 1) standard, the tangible leverage ratio. Long-term minimums for the tangible leverage ratio would be established for three different classes of US banks. For G-SIBs the long-term target would be 14 to 18 percent (depending on the bank's systemic importance). For other large banks, the long-term target would be 11 to 13 percent (again depending on systemic importance). For smaller banks, the long-term target would be 10 percent. These long-term targets would be phased in (in roughly equal annual installments) over 10 years. Risk sensitivity would be introduced into the regime via a new (Pillar 2) risk surcharge. This surcharge would sit on top of the basic minimum leverage ratio, and it would have a positive charge for banks whose assets and/or off-balance-sheet commitments were judged to be unusually risky relative to their peers. The new leverage minimums would be translated into the baseline (unstressed) capital hurdle rates in the annual CCAR stress tests. The stressed hurdle rates would be set below the baseline rates, depending on the severity of the scenarios and the model parameters that link the shocks to bank capital. In the middle of the phase-in period, the Federal Reserve would assess the effects of the higher capital standards on the financial system and on the broader US economy. If that assessment

were positive, the second five-year period of hurdle rate increases would proceed as planned; if not, the Federal Reserve would have the authority to propose and enact a slower rate of increase or even to suspend these increases entirely.

27. The plan has a number of important advantages.

28. The plan would deliver a quantum jump in the amount of loss-absorbing, high-quality capital in the funding structure of the largest US banks. It would create enough of a capital cushion to withstand not only the scale of losses suffered in the 2007–09 crisis but the even larger (hypothetical) losses under a no-more-too-big-to-fail scenario with more limited government intervention. This higher capital cushion would also help deter runs on banks by wholesale creditors, who could be more confident that their bank counterparties were unquestionably solvent. The taxpayer would not be on the hook. There would be enough capital left after a severe crisis to provide sufficient loan growth to support a recovery.

29. The plan's proposed range and pace of capital increases are perfectly consistent with maintaining satisfactory macroeconomic performance. Well-capitalized banks lend more, not less, than weakly capitalized ones. As outlined above, the plan's proposed increases in minimum leverage ratios over a 10-year period would likely lead to approximately a 14-basis-point increase in overall bank lending rates. Such a small and gradual increase in bank lending rates would have only a barely detectable effect on the level of long-term US real GDP—and even that effect could be offset by a very small decrease in the federal funds rate.

30. The plan's three-level structure requires the largest increases in bank capital where they are needed most—at the nation's largest and most systemically important banks. These are the same banks that received the lion's share of official assistance during the Great Recession as well as the ones where the existing leverage ratio is actually lower than in smaller banks of less systemic importance. By mandating lower minimum leverage ratios for non-G-SIBs and small banks (including more than 6,000 community banks), the plan is able to reach a 16 percent (weighted average) leverage ratio for G-SIBs while producing an overall (across all banks) weighted-average minimum leverage ratio target of 14½ percent. The overall (weighted average) increase in minimum leverage ratios under the plan is 600 basis points (for the tangible leverage ratio)—significantly below the 800-basis-point increase that would be needed under an across-the-board 16 percent leverage ratio target.

31. The plan offers a new answer to the question of how an unweighted leverage ratio and some risk weighting of assets can best be used in tandem. The conventional dual standard (both Pillar 1) bank-capital model has been a failure. The leverage ratio gets much closer to what one should want from a single Pillar 1 minimum capital requirement. The proposed Pillar 2 risk surcharge framework would compensate for some weaknesses and omissions in the existing supervisor-led stress tests, address the leverage ratio's lack of risk sensitivity, and provide some deterrence against the possibility of banks loading up on risky assets. Crucially, it would be binding without constraining the height of the basic leverage ratio itself.

32. The plan would steepen the leverage surcharge schedule for G-SIBs. If real progress is to be made in ending too big to fail, and direct restrictions on bank size are not the route that the Executive and the Congress want to take to get there, another way has to be found to motivate the largest banks to decrease over time their systemic footprint. The plan would provide the necessary price incentives to induce them to do so.

33. The likely objections to the plan are not persuasive.

34. Proposals for much heightened capital requirements are not necessarily pie in the sky.[25] These proposals have been put forward by both Democrats and Republicans, and by officials as well as academics. Imposing much higher minimum leverage ratios on the largest US banks has also been favored by community banks to level the playing the field. Among such proposals, the plan's proposed minimum leverage ratio schedule falls squarely in the middle of the range. If banks were much better capitalized, they would be on stronger ground in arguing that structural activity restraints (like the Volcker Rule) are not needed. At some point, CEOs of G-SIBs could well come to the conclusion that higher capital ratios are the neatest, least intrusive, and least costly mechanism for satisfying regulators and the public that they are safe enough.

35. The body of empirical evidence strongly suggests that if the plan were to shrink the size of the largest banks, the banking system, and the financial system as a whole, the results would not be adverse for US macroeconomic performance. This is because the United States has already passed the point where, without subsidies, getting bigger generates increasing returns.

36. Of the potential objections, the weightiest one is that heightened capital requirements for banks could induce increased migration to the shadow banking system, where regulation is laxer, with potential unhappy consequences for financial stability. Even though the size of the cash-like

part of the shadow banking system has fallen from its precrisis peak, this risk has to be taken seriously (Stein, Greenwood, and Hanson 2016).

37. In the wake of the crisis, a set of reforms was put in train to reduce the fragility of the shadow banking system. Not enough time has passed to know whether these reforms will be sufficient, particularly as regards runs on shadow banks with short-term liabilities and illiquid longer-term assets. If danger signs emerge (again), I propose a backup contingency initiative to better run-proof the shadow banks. This initiative owes to former Bank of England governor Mervyn King (2016), who calls it the "pawnbroker for all seasons" (PFAS). At the heart of the PFAS is a limit on the amount of short-term (one year or less) liabilities a bank or shadow bank can issue. These liabilities cannot exceed the sum of reserves held at the central bank plus the estimated value of haircut-adjusted collateral positioned with the central bank. This PFAS "liquidity" reform would be a valuable complement to the higher-capital solvency plan outlined in this book. It could replace the liquidity coverage ratio and the net stable funding ratio, which apply only to banks. Like the plan for much heightened capital requirements, the PFAS could be phased in over 10 to 15 years. The reform is streamlined relative to other shadow-bank reforms and would be an effective way to address the migration and "run" vulnerabilities in the present financial system.

38. Although the G-20's Total Loss-Absorbing Capacity (TLAC) initiative also sets higher minimum capital standards for G-SIBs, it is not a good substitute for the plan. Under TLAC, by January 1, 2022 G-SIBs would be required to have TLAC-eligible instruments equal to 18 percent of their risk-weighted assets as well as to 6.75 percent of their Basel III total leverage exposure. Less than half the minimum TLAC requirement is expected to be made up of subordinated debt and long-term bail-in bonds (CoCos) that are to be converted into equity once certain prespecified minimum capital ratio criteria are met. Under the accompanying Single Point of Entry (SPOE) reform, the structure of G-SIBs would also be altered so that "losses" by bank subsidiaries performing critical economic functions can be passed upward to the bank holding company, thereby allowing such subsidiaries to remain solvent and operational.

39. The minimum leverage ratio for G-SIBs under the plan is 14 to 18 percent versus less than 7 percent under TLAC. The plan therefore provides much greater loss absorbency. Equity already in place is superior to a bond that converts to equity under a set of prespecified criteria. Setting the trigger for bail-in bonds at the right level is tricky. Pure equity has no trigger issue; it already is equity. Bail-in bonds have a much higher probability than equity of being bailed out in a severe crisis. Ask yourself: Which

is going to produce the better crisis dynamic: trying to bail in bondholders in a severe crisis when banks are trying to keep their funding sources from drying up, or having a comfortable equity cushion in place and allowing that equity capital to be drawn down to reflect credit losses? Bail-in bonds can become a crisis amplification mechanism during a severe crisis as the price of these bonds collapses and the market for them dries up. Unlike dividends, there can be no suspension of interest payments on CoCos. The worthwhile SPOE initiative can be implemented just as easily under the plan as under TLAC.

40. Last but not least, for all the additional risks the TLAC initiative brings with it relative to the plan, it is not much cheaper in terms of its effects on overall bank lending rates and on the level of real GDP. As suggested above, my best estimate is that increasing the tangible leverage ratio in US G-SIBs from roughly 8 to 16 percent would raise overall bank lending rates by about by 12 basis points over a 10-year period. Adding in the assumed smaller increases in leverage ratios for large non-G-SIB banks and smaller banks would raise the tally for increases in overall bank lending rates to 14 basis points. The Bank for International Settlements (BIS 2015b) recently published the results of its quantitative impact study of TLAC implementation. While it is hazardous to compare bank-capital plans that have many moving parts and that employ quite different assumptions, my back-of-the-envelope calculation is that TLAC would wind up cutting the increase in overall bank lending rates (relative to my plan) by roughly 7 to 12 basis points.[26] If, as argued above and in chapter 4, the macroeconomic effects of a 14-basis-point increase in overall bank lending rates, implemented gradually over a decade, is barely detectable, the macroeconomic savings from a rate rise smaller than that (under TLAC) would be virtually invisible. The conclusion is clear: TLAC is penny wise and pound foolish.

Appendix I

Event and Impact Studies of US and EU-Wide Stress Tests

There is by now a significant and rapidly growing empirical literature that presents "event studies" of the US and EU-wide stress tests. Such studies focus on two questions: (1) Was the announcement of the tests and/or publication of the results followed by positive cumulative abnormal returns on bank equity for the tested banks (and sometimes, for nontested banks as well) and (2) did the announcement and/or publication of the tests and results—be they positive or negative—provide market participants with information that they did not have before? Good reviews of this literature can be found in Candelon and Sy (2015); Fernandez, Igan, and Pinheiro (2015); and Flannery, Hirtle, and Kovner (2015), while MacKinlay (1997) provides a review of the standard methodology for doing such event studies. Unfortunately, the results of these event studies seem to be quite sensitive to the metrics used to judge impact (that is, average cumulative abnormal returns, absolute value of average cumulative abnormal returns, behavior of price-to-book ratios, credit default swap spreads, and trading volumes), to the presence or absence of tests for significant differences between tested and nontested banks, and to the model used to generate expected returns before the event

Flannery, Hirtle, and Kovner (2015) argue that earlier event studies of stress tests are badly flawed because mean returns for tested banks could be zero for two quite different reasons: the abnormal return is very small for all firms or the returns are large in absolute value but positive for some banks and negative for others. They therefore recommend that researchers look at the absolute value of these returns, as well as at trading volumes. When they do so for the DFAST and CCAR tests conducted in 2009–15, they find that disclosure of the results generated new information about stress tested banks. They also find larger effects on tested banks than on nontested ones.

Very few studies compare the results of the US and EU-wide tests on a like-to-like basis. Greenlaw et al. (2012) do an event-study comparison of the market reaction to the 2009 US stress test with that for the 2009 EU-wide test. Drawing on bank equity prices and CDS prices, they found that the markets assessed the US test much more favorably than the EU-wide one. Candelon and Sy (2015) compare the results of the 2009 SCAP and the 2012 and 2013 CCAR tests on the one hand with the results of the 2009, 2010, and 2011 EU-wide tests and the 2012 EU-wide capital exercise on the other. They look only at average cumulative abnormal returns, not the average absolute value of those returns. For those tests (relating to publica-

tion of results for the tested banks), the only one with large, positive, and statistically significant average abnormal return is the 2009 SCAP. They find positive, statistically significant, albeit much smaller effects for the 2012 CCAR and the 2010 and 2012 EU-wide tests and a negative, statistically significant effect for the 2012 EU-wide test. They argue that the generalized common view that all EU-wide stress tests were unsuccessful is not accurate, pointing in particular to the estimated positive impact of the 2010 test on returns, with an estimated size roughly half that for the 2009 SCAP.

Ong and Pazarbasioglu (2013) compare crisis stress tests in the United States and the European Union. They regard a crisis stress test as having achieved its objectives if it sets a floor under selected financial market indicators. They find that the 2009 SCAP satisfies this criterion but the early EU-wide stress tests did not.

I do not know of any formal event studies of the 2014 EU-wide stress test. A Bloomberg poll, however, taken shortly after publication of 2014 EU-wide stress test results, found that 51 percent of respondents (investors, traders, and analysts who are Bloomberg subscribers) thought that the results "failed to provide an accurate gauge of their financial stability," 32 percent thought the results were accurate, and 17 percent were not sure.[27] The corresponding figures for the US stress tests were 36, 46, and 17 percent.

Some studies suggest that stress tests conducted under extreme crisis conditions are more apt to be successful than tests conducted under more normal conditions. Of the US stress tests, only the SCAP is considered to be a crisis management test; it was also the first test. On the EU side, because the 2007–09 crisis was followed by the 2010–13 debt crisis, most of the tests had a crisis management element to them.

Glasserman and Tangirala (2015) show that tests convey less new information to market participants once they become more routine and predictable.

All in all, I see little in the event-study evidence to contradict my conclusion that the markets received the EU tests more poorly than they received the US tests.

Endnotes

1. For a review of early stress testing, see Hirtle and Lehnert (2014). Moretti, Stolz, and Swinburne (2008) and Ong (2014) present the IMF's approach to and experience with stress testing. Bernanke (2013) notes that the 2009 SCAP was the first time that US regulatory authorities conducted a stress test simultaneously across the largest banks. Stress tests are also sometimes conducted for nonbank financial institutions of various kinds (including insurance companies). This book is confined to stress tests for banks.
2. Between January 20, 2009 (Inauguration Day) and April 30, 2009, an S&P index of financial stocks averaged a 5 percent daily move; the average during normal periods is less than 1 percent. Just before the SCAP results were released, an unweighted average of five-year credit default spreads for Bank of America, Citigroup, Goldman Sachs, JPMorgan Chase, Morgan Stanley, and Wells Fargo stood at roughly 300 basis points, versus about 25 basis points before the 2007 crisis began and about 450 basis points in October 2008, when the Troubled Asset Relief Program (TARP) was announced. After contracting by more than 8 percent in the fourth quarter of 2008, real GDP growth continued to fall during the first two quarters of 2009, and the unemployment rate rose by about 4 percentage points (from 5 to 9 percent) in the 12 months before February 2009 (see Bernanke 2013, Geithner 2014).
3. The Federal Reserve and the US government provided support to financial institutions during the crisis by guaranteeing liabilities and injecting capital into banks and liquidity into an array of markets. In addition, the Federal Reserve cut interest rates to extremely low levels. See Blinder and Zandi (2010, 2015) and Wolf (2014b) for a recap of these support measures. Chapter 1 examines how the effectiveness of other crisis management policies affects the credibility of bank stress tests.
4. Atkinson, Luttrell, and Rosenblum (2013) estimate that the US financial crisis of 2007–09 cost the United States $6 trillion to $14 trillion in forgone GDP. Better Markets (2015) concludes that the crisis led to $7.9 trillion of actual losses of GDP relative to potential GDP and to $3.6 trillion in reduced GDP potential (primarily as a function of reduced capital stocks and reduced labor hours resulting from the effects of the Great Recession). Ball (2014a, 2014b) finds that the Great Recession had dire effects on advanced economies' productive capacity, as measured by OECD and IMF estimates of potential output. The countries with the deepest recessions experienced the greatest long-term damage. For the 23 countries taken as a group, Ball estimates the loss of potential output relative to the precrisis path at more than 8 percent.
5. All of these tests, except the 2011 one, published bank-by-bank results.
6. The 33 bank holding companies participating in the 2016 CCAR stress test increased their (weighted) average common equity tier 1 capital ratios from 5.5 percent in the first quarter of 2009 to 12.2 percent in the fourth quarter of 2016 (Tarullo 2016).
7. Bernanke (2013) reports that banks' holdings of cash and high-quality liquid securities more than doubled between end-2007 and April 2013.
8. See, for example, ECB (2014b, 2016) and Constâncio (2015). As of end-2015, the weighted-average common equity tier 1 capital ratio for the 51 banks participating in the 2016 EU-wide stress test was 13.2 percent (EBA 2016d). The corresponding figure (as of the first quarter of 2016) for the 33 bank holding companies participating in the 2016 US CCAR test was 12.2 percent (Board of Governors 2016a). The IMF (2016b) reports that the three-month moving average of price-to-book ratios in mid-2016 stood at about 0.6 for euro area banks versus 1.0 for US banks.

9. See, for example, the charts in Ong and Pazarbasioglu (2013) and ECB (2014a).
10. As a whole the crisis management supporting cast for the EU-wide stress tests was weak, a problem that contributed to the tests' poor market reception (see chapter 1). Nevertheless, several important nonstress initiatives had a positive impact on banks, including the statement by ECB President Mario Draghi in July 2012 that the ECB would do "whatever it takes" to save the euro and the ECB's announcement of three rounds of long-term refinancing operations for EU banks (the long-term refinancing operation in December 2011, the first targeted long-term refinancing operation in September 2014, and the second targeted long-term refinancing operation in March 2016). Acharya et al. (2015) show that one of the main reasons why the Draghi "whatever it takes" statement had such a positive effect on EU banks was that it generated large capital gains for EU banks holding relatively large shares of sovereign EU periphery bonds.
11. In the internal models–based approach to risk weighting, risk weights are estimated using the bank's internal models rather than set by bank supervisors. Nevertheless, the basic concept is the same for understanding the difference between risk-weighted capital measures and unweighted capital measures (leverage ratios).
12. The EU risk-weight density figures are for mid-2015 and come from Berger, Hüttl, and Merler (2016).
13. Although total leverage exposure provides a more comprehensive picture of risk exposures, some analysts do not regard it as a better measure of risk than total assets because of the contentious treatment of future exposure for derivatives; they prefer the simplicity of total assets (see, for example, Ricks 2016).
14. The BCBS (2016, 17–18) defines total leverage exposure as including (1) on-balance-sheet assets, excluding securities financing transactions and derivatives; (2) securities financing transaction exposures with limited recognition of netting of cash receivables and cash payables with the same counterparty under strict criteria; (3) derivative exposures at replacement cost (net of cash variation margin meeting a set of strict eligibility criteria) plus an add-on for potential future exposure based on the current-exposure method; (4) written credit derivatives exposures at their effective notional amount (net of negative changes in fair value that have been incorporated into the calculation of tier 1 capital) reduced by the effective notional amount of purchased credit derivatives that meet offsetting criteria related to reference name level of seniority and maturity; (5) off-balance-sheet exposures, obtained by multiplying notional amounts by the credit conversion factors in the standardized approach to credit risk, subject to a floor of 10 percent; and (6) other exposures as specified in the Basel III leverage ratio framework. See also the footnotes to the FDIC Global Capital Index in Hoenig (2016b).
15. The Liikanen Report (2012, 40) describes the difference between US GAAP and IFRS as follows: "Under US GAAP, companies with derivatives under a single master netting agreement with the same counterparty are allowed the possibility to report assets and liabilities (including cash collateral) on a net basis, even if they do not intend to settle the cash flows on a net basis. The same treatment is allowed for repurchase agreements and reverse repurchase agreements. Unlike the current US standards, there are no such provisions under IFRS that apply to EU banks."
16. The Basel III netting compromise does, however, introduce one additional complexity, namely, that the relationship between total assets and total leverage exposure is different in countries using US GAAP than in countries using IFRS. Total leverage exposure for the eight US G-SIBs (taken as a group) is about 40 percent larger than total assets

(Allahrakha, Glasserman, and Young 2015), because the add-ons to total assets and the less generous treatment of netting of derivatives make total leverage exposure considerably larger than total assets. In contrast, under IFRS, total leverage exposure seems to be roughly the same as total assets. For example, Berger, Hüttl, and Merler (2016) report that for 12 EU G-SIBs, total leverage exposure was 97 percent of total assets; see Dowd (2016a, 2016c) for the figures on major UK banks and Deutsche Bank. This rough equality between total leverage exposure and total assets under IFRS arises because the add-ons to total assets increase total leverage exposure while the more generous treatment of netting under Basel III reduces total assets enough to roughly offset (or sometimes even overwhelm) the positive effect of these add-ons on total leverage exposure.

17. The hurdle rate is the minimum capital ratio that banks must meet in the test's baseline and adverse scenarios in order to have their capital plans approved by the bank supervisor.

18. See Barth and Miller (2017) on historical bank crisis probabilities in the United States from 1837 to 2009. The period between 1934 and 2007 is sometimes referred to as the "quiet period" for financial crises in the United States; see Gorton (2012).

19. There are two alternative approaches to translating increases in bank funding costs into increases in bank lending rates. I call them the "loans only" approach and the "loans plus" approach; see chapter 4 for a discussion and application.

20. By "overall" bank lending rates, I mean lending rates for the banking system as a whole—rather than lending rates for a subgroup of banks.

21. I am grateful to my Peterson Institute colleague David Stockton for sharing that (Federal Reserve) rule of thumb with me.

22. If one takes the 100-basis-point decrease in the level of real GDP linked to a 100-basis-point increase in the federal funds rate as the benchmark and if one assumes that the federal funds rate impacts 100 percent of the private nonfinancial sector, then a 12-basis-point increase in overall bank lending rates should have an effect on the level of real output that is roughly 4 percent as large, that is, the level of real output would decline by about 4 basis points. This 4-basis-point decline is the product of an increase in interest rates (overall bank lending rates) that is 12 percent as large as the assumed (100 basis point) increase in the federal funds rate and an impact of bank lending rates on the private nonfinancial sector that is 33 percent as large as that of the federal funds rate, that is, .12 times .33 equals .0396—or roughly 4 percent as large as in the federal funds rate benchmark.

23. The Fed argues that too big to fail would be eliminated when the expected systemic loss from the failure of a G-SIB is no greater than the failure of a large non-G-SIB. As, by definition, the systemic loss given default is higher for a G-SIB than for a non-G-SIB, the only way to make the expected losses equal for the two is to reduce the probability of default for the G-SIB just enough that it exactly offsets its higher loss given default. If, for example, the failure of a G-SIB would produce twice the systemic loss as the failure of a non-G-SIB, then the probability of default for the G-SIB needs to be half as large as for a non-G-SIB. The role of the G-SIB capital surcharge is to generate that decline in the default probability for G-SIBs. Among G-SIBs the higher the score for its systemic loss given default (relative to the reference non-G-SIB), the higher the surcharge needs to be.

24. The minimum is 4 percent for the tier 1 leverage ratio and 3 percent for the Basel III leverage ratio.

25. See the postscript (chapter 9) for my preliminary assessment of the Trump administration's plans for financial deregulation.
26. See chapter 8 for the assumptions behind this calculation.
27. Yalman Onaran, "ECB's Stress Test Failed to Restore Trust in Banks, Poll Shows," Bloomberg Business, November 17, 2014.