

Bank Stress Tests and Financial Stability:

Lessons from the 2009–14 US and EU-Wide Tests for Asian Emerging Economies

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Bank stress tests assess whether a bank or group of banks will be adequately capitalized even in a stressed economic scenario. This chapter looks at the bank stress tests conducted over the past five years by bank supervisors in the United States and the European Union, following what former chairman of the Federal Reserve Ben Bernanke declared was “the worst financial crisis in global history.”¹ The purpose is to identify those lessons that would be most helpful to Asian emerging economies.

Stress tests are conducted to evaluate whether banks have sufficient self-insurance to withstand adverse economic shocks, so that a costly banking crisis can be avoided. The lost output cost to the United States, the epicenter of the 2007–09 crisis, has been estimated at \$6 trillion to \$14 trillion (Atkinson, Luttrell, and Rosenblum 2013). In addition to huge output and employment costs, banking crises generate large fiscal costs—mostly due to the fall in tax revenue linked to a deep recession (Reinhart and Rogoff 2009). While banks in emerging Asia suffered less in the 2007–09 crisis than banks in the

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1. Pedro Nicolaci da Costa, “Bernanke: 2008 Meltdown Was Worse Than the Great Depression,” *Wall Street Journal, Real Time Economics*, August 26, 2014, <http://blogs.wsj.com/economics/2014/08/26/2008-meltdown-was-worse-than-great-depression-bernanke-says/> (accessed on January 26, 2015).

United States, the euro area, and the United Kingdom,² massive bank losses were registered by Indonesia, Thailand, and the Republic of Korea during the 1997–98 Asian financial crisis. Luc Laeven and Fabian Valencia (2013) report that the banking crises in these three countries were among the 10 largest in their multicountry sample of systemic banking crises spanning the entire 1970–2011 period.³ More broadly, given their high degree of openness, emerging Asian economies must be concerned not only with the risk of internally generated banking crises but also with contagion from banking fragility elsewhere within the region and from the West.⁴

Six messages can be drawn from the stress tests conducted in the United States and the European Union.

First, bank stress tests are apt to become an increasingly important part of bank supervision globally because they carry advantages not shared by other supervisory tools and because they offer more flexibility than the Basel international regulatory regime. Accordingly, emerging Asian economies should invest in upgrading their stress-testing systems to approach a standard of best practice.

Second, the credibility of stress tests depends in good measure on their institutional framework and design, including (1) the coverage of systemically important banks and links between these banks and large nonbank financial institutions/sectors; (2) the resources, legal authority, and independence of the supervisor conducting the tests; (3) the relevance and severity of the adverse scenarios analyzed in the tests; (4) the quality of the suite of models used by the supervisors to assess the impact of shocks on bank capital; (5) the definition and level of the capital target that banks must meet under stressed conditions; and (6) the mechanism for linking test results to recapitalization actions. A challenge for emerging Asia is to ensure that stress tests run by national bank supervisors have the requisite degree of independence and transparency.

Third, stress tests need to be useful for crisis prevention and crisis management. It is troubling that just before the global economic and financial crisis, stress tests almost uniformly failed to provide early warning of the banking system's vulnerability. To help remedy that failing, two improvements are necessary: (1) the integration into the analysis of top-down, dual-threshold models of banking crisis⁵ and (2) a fuller treatment of feedback, contagion,

2. The IMF (2010) estimates that emerging Asian banks incurred losses equal to roughly 1.5 percent of their total assets during the 2007–09 crisis; the corresponding losses for US, UK, and euro area banks during that crisis were about 7, 5, and 3 percent, respectively.

3. Indonesia's 1997 banking crisis had a fiscal cost of 57 percent of GDP; the corresponding fiscal costs for the Thai and Korean banking crises were 44 and 31 percent of GDP, respectively (Laeven and Valencia 2013).

4. In Goldstein and Xie (2009) I analyze various channels of spillover effects from financial crises elsewhere in emerging Asia.

5. In such models, crisis vulnerability is highest when there is both an abnormally rapid rate of growth of credit to the nonfinancial private sector and an abnormally rapid rise in real property prices; see the section titled "Criticisms of Stress Testing Methodology and the Measurement of Bank Capital."

and amplification effects into the modeling of the financial sector (so that even a moderate shock can produce real-economy effects similar to those observed during a severe banking crisis). Such criticisms of earlier stress tests are hardly academic for emerging Asia. The Bank for International Settlements (BIS 2014) has recently suggested that just such a dual-threshold model of banking crises is now signaling high vulnerability both for the People's Republic of China (PRC) and for an Asian emerging-economy aggregate composed of Hong Kong, China; Indonesia; Malaysia; the Philippines; Singapore; and Thailand. As for contagion, one only needs to recall what occurred during the Asian financial crisis of 1997–98.

Fourth, capital shortfalls revealed by stress tests should be remedied in a way that is friendly to economic growth. A higher desired capital ratio should be translated into an absolute amount of capital rather than allowing banks to achieve the higher capital ratio by cutting back on loans, by engaging in fire sales of assets, and by manipulating risk weights.

Fifth, because capital ratios that use an unweighted measure of bank assets in the denominator—called leverage ratios—do a much better job (*ex ante*) for large banks of distinguishing sick banks from healthy ones than risk-based measures of bank capital, a leverage ratio test should be included in all future supervisor-led bank stress tests conducted in the Asian region. Over time, a leverage ratio should become the primary metric for bank stress tests. Risk-based measures of bank capital should be relegated to a backup role. Asia is well placed to help lead the charge on leverage ratios. A recent International Monetary Fund report (IMF 2014a) indicates that emerging Asia and advanced Asia had average tangible leverage ratios (corrected for international differences in accounting standards) of 5.8 and 6.0 percent, respectively, versus 4.5 percent for North America and 3.6 percent for the euro area.

Sixth, because theory and empirical evidence indicate that the optimal level of bank capital is likely to be far above the minimum ratios set out under Basel III and the actual capital ratios prevailing around the world, bank supervisors in emerging Asia and elsewhere should consider gradually raising the capital hurdle rates in bank stress tests. Again, emerging Asia is in a good position to be part of the leading edge of reform. Its current capital ratios are above the fully phased-in Basel III minimums, and banks in the region increased their capital ratios in 2009–12 without raising the cost of credit or restricting its availability (McCauley 2014).

The US and EU-Wide Stress Tests

Bank stress tests have been conducted by the IMF since the late 1990s, by national central banks and other regulatory authorities before that, and by commercial and investment banks going even farther back.⁶

6. Stress tests are also sometimes conducted for nonbank financial institutions of various kinds (including insurance companies). This chapter restricts the analysis to stress tests for banks.

What put bank stress tests on the front page of major newspapers around the world, however, is of more recent origin. In February–May 2009, US authorities conducted the Supervisory Capital Assessment Program (SCAP)⁷ shortly after the fall of Lehman Brothers and during high anxiety about the viability of major US financial institutions (Geithner 2014). To bolster the SCAP’s credibility, bank-by-bank results were published, and a new, more stringent definition of high-quality bank capital was introduced: *tier 1 common* (T1C). The test also employed a severe loss rate on bank loans (over 9 percent—higher than even during the Great Depression) in the adverse scenario.⁸ Because the US cri-

7. The SCAP was announced on February 10, 2009, and the test results were released on May 7, 2009.

8. Alas, in a chapter on bank stress tests, it is necessary to have some discussion of different measures of bank capital—admittedly, an arcane topic. This chapter makes reference to two types of bank capital ratios: one based on risk-weighted assets (RWA) in the denominator, called risk-based measures of capital; and the other based on unweighted assets/exposures in the denominator, called leverage ratios. Risk weights mostly (about 85 percent) reflect credit risk differences across assets, but market and operational risk are also taken into account. Risk weights typically fall between zero and 100 percent but can exceed 100 percent for some very risky assets. 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 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 chapter makes reference to the following risk-based measures of capital: *common equity tier 1* (CET1), the equity measure at the center of Basel III; *tier 1 common* (T1C), the equity measure relied on in the earlier US stress tests; *core tier 1* (CT1), the equity measure used in the 2011 EU-wide stress test (usually defined as common equity plus government hybrid instruments); *tier 1* (T1), the high quality capital measure used in the first two EU-wide stress tests; *tier 2* (T2), a lower quality component of bank capital; and the *total capital ratio* (CAR), the broadest measure of bank capital, consisting of tier 1 plus tier 2 capital. The Basel Committee on Banking Supervision (BCBS 2010, 13) defines common equity tier 1 capital as consisting of the following elements: (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.

Douglas Elliott (2010) provides the useful intuitive explanation that the noncommon stock elements of tier 1 capital are mainly those kinds of preferred stock that are more like common stock, while the elements of tier 2 capital are mainly those kinds of preferred stock that are more like debt; tier 2 capital also includes subordinated debt. Again in descending order of quality, the three leverage ratios discussed in this chapter are: the tangible leverage ratio—defined as the ratio of adjusted tangible equity to adjusted tangible assets (see Hoinig 2015); the *leverage ratio*—defined as ratio of the book value of equity to the book value of total assets (see Pagano et al. 2014); and the Basel III *tier 1 leverage ratio*—defined as the ratio of tier 1 capital to total exposure. Total 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. Total exposure is always larger than total assets. For a more precise definition of total exposure, see BCBS (2013) and Davis Polk (2014). Some analysts refer to the denominator of the Basel III leverage ratio as “average assets” because the calculation is the average of three month-end lever-

sis management effort had many important elements beyond bank stress tests, it is difficult to assess the impact of the stress test itself. Nevertheless, the results seemed to persuade market participants 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 spreads for pressured banks, and the volatility fear index in the broader US stock market all improved dramatically immediately after the SCAP, and the 10 banks identified as needing additional capital were able to raise almost all (\$66 billion of \$75 billion) of the aggregate shortfall within a month (and without additional government funds).

Buoyed by this record, further rounds of US bank stress tests were conducted in 2011, 2012, 2013, and 2014.⁹ Indeed, such stress tests are now a mandatory and permanent part of the US regulatory and supervisory framework.¹⁰

Senior US regulatory officials (Tarullo 2014b, Bernanke 2013, Fischer 2014b) argue that the 2009–14 stress tests made an important contribution to financial stability. They highlight that the 30 firms participating in the 2014 stress test had doubled their CET1 capital (ratios) since 2009,¹¹ and their liquidity position had improved markedly relative to precrisis levels.¹² Looking

age ratios over a quarter. The *supplementary leverage ratio* (SLR) and the *enhanced supplementary leverage ratio* (ESLR) are the US banking agencies' implementation of the Basel III leverage ratio. The ESLR applies to the eight largest US bank holding companies (BHCs) that are designated as global systemically important banks (G-SIBs). The SLR 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.

9. All of these tests, except the 2011 one, published bank-by-bank results.

10. Large US banks are now required to participate in two distinct but related supervisory programs in which stress tests are a key component. The first is the stress testing required by the 2010 Dodd-Frank Wall Street Improvement and Consumer Protection Act. The second is the stress testing included in the wider annual capital plan assessment, called the Comprehensive Capital Analysis and Review (CCAR). The main distinctions are the following: The Dodd-Frank stress tests apply to a broader range of companies (bank holding companies [BHCs], savings and loan companies, state banks with total assets greater than \$10 billion, and nonbanks designated by the Federal Stability Oversight Council for supervision by the Federal Reserve), and the focus is almost exclusively on the "quantitative" outcomes of the stress tests. In contrast, the CCAR covers only large, complex US BHCs with consolidated assets of \$50 billion or more, and it includes not only stress test methodology and results but also a more "qualitative" assessment of the capital planning process, including policies covering dividends, common stock issuance, and share repurchases. The Federal Reserve coordinates these two stress test exercises, while seeking to reduce duplication and minimize burden. See Board of Governors (2014), Tarullo (2014b), and Bernanke (2013).

11. The 30 firms participating in the 2014 CCAR stress test increased their aggregate CET1 ratio from 5.5 percent in the first quarter of 2009 to 11.6 percent in the fourth quarter of 2013 (Board of Governors 2014).

12. Bernanke (2013) reports that banks' holding of cash and high-quality liquid securities more than doubled between end-2007 and April 2013.

at the large banks as a group is said to have facilitated a more “macroprudential” approach to supervision with greater focus on total bank lending and economic growth, while also making it easier to identify risk outliers. Publication of bank-by-bank results is seen as aiding the efforts of market participants to reach more informed judgments about the true condition of banks. Finally, the stress tests are regarded as having upped the ante for sound risk management, since failure either to meet the regulatory capital benchmark or to demonstrate that the capital planning process is otherwise up to snuff carries nontrivial reputational cost.

A second moment in the sun for bank stress tests has been their application within the European Union: first during the crisis of 2007–09, and later during the European debt crisis of 2010–13 and the recent efforts 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 July 2010, July 2011, and October 2014, just before the European Central Bank (ECB) took over as Single Supervisor of Europe’s largest banks.

EU policymakers say that these tests have helped to assess objectively the health of the European banking system and that concerns about failing the test have prompted banks to raise much more capital than they would otherwise. The median T1C capital ratio for large and complex banks in the euro area in the first quarter of 2014 was within a half percentage point of their global peers (ECB 2014). Also, the difference between price-to-book ratios for large and complex banks in the United States and those in the euro area narrowed significantly over the 2012–14 period. Yet the release of the first EU-wide stress test in 2009 was not immediately followed by a sharp improvement in confidence in EU or euro area banks; so, too, with the 2010, 2011, and 2014 tests.¹³ Indeed, if one looks at market indicators of EU banking stress/confidence, the sharp improvements came instead after the announcement of the long-term refinancing operation (LTRO) in December 2011, and most of all, the statement in July 2012 by ECB President Mario Draghi that the ECB would do “whatever it takes” to save the euro.

Why Did the EU-Wide Stress Tests Fare So Poorly?

The limp market reaction to the first three EU-wide stress tests appears to result from four factors.¹⁴

First, the organizations coordinating the EU-wide stress tests, that is, the Committee of European Banking Supervisors (CEBS) for the 2009 and 2010

13. David Greenlaw et al. (2012) performed 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 credit default spreads, they found that the markets assessed the US test much more favorably than the EU-wide one.

14. In Goldstein (2015), I also argue that the low credibility of the EU-wide stress tests reflects in part the unsuccessful efforts of eurozone economic officials to put together a set of economic policies that make thin the catastrophic tail for banking sector outcomes.

tests, and the European Banking Authority (EBA) in 2011, were new and had little clout vis-à-vis national bank supervisors. The CEBS and EBA also lacked staffing and resources and could only recommend, not compel, recapitalization (Posen and Véron 2014). By contrast, the Federal Reserve, which oversaw stress tests in the United States, had much greater resources and authority.

Second, the EU stress tests of 2009–11 were run before a critical mass had formed on an EU banking union. Before June 2012, there was no agreement on either bank resolution or EU-wide funding of bank failures, whereas in the United States the Treasury had more than \$200 billion left from the initial TARP (Troubled Asset Relief Program) legislation that could be used to recapitalize undercapitalized US banks. Also, EU banks are much larger relative to home-country GDP, compared with that of US banks,¹⁵ and banking is more important in the European Union relative to capital markets. In other words, the “too big to fail” (TBTF) problem is worse in the European Union than in the United States. When funding for bank recapitalization is in question, it is not unreasonable for investors to worry that estimated capital shortfalls in stress tests are being low-balled because supervisors don’t want to identify bank problems that don’t have an immediate solution, lest they stoke market turbulence.

A third detracting factor for the EU tests is that outside estimates of the capital shortfall in the banking system have been considerably larger than the shortfalls emerging from the stress tests. Ever since IMF Managing Director Christine Lagarde (2011) put a spotlight on the need for “urgent capitalization” of Europe’s banks in August 2011, a flurry of estimates have suggested that EU banks are significantly undercapitalized. Viral Acharya and Sascha Steffen (2014) conclude that euro area banks have been “severely undercapitalized” since the 2007–09 financial crisis. Using book values of equity and assets, they estimate an aggregate EU capital shortfall of 82 billion to 176 billion euros. If the market values of equity and assets are employed instead, this estimated capital shortfall rises to between 230 billion and 620 billion euros. And when the estimate of the capital shortfall is applied to a hypothetical systemic financial crisis (with a 40 percent decline in a market equity index), the shortfall is about 580 billion euros.¹⁶ The IMF (2011a) and the OECD (2013) also published estimates suggesting that the aggregate capital shortfall for euro area banks was in the neighborhood of 200 billion to 300 billion euros and

15. Goldstein and Véron (2011) give the ratio of the banking assets of the five largest banks relative to GDP (in 2009): for the United States, the ratio is 43 percent. For the larger EU economies, the ratios are as follows: the Netherlands (406), United Kingdom (336), France (250), Spain (189), Italy (121), and Germany (118). If one looks instead at total bank assets relative to GDP in 2013, the conclusion is similar: the US ratio is 87 percent versus 350 percent for the euro area; see IMF (2014a). Goldstein and Véron (2011) also report that the share of total credit intermediation undertaken by banks is about three times higher in the euro area than in the United States.

16. Acharya, Schoenmaker, and Steffen (2011) reached similar results on undercapitalization in EU banks.

400 billion euros, respectively. These shortfall estimates are much larger than those in the adverse scenarios of the EU stress tests.¹⁷ They also loom large relative to the 55 billion euro common resolution fund agreed by EU finance ministers in December 2013.

Investors who were underwhelmed by the euro area stress tests no doubt were also influenced by the weak macroeconomic environment in which EU-wide stress tests had been conducted. But it merits emphasis that the design of the EU stress tests also contributed to their poor reception.

The methodology and results of the initial October 2009 test were described solely in a three-page press release that summarized the presentation made by CEBS to Ecofin ministers and governors. No individual bank results were published (thereby making it impossible to distinguish weak from strong banks). The capital benchmark used in the 2009 test was the T1 ratio rather than the more demanding T1C or CT1 ratios, and since no bank among the 22 major cross-border banks in the sample saw its T1 capital ratio fall below 6 percent—even in the more adverse scenario—there were no capital actions taken (beyond the government support measures previously announced during the crisis).

The second stress test, with results released in July 2010, was an improvement: A 55-page report detailed its objectives, methodology, and results for 91 banks representing 65 percent of total European banking assets. Individual bank results were published. Amid mounting market concerns over sovereign debt sustainability, the report provided data on banks' exposures to European Union/European Economic Area (EU/EEA) central and local government debt, and included an adverse sovereign debt scenario, resulting in losses to banks' trading books. This time, seven banks saw their T1 capital ratios fall below 6 percent in the adverse scenario, leading to an aggregate shortfall of 3.5 billion euros. Still, as emphasized by Adrian Blundell-Wignall and Patrick Slovik (2010), the sovereign debt scenario was widely viewed as inadequate, since 83 percent of sovereign debt exposures were held in the banking book—not the trading book—and no haircuts were assumed for the former.¹⁸ Another blow to credibility came in October 2010 when the Irish banking system melted down at enormous cost to Ireland's public debt position and to the Irish taxpayer, only several months after Ireland's two largest banks had passed the July 2010 test.

The third EU-wide stress test (July 2011) was coordinated by the European Banking Authority (EBA), with some more improvements, including

17. The official estimates of the aggregate shortfalls in the four EU-wide stress tests were as follows: 2009 test, no shortfall published; 2010 test, aggregate shortfall of 3.5 billion euros; 2011 test, aggregate shortfall of 26.8 billion euros; 2014 test, aggregate shortfall of 24.6 billion euros. In the 2011 EU-wide capital exercise, the aggregate shortfall was estimated to be 115 billion euros (CEBS 2009, 2010; EBA 2011, 2012, 2014a).

18. Blundell-Wignall and Slovik (2010) calculate that if the same losses assumed for the trading book were also extended to the banking book, losses on sovereign debt exposures would have been 165 billion euros instead of 26 billion euros.

additional data from banks.¹⁹ The bank capital measure used in the test, CT1 capital, was more restrictive (tougher) than the T1 measure used in the two earlier tests, although this was offset by the lowering of the stressed capital target from 6 percent (in the July 2010 test) to 5 percent (in the July 2011 test). Haircuts on sovereign debt exposures of banks in the trading book were updated and an increase in provisions was implemented for sovereign debt held in the banking book. Also, market concerns about sovereign debt exposures were allowed to affect the cost of funding in the adverse scenario. The difference between the baseline scenario and the adverse scenario was larger than in previous tests. Thirty of the 91 banks in the test fell below the 5 percent capital hurdle rate, with an aggregate shortfall of 27 billion euros. The EBA also issued its first formal recommendation to national supervisory authorities: Banks below the 5 percent threshold should promptly remedy their shortfall, and those with capital ratios above but close to the threshold and with sizable exposure to sovereigns under stress should strengthen their capital positions.

Despite these improvements, the Stoxx Europe 600 Banks Index fell by more than 3 percent (to a two-year low) on the first trading day after the July 2011 EU-wide stress test results were released (Ahmed et al. 2011).²⁰

Stung by the poor market reaction, the EBA soon undertook its EU-Wide Capital Exercise in October 2011.²¹ The results, revealed in October 2012,²² assessed the capitalization of 70 banks against an exceptional and temporary capital benchmark of 9 percent CT1 capital. Thirty-seven banks fell below the target, with an aggregate capital shortfall of 116 billion euros. The EBA urged national banking supervisors to implement recapitalization plans for all undercapitalized banks.

Both the 2011 stress test and the follow-up EU-Wide Capital Exercise have been widely criticized. The most salient criticism comes from Jakob Vestergaard and María Retana (2013). They argue that the EBA made three major mistakes.²³

First, the EBA employed only risk-based measures of bank capital despite the accumulating evidence that such measures have very limited ability to

19. Enam Ahmed et al. (2011) report that 3,200 data points per bank were supplied compared with 149 per bank in the 2010 stress test.

20. The behavior of Bloomberg's Europe 500 Bank and Financial Services Index, in the year following release of the 2011 stress tests results, provided a similar market verdict on that test.

21. In October 2011, the EBA also conducted the Basel III monitoring exercise on a sample of 158 European banks. Its main finding was that more than half the banks did not meet the Basel III targets for either equity to risk-weighted assets (7 percent) or the leverage ratio of equity to total assets (3 percent) (Vestergaard and Retana 2013).

22. This is well described in Vestergaard and Retana (2013). I provide a summary of their account.

23. Some others have offered additional criticisms, including that the 2011 stress test did not contain a sovereign default scenario (Ahmed et al. 2011).

discriminate between healthy and sick (large) banks.²⁴ A leverage ratio of 4.5 percent would have identified all the banks that failed over the subsequent two years; in contrast, there was no value of the risk-based CT1 measure that would have identified the failing banks while still allowing some banks to pass the test.

A second charge made by Vestergaard and Retana (2013) is that the EBA selected the CT1 capital measure as the pass-fail metric because it wanted the test to generate two results: that there would be relatively few failures and that these failures would occur primarily in relatively small banks on the periphery of the euro area. If a leverage ratio of 3 percent had been chosen instead, 26 banks would have failed (instead of 3 with the CT1 ratio), and among the failures would have been quite a few large German and French banks, including Deutsche Bank, Commerzbank, BNP Paribas, and Société Générale.²⁵

The third major mistake, according to Vestergaard and Retana (2013), was to specify the bank capital target as a *ratio* rather than as absolute amounts of bank capital,²⁶ thereby opening the door for banks to meet much of the target by cutting back on loans, engaging in fire sales of assets, and manipulating risk weights (by decreasing the denominator of the capital ratio). Vestergaard and Retana (2013) were therefore not surprised that only 38 percent of the reported recapitalization occurred through the raising of new equity capital.

Yet a further blow to credibility came when Dexia—the large (\$700 billion) Belgian-French bank that got an easy pass (from the CT1 measure) in the adverse scenario of the July 2011 test—plunged into crisis later that year, requiring a bailout by Belgian and French authorities at considerable expense to taxpayers.²⁷ Viral Acharya, Dirk Schoenmaker, and Sascha Steffen (2011) report that Dexia’s leverage ratio—using unweighted assets in the denominator and either the market or book value of equity in the numerator—was only between 0.49 percent and 1.34 percent.

Despite the poor market reception to the first three EU-wide stress tests, some analysts were cautiously optimistic that the 2014 stress test would earn higher marks because at least some of the handicaps and flaws outlined above were expected to be corrected or at least diminished (Posen and Véron 2014).

24. Vestergaard and Retana (2013) point to the empirical work of Blundell-Wignall and Roulet (2012), who looked at a sample of 94 US and European banks during 2004–11 and found that (risk-based) T1 capital ratios had no support as a predictor of default, whereas a simple (unweighted) leverage ratio found strong support in the data.

25. If the hurdle rate for the leverage ratio had instead been set at 4.5 percent, 50 of the 70 banks would have failed the 2011 test. Vestergaard and Retana (2013) also show that German and French banks have much lower ratios of risk-weighted assets to total assets and lower leverage ratios than Spanish and Italian banks, and these differences almost guarantee that the largest German and French banks will look much better under risk-based capital measures than under unweighted capital measures.

26. This argument was also made by, among others, IMF (2011a) and Greenlaw et al. (2012).

27. “How Did Europe’s Bank Stress Test Give Dexia a Clean Bill of Health?” *Guardian*, October 5, 2011.

The 2014 results for the EU-wide stress test and accompanying asset quality review (AQR) were published on October 26, 2014. There were three key findings²⁸: (1) the aggregate capital shortfall for the 123 participating banks was 24.6 billion euros, (2) 14 banks in Italy, Greece, and Cyprus failed to meet the capital hurdle rates in the baseline and/or adverse scenarios, and (3) the largest banks in France and Germany had ample capital.

Despite extensive documentation, choice of a higher quality of capital in the numerator of the capital ratio, and a larger decline (than in previous tests) for the capital ratio under the adverse scenario, the 2014 results have drawn, at best, a mixed response. Some critics emphasized that (as in earlier tests) the exclusion of a leverage ratio test biased the results in the direction of few failures and in favor of large French, German, and Dutch banks (Goldstein 2014). Other critics focused on the failure to include a deflation scenario and on the artificial boosting of capital ratios due to the ECB's permissive attitude toward deferred tax assets. In contrast, more positive assessments of the results highlighted the considerable resources devoted to the AQR and the ECB's rigorous methodology (Heim 2014).

Thus far, the market verdict on the test has been negative. The Stoxx Europe 600 Banks Index is marginally lower at the time of writing than it was on the last workday immediately preceding the test (October 24, 2014). Moreover, Benn Steil and Dinah Walker (2014) show that 28 of the 31 banks in the Stoxx Euro 600 Banks Index that were tested now trade at lower price-to-book ratios than they did before the test results were released.

Although the US and EU-wide tests have captured most of the attention, bank stress tests are now widespread. All 27 members of the Basel Committee on Banking Supervision (BCBS) use them, including Hong Kong, China; India; Indonesia; the PRC; the Republic of Korea; and Singapore (Bernanke 2013). The IMF also includes stress tests of banks as an element of its wider Financial Sector Assessment Program (FSAP), and makes an FSAP assessment mandatory at least once every five years for 25 jurisdictions with systemically important financial sectors (in emerging Asia, this list includes Hong Kong, China; the PRC; the Republic of Korea; and Singapore).

Operational Features of the US and EU-Wide Tests

Tables 8.1 and 8.2 illustrate operational features of the US and EU-wide tests, along the following lines.

Coverage. The focus is on the largest and most interconnected banks. The US CCAR tests employ a simple asset size cutoff, whereas the EU tests cover at least 50 percent of banking assets in each country.²⁹

28. In addition to these findings, it was reported that the AQR resulted in a decrease in the weighted-average core CET1 capital ratio of only 40 basis points.

29. Nonbanks are typically not included, presumably because bank supervisors do not have the same authorization to recommend/mandate corrective action if their banks should fail the test,

Table 8.1 US bank stress tests, 2009–14

Stress test	Date	Supervisors	Coverage	Time horizon	Scenarios		Models
SCAP	October 2009	Fed, FDIC, OCC	19 largest domestic BHCs; 66% of banking system assets	2009–10	Baseline (supervisor led) More adverse (supervisor led)	Macroeconomic: real GDP, unemployment rate, house prices. Market Stress Scenario: firms with trading assets greater than or equal to \$100 billion	Supervisor models
CCAR	March 2011	Fed, FDIC, OCC	19 BHCs (same as SCAP)	2011–12	Baseline (supervisor led) More adverse (supervisor led) Company-run equivalents of above	Macroeconomic: Real GDP, unemployment rate, asset prices. Severe Global Market Shock ^a	Bank models checked by supervisors
CCAR	March 2012	Fed, FDIC, OCC	19 BHCs (same as SCAP)	2012–13	Baseline (supervisor led) More adverse (supervisor led) Company-led equivalents of above.	Macroeconomic and Financial Market: deep recession in US, asset price declines, increase in risk premia, slowdown in global economic activity Severe Global Market Shock ^a	Supervisor models and bank models
CCAR	March 2013	Fed, FDIC, OCC	18 BHCs; 70% of banking assets	2013–15	Baseline (supervisor led). Adverse (supervisor led). Severely adverse (supervisor led). Company-led equivalents of above.	Macroeconomic and Financial Market Interest Rate Scenarios Severe Global Market Shock ^a	Supervisor models and bank models
CCAR	March 2014	Fed, FDIC, OCC	30 BHCs; 80% of assets of all BHCs (including 12 BHCs that did not participate in previous CCARs)	2014–15	Baseline (supervisor led). Adverse (supervisor led). Severely adverse (supervisor led). Company-led equivalents of above.	Macroeconomic and Financial Market Interest Rate Scenarios Severe Global Market Shock ^a Counterparty Default ^b	Supervisor models and bank models

Bank capital

Stress test	Hurdle rate	Average change in capital ratio (stressed minus starting)	Failures	Disclosure	Remedial actions
SCAP	Tier 1 (stressed) 6% Tier 1 common (stressed) 4%	Median loss is -7.5% of risk-weighted assets under more adverse scenario.	10 of 19 banks needed additional capital	Bank-by-bank results	Firms that didn't meet hurdle rate were required to raise dollar amounts of capital within 6 months; government backup in place if a firm couldn't raise enough private capital.
CCAR	Tier 1 common (stressed) 5% Tier 1 leverage (stressed) 3% Also must maintain four capital ratios above minimum regulatory requirements.	Not available	Not available	No bank-by-bank results	One month after CCAR report, firms receive detailed assessment of their capital plans—including areas where plans and processes need to be strengthened.
CCAR	Tier 1 common (stressed) 5% Tier 1 leverage (stressed) 3% Also must maintain four capital ratios above minimum regulatory requirements.	Tier 1 common: -3.8% (6.3% vs 10.1%) Tier 1 leverage: -2.7% (4.7% vs 7.4%)	4 of 19 firms had one or more stressed capital ratios that fell below hurdle rates	Bank-by-bank results	Federal Reserve notifies BHCs if it has any objections to its capital plan; if Fed objects, no capital distributions permitted until Fed gives written approval.
CCAR	Tier 1 common (stressed) 5% Tier 1 leverage 3-4% Also must maintain four capital ratios above minimum regulatory requirements.	Tier 1 common: -4.5% (6.6% vs 11.1%) Tier 1 leverage: -2.7% (5.3% vs 8.0%)	2 of 18 received objection to capital plan. Two other firms received conditional non-objection to plans	Bank-by-bank results	Federal Reserve notifies BHCs if it has any objections to its capital plan; if Fed objects, no capital distributions permitted until Fed gives written approval.
CCAR	Tier 1 common (stressed) 5% Tier 1 leveraged (stressed) 3-4% Also must maintain four capital ratios above minimum regulatory requirements.	Tier 1 common: -5.0% (6.6% vs 11.6%) Tier 1 leverage: -3.0% (5.4% vs 8.4%)	5 of 30 received objection to capital plans (of which 4 of 30 had objection on qualitative grounds, and one on quantitative grounds)	Bank-by-bank results	Federal Reserve notifies BHCs if it has any objections to its capital plan; if Fed objects, no capital distributions permitted until Fed gives written approval.

SCAP = Supervisory Capital Assessment Program; BHCs = bank holding companies; CCAR = Comprehensive Capital Analysis and Review; OCC = Office of the Comptroller of the Currency; FDIC = Federal Deposit Insurance Corporation

- a. Applies to six largest firms with significant trading activities.
- b. Applies to eight firms with significant trading activity and/or important custodial operations.

Source: Board of Governors (2009a, 2009b, 2011, 2012, 2013, 2014).

Table 8.2 EU-wide bank stress tests, 2009–14

Stress test	Date	Supervisors	Coverage	Time horizon		Scenarios	Models
First EU-wide stress test	October 2009	CEBS, EC, ECB, national supervisors	22 major cross-border banking groups, 60% of total EU banking assets	2009–10	Baseline (supervisor led) More adverse (supervisor led)	Macroeconomic: EU real GDP, unemployment rate, property prices (same variables in US).	Supervisor models
Second EU-wide stress test	July 2010	CEBS, EC, ECB, national supervisors	91 European banks, 20 EU member states, covers 65% of EU total banking assets	2010–11	Baseline (supervisor led) More adverse (supervisor led)	Macroeconomic: EU real GDP, unemployment rate, property prices, foreign economic activity. Sovereign debt shock to trading book.	Banks' own models, supervisor models
Third EU-wide stress test	July 2011	EBA, ECB, ESRB, EC, national supervisors	90 European banks, 21 EU members	2011–14	Baseline (supervisor led) More adverse (supervisor led)	Macroeconomic: Sovereign debt shock to trading book; increased provisions for sovereign debt in banking book.	Banks' own models, supervisor models
Fourth EU-wide stress test	October 2014	EBA, ECB, ESRB, EC, national supervisors	123 European banks, covers more than 70% of total EU banking assets	2014–15	Baseline (supervisor led) More adverse (supervisor led)	Macroeconomic: adverse scenario to include (1) increase in global bond yields; (2) further deterioration in credit quality in EU countries with feeble demand; (3) stalled policy reforms; (4) lack of progress on bank balance sheet repair.	Banks' own models, supervisor models

Bank capital

Stress test	Hurdle rate	Average change in capital ratio (stressed minus starting)	Failures	Disclosure	Remedial action
First EU-wide stress test	Tier 1 (stressed): 6.0%	Tier 1: -0.1% (7.8% versus 7.9%)	None announced	No bank-by-bank results published	None
Second EU-wide stress test	Tier 1 (stressed): 6.0%	Tier 1: -1.1% (9.2% versus 10.3%)	7 banks	Bank-by-bank results; sovereign debt exposures	Remedial actions to be decided by national supervisory authorities
Third EU-wide stress test	Core tier 1 (stressed): 5%	Core tier 1: -1.5% (7.4% versus 8.9%)	20 banks	Bank-by-bank results; sovereign debt exposures	EBA recommends that national supervisors request all banks failing stress tests to promptly eliminate their capital shortfalls. Also, EBA launches EU-Wide Capital Exercise in October 2011.
Fourth EU-wide stress test	Common equity tier 1: 8% baseline, 5.5% (stressed) adverse scenario	Common equity tier 1: -2.6% (8.5% versus 11.1%); also, decline of 0.4% due to asset quality review	24 banks (14 banks, after 2014 capital raising)	Bank-by-bank results	Banks failing test have two weeks to submit new capital plan. Banks below baseline (adverse) hurdle rate have six (nine) months to achieve hurdle rate.

EC = European Commission; ECB = European Central Bank; CEBS = Committee of European Banking Supervisors; EBA = European Banking Authority; ESRB = European Systemic Risk Board

Sources: CEBS (2009, 2010); EBA (2010, 2011, 2012, 2013, 2014a, 2014b).

Frequency. Since 2011, US supervisors have been required by legislation to conduct supervisor-led stress tests annually.³⁰ No such requirement exists in the European Union. An annual requirement prevents authorities from delaying a test out of concern over exposing the banking system’s fragility. More frequent (supervisor-led) stress tests are seen as impractical because of the data and modeling requirements.³¹

Scenario horizons. The US and EU tests generally cover two calendar years in a row, a time frame that fits two-year baseline forecasts for the home economy and for its main trading partners (such as in the IMF’s *World Economic Outlook*). A two-year horizon is long enough to allow shocks to take effect but not so long as to invite large forecast errors.

Types of scenarios. Bank stress tests include a baseline scenario and at least one “adverse” scenario.³² The most popular variables are real GDP growth, inflation, the unemployment rate, housing prices, and equity prices. Bank solvency is deemed threatened when a recession is paired with a collapse of property and equity prices. Over time, more variables have been added, including a wider array of interest rates and asset prices and a fuller characterization of foreign economic conditions. The 2014 CCAR scenarios (Board of Governors 2014) contained a block of 48 variables. “Bespoke” scenarios have also become more common, reflecting either market concerns at a point in time or structural vulnerabilities of some banks in the test. For example, the EU-wide tests have included a sovereign debt scenario since 2010, while the US tests have always included—for the six largest banks with significant trading activity—an adverse global market scenario (meant to capture a severe deterioration in market conditions, like that prevailing between June and December of 2008).

Models used to estimate the effects of the scenarios on bank capital. Stress test managers now rely on a multiplicity or “suite” of models.³³ In ad-

and perhaps because stress tests for nonbanks would require different scenarios than for banks. Foreign banks with subsidiaries are increasingly included if they are thought to be important for the functioning of the financial system.

30. That same legislation requires company-run stress tests, at least twice a year.

31. See EBA (2014a) for an enumeration and explanation of the substantive data requirements for banks participating in the EU-wide stress tests. Ahmed et al. (2011) reported that data points per bank rose from about 150 in the 2010 EU-wide stress test to 3,500 per bank in the 2011 test. The 2014 EU-wide test used roughly 12,000 data points per bank. Bernanke (2013) indicates that for the 2013 CCAR, the supervisors collected and analyzed loan and account-level data on more than two-thirds of the \$4.2 trillion in accrual loans and losses held by the 18 banks participating in the test. In the United States, it takes about six months after the submission of the last bank data for stress test results to be published.

32. The guideline for adverse scenarios is that they should be “severe but plausible.” For the US tests, supervisors have pledged that the severely adverse scenario will reflect, at a minimum, the economic and financial conditions typical of a severe post-WWII US recession (Tarullo 2014b).

33. Bernanke (2013) acknowledged that the Federal Reserve uses more than 40 models to project how categories of bank losses and revenues would respond to hypothetical scenarios.

dressing why so many models are needed, analysts (Bank of England 2013; Borio, Drehmann, and Tsatsaronis 2012) offer the following explanations.

Stress tests involve credit risk, market risk, sovereign risk, and liquidity and funding risks. A single model will not be capable of handling all these types of risk. Although attention often centers on loan losses, models of bank earnings are no less important.³⁴ Standard macromodels don't capture the effect of macroconditions on the elements of bank balance sheets; to do so requires specialized auxiliary models. Since the probability of model error is high, a "consensus" approach based on the output of a group of models is warranted. So-called bottom-up approaches that rely on banks' own models to estimate the effect of shocks on bank performance are good for capturing the granularity and idiosyncratic aspects of individual banks, but those short-fall estimates need to be weighted against "top-down" estimates, in which the regulator imposes consistency and uses its own set of models. A set of models also makes it harder for the banks to "game" the tests by increasing exposure to risks that are underestimated by a particular model.

Capital hurdle rates. The capital hurdle rate indicates the minimum capital ratio that banks need to reach under the various scenarios. Falling below the hurdle rate yields a verdict of failure (as in the EU-wide tests) and/or (as in the CCAR tests) requires a new capital plan that enables the bank to pass the test.

The capital hurdle rate is meant to convey the message that banks have sufficient capital to absorb losses under adverse conditions while still meeting international, regional, and national regulatory minimums for capital adequacy. Minimum international regulatory standards for bank capital are represented by Basel III.³⁵ The United States and the European Union issued final Basel III implementation regulations in mid-2013. Since the BCBS decided to phase in the Basel III requirements over a six-year period ending in December 2018, and since the phase-in period is different for different measures of bank capital, meeting the Basel III minimums is a moving and differentiated target. The only relevant regional minimum capital standard for our purposes is the EU's fourth *Capital Regulation Directive* (CRD IV); it too went into effect in mid-2013. It mostly mirrors Basel III, but has been criticized both for watering down some of the excluded items in the definition of CET1 capital and for making it harder for EU countries to impose national minimum capital standards that are considerably above the Basel III minimums (Goldstein 2012, Vestergaard and Retana 2013). Outside the European Union, there

34. Recent studies of bank capital increases over the 2007–12 period show that retained earnings made the largest contribution to such increases (Cohen and Scatigna 2014).

35. The minimum capital adequacy levels under Basel III are 4.5 percent of risk-weighted assets for CET1 capital (exclusive of several additional buffers), 6 percent of risk-weighted assets for T1 capital, 8 percent of risk-weighted assets for total capital, and 3 percent of (unweighted) total assets for T1 leverage.

are no limits to how much national minimum capital standards may exceed Basel III.³⁶

Table 8.1 shows that the 2009 SCAP used a stressed capital hurdle rate of 4 percent for T1C. When the CCAR was introduced in 2011, the stressed capital hurdle rate was raised to 5 percent. A stressed T1 leverage rate of 3 percent was also introduced into the tests. In the 2012–14 CCARs, the stressed T1C hurdle rate was maintained at 5 percent, while in 2014, the stressed hurdle rate for T1 leverage was raised to 4 percent. Table 8.1 also shows the average change in the capital ratio, defined as the difference between its stressed level in the most adverse scenario and the starting level just before the first year of the scenarios. What the calculations show is that the fall in the capital ratio under the most adverse scenario has been getting larger over the 2012–14 period, thus lending support to the claim that the CCAR scenarios cum stress test models are becoming somewhat tougher over time.³⁷

Table 8.2 provides similar information on stressed bank capital hurdle rates for the first four EU-wide stress tests. The first two EU tests had a 6 percent stressed hurdle rate, but applied it to a lower-quality measure of bank capital, namely, T1. Not until the 2011 EU-wide test was the hurdle rate defined as CT1 capital, and then the rate was lowered to 5 percent. In the 2014 stress test, the hurdle rate was defined as CET1, and the stressed hurdle rate was increased to 5.5 percent. A leverage ratio was not part of the 2014 test. As in the US tests, the decline in the capital ratio during the adverse scenario has gotten larger over time.

Disclosure. The United States had no supervisor-led test in 2010, and the European Union had no EU-wide tests in either 2012 or 2013. Moreover, the first CCAR report in 2011 contained no bank-by-bank results, and this was only two years after the widely acclaimed success of such bank-by-bank disclosure in the 2009 SCAP. In the face of market skepticism, the CEBS and the EBA appeared to be dragged, kicking and screaming, into progressively greater disclosure over the 2009–11 period. During 2012–13, those concerned about

36. In a recent Bank of Canada study, Éric Chouinard and Graydon Paulin (2014) suggest that most large, internationally active banks should have little trouble in meeting the Basel III standards, at least under nonstressed conditions. Using a broad sample of 100 large banks, they report that the average CET1 capital ratio was 9.5 percent in mid-2013, and that only five of the 100 banks had a CET1 ratio below 7 percent (the Basel III minimum that would apply for CET1 plus the 2.5 percent capital conservation buffer). Similarly, Chouinard and Paulin (2014) indicate that the (aggregate) T1 leverage ratio for this same group of banks was 4.3 percent in mid-2013, again above the Basel III minimum.

37. Senior US regulatory officials have stated that, unlike a professional golf tournament, US stress tests are not designed with a prespecified failure rate in mind (Tarullo 2014b). The failure rate in a stress test is not necessarily a good indicator of the severity of the test because, among other things, the failure rate is so sensitive to the definition and height of the capital hurdle rate.

European banking fragility had to wait for what was advertised as a bigger and better stress test cum AQR, undertaken only in October 2014.³⁸

Still, the steps toward greater disclosure in the United States and the European Union have been substantial in terms of test objectives, participating banks, recent trends in bank capital and liquidity, methodology, macroeconomic and market risk scenarios, model approach, treatment of securitizations, data templates, and individual bank losses by type of exposure. All in all, I would hardly call the process a “black box.” Apparently, supervisory officials in the United States and the European Union have concluded that what they gain from greater transparency and disclosure surrounding the stress tests—in terms of market discipline, improved public confidence during crises, and fuller bank engagement in the exercise—more than compensates for any risk of market turbulence or false complacency associated with publication of the results.

Remedial policy actions in response to the test results. Without remedial action on individual banks or the system as a whole, stress tests would not be of much help. The unhappy Japanese experience with “zombie” banks in the 1990s is but one case in point. In planning the framework for its own stress tests, due in late 2014, the Bank of England (2013) has set out the measures that banks could be required to take if there was a need to strengthen their capital. These include (1) constraining dividend distributions, share buybacks, or discretionary payments on certain T1 capital instruments; (2) constraining (variable) remuneration to staff; (3) issuing equity or other capital instruments that can definitely absorb losses on a “going concern” basis (outside of resolution or liquidity); (4) engaging in liability management exercises; and (5) reducing certain risk exposures or business lines.

If the stress tests reveal that the banking system as a whole is significantly undercapitalized, there are likewise remedial policy actions that could be taken, including increasing the countercyclical capital buffer, increasing national minimum capital requirements, constraining dividend payments for all banks, requiring new equity issuance, and, in a deep crisis, using public funds to recapitalize banks unable to tap private sources.

Criticisms of Stress Testing Methodology and the Measurement of Bank Capital

Even though stress testing is now a “cornerstone of a new approach to regulation and supervision of the . . . largest banks,” as Daniel Tarullo (2014b) of the Federal Reserve Board has asserted, some critics have identified serious problems in the methodology. Four such concerns merit discussion.

38. As noted earlier, the EBA published the results of a Basel III monitoring exercise in April and September 2012 and the results of an EU-wide capital exercise in October 2012, but neither analyzed the conditions of EU banks under an adverse scenario.

First, bank stress tests have been found seriously wanting as an early warning indicator of banking crises. Claudio Borio, Mathias Drehmann, and Kostas Tsatsaronis (2012, 7) offer the following bold charge: “To our knowledge, no macro stress test carried out ahead of the [2007–09] crisis identified the build-up of the vulnerabilities. The message was overwhelmingly: ‘The system is sound.’ Rather than being part of the solution, stress tests turned out to be part of the problem.” For example, they point to the clean bill of health given to Iceland’s banking sector in the 2008 IMF FSAP.³⁹

According to Laeven and Valencia (2013), 18 countries experienced “systemic” banking crises during the 2007–11 period. Since they report that all of these systemic crises (with the exception of Nigeria) started in 2007 or 2008, I looked at the FSAPs (cum bank stress tests) published by the IMF in 2006–07 for the seven larger economies that were on the Laeven-Valencia list: Greece (2006), Denmark (2006–07), Ireland (2006), Spain (2006), the United Kingdom (2006), Belgium (2006), and Portugal (2006).⁴⁰ What I was looking for in these FSAPs (preferably in the executive summaries) was a clear published warning of a potentially serious banking crisis, along with a recommendation for strong corrective policy response.⁴¹ I found little of it (Goldstein 2015). From an early warning perspective and taken as a group, there is not a lot here for the IMF to brag about.⁴²

The BIS authors are highlighting a disconnect between the early warning literature on banking crises and the adverse scenarios typically employed in the bank stress tests. Banking crises typically occur when credit growth to the private sector and real property prices are well above their norms. These are dual-threshold models in which a crisis is indicated when credit growth and real property prices are at or near the peak (Borio and Drehmann 2009; Borio, Drehmann, and Tsatsaronis 2012; BIS 2014).⁴³ The intuition is that credit growth is a proxy for leverage (and lending standards), while property prices are proxy for collateral (BIS 2014). Sharp declines in real economic growth or large increases in the unemployment rate *do not* stand out as good advance indicators of banking crises, since these crises typically begin when output growth is still

39. “The banking system’s reported financial indicators are above minimum regulatory requirements and stress tests suggest that the system is resilient” (Borio, Drehmann, and Tsatsaronis 2012, 1).

40. The United States did not have an FSAP during this period. According to the IMF’s Independent Evaluation Office (IMF 2011c), the IMF repeatedly asked to do an FSAP during the 2004–07 period, but US authorities declined those requests.

41. I say “published” warning because I am told that IMF FSAP missions typically leave with country authorities a confidential memorandum that is not published; since such memoranda are not available to outside analysts, I have to base my commentary on the published reports alone.

42. My assessment is similar to that reached by the IMF’s Independent Evaluation Office in 2011 (IMF 2011c) in its report on the performance of Fund surveillance in the 2004–07 run-up to the global economic and financial crisis.

43. The BIS authors also find that debt service ratios can be useful in the near term in anticipating financial strains and crises.

in the upswing. Once a banking crisis erupts, real output does show a marked fall and this output decline has a negative feedback effect on banks. But it is the banking crisis that causes output to fall, not the other way around. A major selling point of these early warning models is that they seem to have caught the bulk of the systemic banking crises over the past 40 years or so, including the 2007–09 crises in the United States and the United Kingdom, and the Asian financial crisis of 1997–98 (BIS 2014). The takeaway is that stress tests may be a good way to differentiate weak banks from stronger ones once a banking crisis is already under way, but they are not apt to see one coming, especially when many other risk indicators—like credit default spreads, interest rate spreads, and equity market volatility—are sending “all is clear” signals.

Because credit-to-GDP ratios typically fall after banking crises, US and EU supervisors might respond that it would not have been useful to include a credit boom scenario in their 2009–14 series of stress tests; indeed, during this recovery period, the concern was to get bank lending up, not down. If credit growth and property prices become elevated in the future, that would be the time—so the argument might go—to include such a scenario in the stress tests.

According to the BIS (2014), red lights are flashing for the credit-to-GDP and property-price early warning indicators for an Asian emerging-economy aggregate, composed of Hong Kong, China; Indonesia; Malaysia; the Philippines; Singapore; and Thailand. The credit-to-GDP indicator is likewise flashing red for the PRC (and for Brazil, Switzerland, and Turkey), and it is flashing yellow for the Republic of Korea.⁴⁴ In short, a prominent early warning model of banking crises is pointing to high potential vulnerability in much of emerging Asia over the next few years.

Hong Kong, China; Malaysia; the PRC; the Republic of Korea; and Singapore have had IMF FSAP missions cum bank stress tests during the 2011–14 period. My reading of those FSAP reports—sometimes supplemented by looking at the recent Article IV consultation report—is that they are better than the FSAPs done in 2004–07 in identifying and highlighting the systemic risk to the banking system caused by very rapid credit growth and highly elevated property prices.⁴⁵ But those IMF reports still place too much confidence in the usually reassuring results of the stress tests; and even more so, the reports are still too timid in recommending strong corrective and protective remedial measures.⁴⁶

44. The BIS early warning indicator for credit booms refers to total credit to the private sector and hence is not affected by sharp shifts between bank and shadow bank financing.

45. Going beyond credit booms and property prices, the recent IMF FSAPs are also better than ones done earlier in dealing with liquidity risks and in evaluating various types of contagion.

46. My reasons for suspecting that too much confidence is being placed in the largely optimistic outcomes of stress tests are explained more fully in the remainder of this section. In short, the stress tests rely almost exclusively on risk-based measures of capital instead of leverage ratios, and the stress test models themselves do not include either enough adverse feedback effects from the financial sector to the real sector or large amplification effects within the bank and nonbank financial sectors. See Goldstein (2015) for quotes from these FSAP reports pertaining to Asian emerging economies.

Even when and where early warning models of banking crises and IMF-run stress tests reach a similar verdict, national bank supervisors may disagree with the findings. The People's Bank of China, referring to its own stress tests covering 17 systemically important domestic banks, concluded: "Under light, middle and heavy stress scenarios, the banking system's overall capital adequacy would remain at the relatively high level: even the most serious scenarios would not see capital adequacy fall below 10.5 percent."^{47,48}

A second major criticism of bank stress tests is that they fail to capture adequately the heightened uncertainty, nonlinearity, and contagion that make the output loss deeper and the recovery slower for recessions accompanied by financial crises than for normal recessions.⁴⁹ As emphasized by Borio, Drehmann, and Tsatsaronis (2012), the feedback effects from financial sector stress to the real economy tend to be rather weak in the models underlying the tests, with the result that it takes very large shocks to generate serious capital inadequacy for banks.⁵⁰ In contrast, during a real systemic banking crisis, risks can migrate quickly from one institution, asset class, or county to others; insolvency and liquidity risks can reinforce one another, leading to severe funding strains for banks and their customers; and market participants whose claims are not guaranteed may find it logical to "run" into cash or treasuries until they get better information.⁵¹ On top of this, delays or conflicts in formulating a muscular government response to a crisis can undermine confidence in ways that are not evident from earlier time series.

47. See "China Confident After Bank Stress Tests, Even As Growth Slows," Reuters, April 30, 2014.

48. There are also the views of outside analysts to consider on the risk of banking crises. Speaking in April 2014, Nicholas Lardy (2014) concluded that the risk of a financial crisis in the PRC—despite the large run-up in credit—has been somewhat exaggerated and emphasized six mitigating factors: (1) bank lending is almost entirely funded by relatively stable (and largely captive) bank deposits and not by wholesale funding sensitive to sudden stops; (2) the shadow banking sector, despite recent growth, is still smaller as a percentage of GDP than both the global average and its counterpart in the United States; (3) the PRC still has a plain vanilla financial system, with relatively limited loan securitization; (4) although external debt is on the rise, the PRC's net international investment position is very strong; (5) the rate of credit growth could well moderate in the next few quarters, as it has often done in the past after sharp increases; and (6) the effects of a credit slowdown are likely to be tolerable, since the slowdown's negative effect on growth is likely to be offset in part by improved credit allocation to the private sector (where rates of return are much higher).

49. See Reinhart and Rogoff (2009) for the differences between banking crises and normal recessions.

50. As Borio, Drehmann, and Tsatsaronis (2012, 7) state, "the very essence of financial instability is that normal-size shocks cause the system to break down."

51. Kartik Anand, Guillaume Bédard-Pagé, and Virginie Tralet (2014) indicate that when the Bank of Canada included liquidity and spillover effects, in addition to solvency risk, in the stress tests that ran for its 2013 FSAP with the IMF, it found that the capital position of Canadian banks was 20 percent lower than when these effects were omitted. I suspect that this is a lower bound to the true effects.

One example of the forces at work comes from the Asian financial crisis of 1997–98, where the initial shock was to the economy of Thailand—not one of the world’s major trading or investment hubs.⁵² Yet the crisis spread quickly to Indonesia, Malaysia, the Republic of Korea, and the Philippines, leaving in its wake crashes in exchange rates and equity markets, deep recessions, and banking crises. I offered the “wake-up call” hypothesis as an explanation (Goldstein 1998).⁵³ I posited that Thailand served as a wake-up call for international investors to reassess the credit worthiness of Asian borrowers. And when they made that reassessment, they concluded that quite a few emerging Asian economies had vulnerabilities similar to Thailand’s: large external deficits, appreciating real exchange rates, sizable currency mismatches, weak financial sectors with poor prudential supervision, export slowdowns (in 1996), and declining quality of investment. As currencies and equity markets were written down to reflect this reassessment, the crisis spread. A weighted average of fundamentals that gives greater weight to those where Thailand was relatively weak is more consistent with an ordinal ranking of the Asian economies most affected by the crisis than does one predicated on either the extent of bilateral interdependence with Thailand or the strength of fundamentals irrespective of similarities with Thailand.⁵⁴

This example suggests that it is possible to generate a systemic crisis from a relatively modest initial shock if that shock leads to a reassessment of risk in a wider class of assets or financial institutions where previously vulnerabilities were underestimated.

52. A second good example comes from the 2007–09 global economic and financial crisis, where an intriguing question is how a shock to the relatively small US subprime mortgage market wound up generating such a widespread and systemic crisis. Part of the answer comes from what Gary Gorton and Andrew Metrick (2010) call the “run on repo,” that is, a run on the repurchase market. Here, weakness in the subprime mortgage market in early 2007 caused repo buyers of securitized bonds to become anxious about the quality of their collateral. As real estate and mortgage prices continued to slump, that anxiety continued to increase and it was reflected in large-scale selling of collateral and demands for larger “haircuts” in a widening segment of the huge repo market. Because many of the largest US investment houses and commercial banks were using the repo market to fund themselves, it wasn’t long before the drying up of funds in the repo market led to fears about the liquidity of counterparties in the interbank market. The forced rescue of Bear Stearns in March 2008 stoked further fears and induced the contagion to spread to highly rated credit securities unrelated to the subprime markets. Soon the entire securitized banking model came under intense pressure. In the second half of 2008, the panic hit a wider array of asset markets, financial institutions, and the real economy, ultimately contributing to the failure of Lehman Brothers, the AIG bailout, and the government takeovers of Fannie Mae and Freddie Mac.

53. I call it a “wake-up call” because judging from most market indicators of risk, private creditors and rating agencies were “asleep” about vulnerabilities in the crisis countries prior to the outbreak of the Thai crisis.

54. Pavan Ahluwalia (2000) also finds that shared (visible) characteristics with the “ground zero” country—what he calls “discriminating contagion—were helpful in explaining the pattern of currency crises during the Mexican, Russian, and Asian crises (after controlling for trade and financial interdependence).

Efforts to get more “chaos” and feedback effects into the models employed in stress tests are making some progress, but they are still at an early stage. Adverse liquidity scenarios are now more prevalent, and the use of current market prices rather than historical book values to capture changing risk profiles is increasingly standard. And several central banks—including the Bank of England (2013) and the Bank of Canada (Anand, Bédard-Pagé, and Traclet 2014)—have systemwide stress testing models in place that incorporate some kinds of feedback loops and amplification mechanisms.

A third important criticism of stress tests is directed at the measuring rod for the whole exercise: a *risk-weighted* measure of bank capital. The last five years have witnessed a growing chorus of doubts about the reliability of RWAs, the aggregate that serves as the denominator for all risk-weighted capital metrics. This is no narrow technical disagreement, but rather an assault on what the current chairman of the BCBS has called the “cornerstone” of the Basel framework since it was introduced 25 years ago (Ingves 2014a, 2).⁵⁵

Critics (myself included) argue that the deficiencies of these measures are so serious that the leverage ratio should instead serve as the primary measuring rod for capital adequacy. The case for downplaying the risk-based measures has been made forcefully by Andrew Haldane (2013, 2012) and by Thomas Hoenig (2013, 2012). Their main points are the following:

- Risk-based capital ratios did poorly in predicting bank failures during the 2007–09 crisis (among a sample of 100 large, complex global banks) compared with a simple leverage ratio, and this finding seems to be robust to the inclusion of macrocontrol variables.
- Risk-based capital measures misled investors and the public during the global crisis about the safety of the 10 largest US banking firms, which reported an average T1 capital ratio of above 7 percent and were regarded as well capitalized. Yet many needed official support during the crisis. Their average leverage ratio was only 2.8 percent—not enough to absorb a major shock (Hoenig 2013).⁵⁶

55. Recall that when Basel I was introduced in 1988, there was only a small set of supervisor-set risk weights. Responding to criticism that Basel I did not include enough risk sensitivity and granularity, Basel II, agreed to in 2004, vastly expanded the number of risk weights by permitting banks to use internal models to calculate these weights (subject to supervisory oversight) and by increasing risk weight gradations in the standard, supervisor-set model to include credit ratings and a host of other refinements.

Major disappointment with the performance of Basel II in the run-up to the global economic and financial crisis of 2007–09 led, in turn, to agreement on Basel III in 2010. In brief, Basel III made improvements to the quantity and quality of bank capital, and introduced quantitative liquidity standards. It also included for the first time (in an international agreement) a minimum capital ratio (called the leverage ratio) that uses *unweighted* assets in the denominator. The leverage ratio is meant to serve as a backstop or safety net to guard against flaws in the risk-based capital standards.

56. Hoenig (2013) also points out that for the US banking industry as a whole, average tangible leverage ratio decreased from 5.2 percent in 1999 to 3.3 percent in 2007.

- A tangible leverage ratio (tangible equity to tangible assets) is more closely related to market measures of bank health (the price-to-book ratio, estimated default frequency, credit default swap spreads, and the market value of equity) than is the ratio of T1 capital to risk-weighted assets.
- The ratio of risk-weighted assets to total assets for 17 major international banks fell from over 70 percent in 1993 to below 40 percent at the end of 2011. Yet neither the record of bank fragility before and during the recent crisis nor the behavior of market-based measures of bank riskiness suggest that bank safety has been on a steadily declining trend (Haldane 2013). By contrast, bank leverage (the inverse of the leverage ratio) has risen over this period and is negatively correlated with bank risk weights.⁵⁷
- Risk weights have produced an uneven playing field. Banks with the same hypothetical portfolios derive quite different risk weights from their internal models, particularly for trading book assets (Haldane 2013). Modeling choices seem to be the main drivers of the variation in risk weights (Chouinard and Paulin 2014). Banks using internal models for calculating risk weights (usually larger banks) typically exhibit much lower ratios of RWA to total assets than banks that use standardized risk weights (usually small banks) (Hoenig 2013). In some of the largest international banks, risk weight management has made it possible to drive the ratio of RWA to total assets (TA) to less than 20 percent. In the fourth quarter of 2012, Deutsche Bank reported a ratio of RWA/TA of just 17 percent.
- The superior diagnostic performance of leverage ratios suggests that “noise” is overwhelming “signal” in risk weight calculations (Haldane 2013). One reason is that risk weights are static and backward-looking, and banks may use misleading sample periods for estimating them. As Robert Engle (2009) concludes, risk weights suffer from the risk that risk will change.⁵⁸
- For all of these reasons, at least one of the bank capital hurdle rates in stress tests should be an unweighted leverage ratio (as the Federal Reserve has done, starting with the March 2012 CCAR stress test). Mark Carney, former governor of the Bank of Canada and the sitting governor of the Bank of England, has stated: “If I had to pick one reason why Canadian banks fared as well as they did [during the 2007–09 crisis], it was because

57. Haldane (2013) states that the downward trend in risk weights is consistent with the hypothesis that banks have had the incentives and the ability to “game” the system to artificially boost their capital ratios. Stanley Fischer (2014b, 2), vice chair of the Federal Reserve, observes, “Any set of risk weights involves judgments and human nature would rarely result in choices that made for higher risk weights.”

58. Some worry, of course, that if an unweighted leverage ratio replaced risk-weighted measures of bank capital, banks would shift unduly into high risk–high return assets. But Hoenig (2013) argues that with more capital at risk and without regulatory risk weights affecting choices, managers will allocate capital in accordance with market risk and returns.

we had a leverage ratio.”⁵⁹ Over time, we should be moving toward making the leverage ratio the primary indicator of bank solvency.

Asian economies would be wise to take note of the evidence on risk-weighted assets. As Andrew Sheng (2013) indicates, banks in emerging Asia have made relatively little use of the internal ratings approach to estimating risk weights, instead favoring the more conservative standardized approach. Asian banks therefore tend to have relatively high ratios of RWA/total assets, particularly in comparison with European banks. Vanessa Le Leslé and Sofiya Avramova (2012) report that the average RWA/total assets for banks in the Asia-Pacific was a little over one-half (0.55) in 2011, considerably higher than the 0.35 ratio recorded by European banks.

More fundamentally, Asian emerging economies should lean on measures of bank capital that provide an accurate picture of bank solvency. There is small comfort in double-digit risk-weighted capital ratios if, when faced with an extremely adverse scenario, the banks can remain solvent only with massive public support.

Asian authorities appear to be committed to meeting the 3 percent target by the BCBS deadline at the end of 2018. Table 8.3, drawing on a recent Moody’s (2014) study, shows what is announced and expected about leverage ratio implementation in the United States, Europe, the Asia-Pacific, and the Middle East and Africa. All the Asian economies listed plan to meet the BCBS deadline. The PRC opted both for early implementation (2013) and for a more ambitious level of 4 percent. India too plans to exceed the minimum by adopting a 4.5 percent standard (Moody’s 2014).⁶⁰

Figure 8.1 shows regional averages for actual T1 leverage ratios.⁶¹ For year-end 2013, the average for the Asia-Pacific is slightly above 6 percent, which is below the averages for North America, Latin America, and the Middle East, but above that for Europe.⁶²

59. “Mark Carney Sees Logic in Tougher Cap on Banks’ Leverage,” *Independent*, September 29, 2014.

60. In other regions, the economies that already have or plan to exceed the BCBS minimum include the United States, Bermuda, the United Kingdom, Switzerland, and South Africa. In 2014, the US authorities issued a leverage rule for the eight firms that are classified as global systemically important banks (G-SIBs). They face a minimum (T1) leverage ratio of 5 percent for the holding company and 6 percent for the lead bank subsidiary.

61. While the leverage ratio embodied in Basel III is defined as T1 capital relative to total exposure, many analysts (including me) would prefer a definition of the leverage ratio that would have the highest quality of capital in the numerator, so as to benefit from its superior loss absorbency both in good times and in crisis.

62. Asian economies rank higher in cross-regional comparisons of leverage ratios when “tangible” leverage ratios are the metric; see the discussion in the section on “Lessons for Emerging Asia.” Comparing bank leverage ratios between US and European banks has long been complicated by the different accounting treatment accorded to derivatives in the two locations. US banks use US Generally Accepted Accounting Principles (GAAP), whereas European banks use the International Financial Reporting Standards (IFRS). The GAAP provide a more lenient treatment of “netting”

Table 8.3 Leverage ratio implementation

Americas														
	BCBS	✓ US (advanced)	US (nonadvanced)	✓ Bermuda	Canada	Mexico	Brazil							
Pillar 1 requirement	2018	2018	2015	2018	2018	2018	2018							
Minimum ratio	3%	3% (5% G-SIB)	4% (GAAP ratio)	7%	3%	3%	TBD							
Europe														
	BCBS	✓ UK ^a	France	Germany	Austria	Spain	Portugal	Netherlands	✓ Swiss Institute of Bioinformatics	Russian Federation	Denmark	Norway	Sweden	
Pillar 1 requirement	2018	2014	2018	2018	2018	2018	2018	2018	2013	2018	2018	2018	2018	
Minimum ratio	3%	3%	3%	3%	3%	3%	3%	3%	>4% ^b	TBD	3%	3%	3%	
Asia Pacific														
	BCBS	✓ People's Republic of China	Hong Kong, China	Taipei, China	✓ Australia	Singapore	Indonesia	Malaysia	Thailand	Philippines	✓ India	Republic of Korea	Japan	New Zealand
Pillar 1 requirement	2018	2013	TBD	2018	2018	TBD	2018	TBD	2018	TBD	2018	2018	TBD	n.a.
Minimum ratio	3%	4%	3%	3%	3% ^c	TBD	3%	TBD	3%	TBD	5%	3%	TBD	n.a.
Middle East and Africa														
	BCBS	✓ South Africa	Israel	Pakistan	Saudi Arabia	Kuwait	Oman	Morocco	Qatar					
Pillar 1 requirement	2018	2018	TBD	TBD	2018	TBD	TBD	TBD	TBD					
Minimum ratio	3%	4%	TBD	3%	3%	TBD	TBD	TBD	TBD					

BCBS = Basel Committee on Banking Supervision; n.a. = not available; GAAP = Generally Accepted Accounting Principles; G-SIB = global systemically important banks; TBD = to be determined

✓ = More strict than BCBS

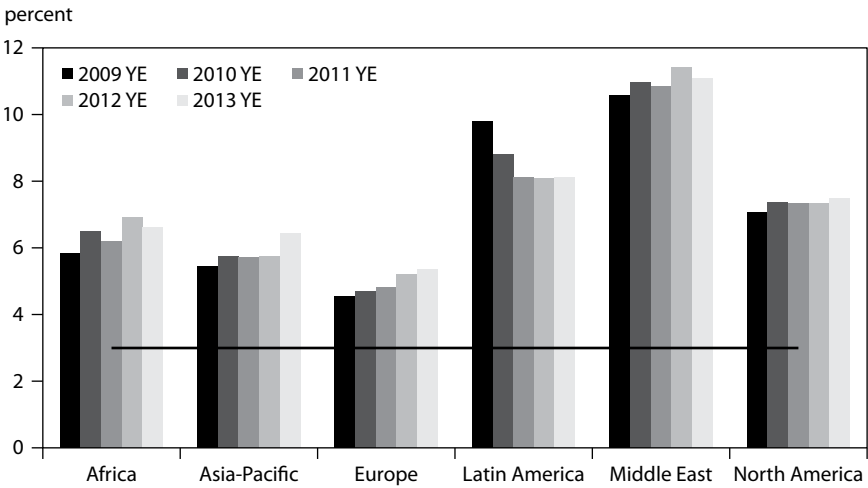
a. Capital numerator is fully loaded common equity tier 1 (CET1) and transitional tier 1.

b. Uses total capital in the numerator, including contingent capital instruments.

c. Fully loaded tier 1; no transitional measures.

Source: Moody's Investors Service (2014).

Figure 8.1 Leverage ratio (Tier 1/average assets): Asia-Pacific versus other regions



YE = year end

Note: Black line indicates 3 percent Basel Committee on Banking Supervision Tier 1 leverage.

Source: Moody's Investors Service, Banking Financial Metrics, 2014.

A fourth criticism addresses the *level* of the capital hurdle rate. Even after Basel III is fully implemented in 2019, the concern is that minimum bank capital requirements will still be far too low and that bank stress tests ought to assist the path toward a more appropriate level of bank capital by using higher hurdle rates.

Table 8.4 shows the minimum capital ratios agreed under Basel III and the transition path to full implementation. Consider the minimums for risk-weighted capital. If one takes the minimum 4.5 percent ratio for CET1 and adds to it 2.5 percent for the capital conservation buffer and, say, another 2.5 percent for the surcharge applicable to a G-SIB, the minimum CET1 ratio rises to 9.5 percent.⁶³ This is clearly better than the 2 percent minimum for CET1 applied under Basel II. But critics (including me) say that Basel III capital minimums are still too low, citing bank losses during a country's most serious crisis, the implications of a macroprudential approach for capital holdings, and the benefit-cost calculus for higher capital levels.

for derivative positions than does IFRS, with the result that total assets of US banks with large derivative positions are much smaller under the GAAP than under the IFRS. See Hoenig (2013) for the effect of these accounting differences on leverage ratios. Chouinard and Paulin (2014) indicate that for a sample of 100 large, internationally active banks, the average leverage ratio, defined as T1 capital divided by total exposure (using Basel III definitions) was 4.3 percent.

63. At the discretion of national authorities, a "countercyclical" capital buffer of another 1 to 2.5 percent could be added on during credit-boom periods to bring the total to 10.5 to 12 percent.

Table 8.4 Basel III phase-in arrangements, 2013–19 (percent)

	Basel II	2013	2014	2015	2016	2017	2018	2019
Capital								
Leverage ratio	None	Parallel run (2013–17), disclosures start January 1, 2015					Pillar 1 (3.0)	
Minimum common equity tier 1 (CET1) ratio	2.0	3.5	4.0	4.5	4.5	4.5	4.5	4.5
Capital conservation buffer (CCB)	None	0	0	0	0.625	1.250	1.875	2.5
Min CET1 plus CCB	2.0	3.0	4.0	4.5	5.125	5.75	6.375	7.0
Phase-in of deductions from CET1	None	0	20	40	60	80	100	100
Minimum tier 1 ratio	4.0	4.5	5.5	6.0	6.0	6.0	6.0	6.0
Minimum capital adequacy ratio	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Capital instruments that no longer qualify as noncore tier 1 or tier 2 capital	n.a.	Phased out over 10-year horizon, starting 2013						
Countercyclical capital buffer (voluntary)	None	0	0	0	0.625	1.250	1.875	2.5
Liquidity								
Liquidity coverage ratio	None			60	70	80	90	100
Net stable funding ratio	None						Introduce minimum standards	

n.a. = not applicable

Source: Moody's Investors Service (2014).

In assessing bank capital levels, one can ask what capital ratio would be sufficient for banks to meet the market pressures that induce them to hold more capital than the regulatory minimums, while also keeping them solvent and able to lend after a systemic banking crisis. Samuel Hanson, Anil Kashyap, and Jeremy Stein (2010) employed just such an approach to US banking losses during the 2007–09 crisis. They observed that the four largest banks were holding a T1C capital ratio of roughly 8 percent of risk-weighted assets in the first quarter of 2010, near the lower end of the economic cycle. This was four times the regulatory minimum. The authors argued that banks were holding that excess because markets (mindful of losses in the crisis) were pressuring them to do so. Hence, they regard 8 percent as the market-induced minimum at the lower end of the cycle. They also note from IMF (2010) figures that US banks lost about 7 percent of assets during the 2007–09 crisis. They then ask the following question: If banks want to meet the market-induced minimum capital ratio at the bottom of the cycle after suffering a loss equal to 7 percent of total assets, what should the minimum capital ratio be at the top of the cycle? Their answer is 15 percent (since 15 percent minus an asset loss of 7 percent equals a market-induced minimum of 8 percent).

The T1C capital ratio of the 30 banks participating in the 2014 CCAR stress test in the fourth quarter of 2013 was 11.6 percent.⁶⁴ Applying the same methodology, again using the 7 percent asset loss from the 2007–09 crisis, yields a minimum (for the top of the cycle) of around 19 percent, and this without even accounting for the difference between total assets and risk-weighted assets (RWAs are approximately 50 percent of TAs in the United States for the largest banks under the US GAAP). Redoing the calculation using RWAs produces an answer closer to a risk-weighted capital minimum of roughly 25 percent.

Asian economies remained relatively unscathed in terms of incurred bank losses during the 2007–09 crisis.⁶⁵ But the Asian financial crisis of 1997–98 was marked by massive bank losses in Indonesia, Thailand, and the Republic of Korea. Hence, for the emerging Asian economies (and starting with a T1C capital ratio of roughly 10 percent), that same methodology would likewise yield estimates for the minimum risk-weighted capital ratio that are far above both current levels and the Basel III minimums.

If we moved from risk-based measures of bank capital to leverage ratios, then the same methodology (for example, using a current level of the T1 leverage ratio for large US banks of 8 percent) would imply that the minimum ought to be in the neighborhood of 15 percent.⁶⁶ That is far above the Basel III minimum T1 leverage ratio of 3 percent.

64. Using a broad sample of 100 internationally active banks, Chouinard and Paulin (2014) find that the average fully-phased-in CET1 common capital ratio in mid-2013 was 9.5 percent.

65. The IMF (2010) estimates that emerging Asian banks incurred losses equal to about 1.5 percent of total assets during the 2007–09 global crisis.

66. As noted earlier, the denominator in the Basel III leverage ratio is total exposure—a measure that is broader and larger than total assets; there are also some strong hints that the excess of total

A second route to the higher minimum capital conclusion is through the implications of the macroprudential approach to supervision. As outlined by Greenlaw et al. (2012), the macro approach focuses on (1) the balance sheet capacity of the banking system to support the economy, (2) averting runs by wholesale creditors on systemic banks, (3) avoiding fire sales and bank deleveraging during periods of stress, and (4) the links between banks and nonbanks. They argue that with substantial reliance on uninsured wholesale financing, the “run point” for a systemic bank happens at a higher capital ratio than the solvency point, so such banks need more capital to avoid runs. To support the weaker parts of the financial system during periods of stress, even solvent banks may be required to resist drawing down their capital. The bottom line of Greenlaw et al. (2012) is that if one wants to discourage runs that have costly macroeconomic effects, the banking system needs higher capital.

Two recent examples help to illustrate this macroprudential perspective. Boston Federal Reserve President Eric Rosengren (2014) lamented that US broker-dealers still obtain over half their funding from the short-term repo market. US money market mutual funds are the largest net suppliers of repurchase agreement financing. Despite some postcrisis reforms to the money market funds industry, Rosengren (2014) argues that there could again be serious interruptions in repo financing from money market funds, with cascading effects on broker-dealer liquidity. Rosengren (2014, 11) recommends that since “highly capitalized institutions are much less subject to runs,” there should be an increase in capital for any (bank) holding company with significant broker-dealer operations.⁶⁷

A second example recently highlighted by Philip Turner (2014) and summarized by the BIS (2014) concerns the shift from bank lending to market-based debt financing by nonfinancial corporations in emerging-market economies. Turner (2014) shows that financing of emerging-market nonbanks by international bonds is about twice as large as cross-border lending by international banks (to these borrowers). The availability of market funding is very procyclical and funding strains could develop when interest rates eventually go up significantly in the advanced economies. Turner (2014) also draws attention to the fact that nonfinancial corporate deposits in some emerging economies stand at more than 20 percent of the banking system’s total assets.

exposure over total assets is biggest for G-SIBs. This means that bank losses will be smaller relative to total exposure than to total assets, thereby reducing the optimal leverage rate. The problem is that since the Basel III leverage ratio was introduced only in 2010, the time-series is very short and there is no reliable way of knowing whether the ratio of total exposure to total assets is different in crises than during normal periods. My best guess is that for large US banks, substituting total exposure for total assets would use reduce estimates of the optimal Basel III leverage rate from 15 percent to perhaps 12 to 13 percent.

67. Lest one think that Rosengren’s (2014) concern about potential runs from wholesale creditors is a narrow, special case confined to the United States, Greenlaw et al. (2012), drawing on IMF (2010) research, point out that among 14 advanced economies examined, the United States had one of the lowest ratios of dependence on wholesale funding relative to bank capital.

If these firms lose access to nonbank financing, they may have to run down their bank deposits—causing, in turn, funding problems for banks.

The importance of nonbank funding looms large in emerging Asia, where the financial system exhibits considerable diversity and is not dominated by banks. In chapter 3 of this volume, William Cline examines four channels of financial intermediation: bank loans, loans by nonbanks, bonds and debt securities, and stock market capitalization. If bank loans make up 50 percent or more of the total, Cline labels the system bank dominated; if bonds plus equity market capitalization account for 60 percent or more of the total, the system is portfolio dominant; and if neither of those two thresholds are reached, the system is called diversified.

Of the nine emerging Asian economies examined, only two, the PRC and Viet Nam, are bank dominated. Malaysia, the Philippines, and Sri Lanka are portfolio-dominated; and India, Indonesia, the Republic of Korea, and Thailand are diversified. As another indicator of diversity, a recent McKinsey report (Alvarez et al. 2013) sees India, Indonesia, Malaysia, Thailand, and Viet Nam as characterized by relatively heavy reliance on retail deposits, lack of wholesale funding opportunities, relatively low banking penetration, relatively high asset growth, and relatively high interest rate volatility. In contrast, Hong Kong, China and Singapore are characterized as having higher reliance on international wholesale funding, moderate asset growth, and relatively high banking penetration. Cross-country comparisons by the BIS (2014) show Malaysia and Indonesia as having relatively high shares (20 percent or more) of banking deposits accounted for by nonfinancial corporations.

The third road to higher bank capital requirements is through benefit-cost evaluations of alternative capital levels. The benefits are taken to be a lower incidence of systemic banking crises, with attendant lower output, employment, and fiscal losses. The costs are assumed to be higher spreads or reduced availability of bank loans, with negative effects on economic growth. Not surprisingly, the banking industry's evaluation of this benefit-cost calculus is much less favorable than that of both the official sector and, by now, most finance academics.⁶⁸

In making the case that the social costs of higher bank capital are low, Anat Admati and Martin Hellwig (2013) and other proponents stress the following arguments: Bank capital, unlike reserve requirements, is not something that banks must hold in a strongbox at the expense of higher lending; instead, capital requirements are about how banks are permitted to fund themselves. True, the Modigliani-Miller theorem about the total cost of financing being

68. The gulf is wide. For example, the IIF (2010) estimated that full implementation of banking reform (of which higher capital standards in Basel III was the most important element) would drive down annual G-3 (United States, European Union, and Japan) real GDP growth by 0.6 percentage points. In contrast the Macroeconomic Assessment Group put together by the BCBS and FSB (2010) concluded that the negative growth effect would be only 0.5 percentage points per year for five years—one-twelfth the IIF's estimate. In 2010, the FSB and the BCBS reviewed the studies on the benefits and costs of Basel III and came to the conclusion that the *net* benefits would be on the order of 30 percent of GDP for G-20 economies (BCBS and FSB 2010).

invariant to the mix of debt and equity 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 sizeable increase in overall financing costs—is a much better approximation than the doomsday claims of the banking industry.

There is no reason why higher capital requirements must reduce bank lending. If higher capital requirements are expressed in terms of absolute amounts of capital and if higher capital is obtained by a combination of new equity issuance, retained earnings, and a temporary suspension of dividend payments, the effects on the economy are likely to be benign. Any adverse selection and signaling effects of new equity issuance can be minimized by increasing capital requirements across the board.

Time-series evidence for more than 100 years of US and UK data yields no statistically significant link between higher bank equity on the one hand, and interest rate spread on bank loans, loan growth, and economic growth on the other (Hoenig 2012; Miles, Yang, and Marcheggiano 2011). The world's ten largest nonfinancial corporations finance themselves with an equity share of about 50 percent (Ingves 2014a), yet these companies have no problem in expanding their investments. Bank credit crunches typically happen when banks have very low levels of equity, not high ones. Yes, there are a handful of studies that find that higher capital requirements reduce lending. Their conclusions, however, hold only under quite restrictive conditions, unlike those prevailing under, say, a Basel III-type increase in minimum capital standards (e.g., Bridges et al. 2014 and references therein).

The existence of a sizable shadow banking system is not a good reason to avoid raising significantly bank equity standards. Rather, all financial institutions whose failure would have systemic consequences should be required to have enough equity.

Using a sample of 94 large banks from advanced and emerging economies, Benjamin Cohen and Michela Scatigna (2014) study the increase in capital ratios between end-2009 and end-2012. One of their main conclusions is worth repeating: “Bank capital ratios have increased steadily since the financial crisis. . . . On average, banks continued to expand their lending, though lending growth was relatively slower among European banks. . . . Banks that came out of the financial crisis with higher capital ratios and stronger profitability were able to expand lending more” (Cohen and Scatigna 2014, 2).

Of particular interest for emerging Asian economies, Robert McCauley (2014) has examined the results for emerging-market banks from the Cohen and Scatigna (2014) study and reports that emerging-market banks raised their capital ratios over the 2009–12 period by 1.1 percentage points. Their return on assets widened, but not from a raising of the net interest margin (it came instead from lower operating costs and other factors). Emerging-market banks did *not* shrink their loan books⁶⁹; indeed, loan growth was boosted

69. Chouinard and Paulin (2014) likewise report that in Canada total credit continued to expand in the postcrisis period, even as banks built up their capital levels.

almost by half over this period. McCauley's (2014, 3) conclusion is worth highlighting: "To sum up, the evidence to date from Asia and the Pacific is that banks have managed to raise their capital ratios without raising the cost of credit in aggregate or by seriously restricting its availability."

While these arguments don't lead to a specific figure for minimum capital requirements, some analysts have interpreted them as pointing to minimum leverage requirements in the neighborhood of 15 to 20 percent. In a November 2010 letter to the *Financial Times*, 20 distinguished professors of finance (including two Nobel laureates) reached the following conclusion: "Basel III is far from sufficient to protect the system from recurring crises. If a much larger fraction, at least 15 percent of banks' total, non-risk-weighted assets, were funded by equity, the social benefits would be substantial. And the social cost would be minimal, if any."⁷⁰

This does not mean that bank stress tests should immediately set hurdle rates at 15 or 20 percent, but it does suggest that over time supervisory authorities should progressively raise the bar to get closer to the optimum.⁷¹ After all, Basel III will be fully phased in by 2019. As Yogi Berra, the NY Yankees Hall of Fame catcher, put it succinctly, "If you don't know where you're going, you may not get there."

Moody's Investors Service (2014) has been tracking the implementation of the Basel III risk-weighted capital standards. Table 8.5 shows its tally for Asia-Pacific and for other regions. With the exception of the Middle East and Africa, no region has exceeded the timetable or minimum CET1 ratio more consistently than Asian emerging economies, with Taipei, China (7 percent), Singapore (6.5 percent), the Philippines (6.0 percent), India (5.5 percent), and the PRC (5.0 percent) opting to go for more than the BCBS 4.5 percent minimum. In addition, the PRC, Indonesia, Thailand, and the Philippines chose to implement ahead of the January 2015 BCBS deadline; only the Republic of Korea and Taipei, China are planning a delayed implementation.⁷²

As for the existing level of common equity relative to risk-weighted assets for the region, Moody's (2014) shows the ratio of tangible equity to risk-weighted assets, as of year-end 2013, to be slightly above 10 percent for the Asia-Pacific—clearly above the 7 percent Basel III minimum. The IMF (2014b), in its latest *Regional Economic Outlook*, provides a country-by-country breakdown, but only for the ratio of T1 capital to RWA. In its tabulation, Singapore, Indonesia, Philippines, and Hong Kong, China have the highest T1 ratios (13

70. "Healthy Banking System Is the Goal, not Profitable Banks," *Financial Times*, November 9, 2010. Sitting FDIC Vice Chairman Hoenig (2013) has supported a 10 percent minimum for the tangible leverage ratio.

71. In Goldstein (2015), I offer a proposal for how to use the flexibility inherent in stress tests to raise gradually the tangible leverage ratio to roughly 15 percent over a 10-year period.

72. Peter Morgan and Victor Pontines (2013) argue that the more restrictive definition of capital in Basel III (that is, emphasizing T1C) should not be a problem for Asian emerging economies because it will not represent much of a change. They maintain that in these economies there are few alternatives to equity and that the major component of capital has always been common equity.

Table 8.5 Basel III minimum risk-weighted capital requirements by region, CET1, Tier 1, and total capital adequacy ratio

Americas														
	BCBS	US (advanced)	US (non-advanced)	Bermuda	✓ Canada ^a	✓ Mexico	✓ Brazil							
Minimum CET1	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%							
Minimum T1	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%							
Minimum CAR	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%							
Compliant by	January 2015	January 2015	January 2015	January 2015	January 2015	January 2013	October 2013							
Asia Pacific														
	BCBS	✓ People's Republic of China	Hong Kong, China	✓ Taipei, China	✓ Australia	✓ Singapore	✓ Indonesia	Malaysia	✓ Thailand	✓ Philippines	✓ India	Republic of Korea	Japan	✓ New Zealand
Minimum CET1	4.5%	5.0%	4.5%	7.0%	4.5%	6.5%	4.5%	4.5%	4.5%	6.0%	5.5%	4.5%	4.5%	4.5%
Minimum T1	6.0%	6.0%	6.0%	8.5%	6.0%	8.0%	6.0%	6.0%	6.0%	7.5%	7.0%	6.0%	6.0%	6.0%
Minimum CAR	8.0%	8.0%	8.0%	10.5%	8.0%	10.0%	8.0%	8.0%	8.5%	10.0%	9.0%	10.5%	8.0%	8.0%
Compliant by	January 2015	January 2013	January 2015	January 2019 X	January 2013	January 2015	January 2014	January 2015	January 2014	January 2014	March 2015	January 2019 X	January 2015	January 2013
Europe														
	BCBS	UK ^c	France	Germany	Austria	✓ Spain	✓ Portugal	✓ Netherlands	✓ Swiss Institute of Bioinformatics	Swiss category 2	✓ Russian Federation	Denmark	✓ Norway	✓ Sweden
Minimum CET1	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	10.0% ^d	9.2%	5.0%	4.5%	4.5%	4.5%
Minimum T1	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	7.0%	6.0%	13.0% ^d	11.4%	6.0%	6.0%	6.0%	6.0%
Minimum CAR	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	19.0% ^d	14.4%	10.0%	8.0%	8.0%	8.0%
Compliant by	January 2015	January 2015	January 2015	January 2015	January 2015	January 2014	January 2014	January 2014	January 2019 X	January 2017 X	January 2015	January 2015	January 2013	January 2014

(continued on next page)

Table 8.5 Basel III minimum risk-weighted capital requirements by region, CET1, Tier 1, and total capital adequacy ratio
(continued)

Middle East and Africa	✓	✓	✓	✓	✓	✓	✓	✓	
	BCBS	South Africa	Israel	Pakistan	Saudi Arabia	Kuwait	Morocco	Oman	Qatar
Minimum CET1	4.5%	5.0%	9.0%	6.0%	4.5%	7.0%	5.5%	7.0%	6.0%
Minimum T1	6.0%	8.25%	9.0%	7.5%	6.0%	8.5%	6.5%	9.0%	8.0%
Minimum CAR	8.0%	9.0%	12.5% ^a	10.0%	12.0%	10.5%	9.5%	12.0%	10.0%
Compliant by	January 2015	January 2019 x	January 2015	January 2015	January 2015	January 2016 x	January 2014	January 2014	January 2014

BCBS = Basel Committee on Banking Supervision; CET1 = common equity tier 1; T1 = tier 1; CAR = capital adequacy ratio; CCB = capital conservation buffer; D-SIBs = domestically important banks

x = compliant date is less strict than BCBS; ✓ = more strict than BCBS

a. Canadian financial system is dominated by six banks classified as D-SIBs, which hold around 93% of Canada's total banking assets. The D-SIBs are required to meet "all-in" capital targets (including the 2.5% CCB) of 7% for the CET1 ratio by the first quarter of 2013, and 8.5% for the T1 ratio and 10.5% for the total CAR by the first quarter of 2014. Beginning on January 1, 2016, the "all-in" capital target for CET1 ratio for D-SIBs will be 8%, including a D-SIB buffer of 1%.

b. Brazil currently has an 11% total capital ratio requirement under local Banco Central do Brasil rules; the requirement will decrease from 11% in 2013 to 8% in 2019, at the same time as other Basel II rules (such as buffers and capital deductions) are phased in, thus overall capital levels (including buffers) and quality will remain strong.

c. A UK requirement of 7% CET1 by January 2014 (includes CCB) only applies to the largest 8 banks. Others are subject to the 4.5/6/8 phase-in arrangements.

d. For SIBs, minimum CET1 includes 4.5% minimum plus a 5% CET1 buffer component (part of an 8.5% permanent buffer requirement, of which 5.5% must be met through CET1 and up to 3% can be met through high-trigger contingent capital instruments or CoCos). Tier 1 minimum includes 4.5% CET1 plus the 8.5% buffer. The minimum total capital includes a progressive component of up to 6% composed of low-trigger CoCos. The progressive component is revised each year by Swiss regulator FINMA according to the size and resolvability of the institution.

e. CET1 and CAR will increase to 10% and 1.5% respectively for banks with more than 20% market share.

Source: Moody's Investors Service (2014).

to 15 percent), while Taipei, China; the PRC; and India have the lowest (8 to 10 percent); the Republic of Korea and Thailand are in the middle (with 11 to 12 percent).⁷³

Lessons for Emerging Asia⁷⁴

This chapter has reviewed the experience of US- and EU-wide supervisors with bank stress tests, with an eye toward identifying lessons for Asian emerging economies considering whether and how to alter their own stress tests. Six lessons stand out.

1. Bank stress tests are likely to become an increasingly important part of bank supervision because they respond to a demand that other parts of the supervisory toolkit cannot easily accommodate, and because they offer more flexibility than the Basel international regulatory regime. There is a strong case for having emerging Asian economies invest in upgrading their stress-testing systems to increase their credibility.⁷⁵ The global economic and financial crisis of 2007–09 demonstrated anew how costly systemic banking crises can be. During such crises, the opacity of bank financial statements, combined with elevated uncertainty about macroeconomic and market risks, make it difficult to get an accurate picture of the solvency of individual banks and the banking system as a whole. Bank capital ratios are static and backward-looking and don't address tail risk within a forward-looking set of severe but plausible scenarios. Similarly, analyses of one bank at a time

73. Other things equal, countries with TBTF banks need to ensure that these banks have enough self-insurance, that is, capital. One index of TBTF, suggested by William Cline in chapter 3, is the average assets of the country's five largest banks relative to GDP. On this measure some emerging Asian economies have a TBTF problem, but not one in the same league as some EU economies. The average size of the five largest banks in Malaysia is about 30 percent of its GDP; the corresponding figures for the PRC, the Republic of Korea, and Thailand are 25, 20, and 18 percent, respectively. This is considerably worse than in the United States (11 percent), but in the same ballpark as that of Japan and Germany (slightly above 25 percent). But even in Malaysia, the TBTF score is low relative to those of the United Kingdom and the Netherlands (both over 90 percent) and of France (nearly 70 percent).

74. Although this chapter has concentrated on the lessons that emerging Asia might take away from the bank stress testing experiences of the United States and the European Union, the lessons of international experience go in both directions. As but one salient example, macroprudential instruments have been used more extensively in Asia than in any other region (IMF 2014b and McCauley 2014). Fed Chair Janet Yellen (2014) has recently made the case that for the US economy the proper policy instrument assignment is to use macroprudential policies to deal with financial stability risks, thereby leaving monetary policy to concentrate on price stability and full employment. In implementing such a policy assignment, one would think that there would be a lot to learn from emerging Asia's experience with macroprudential policies, especially those related to cooling down overheated property markets.

75. Fischer (2014a, 4) has argued that bank stress tests are likely to add significantly to the quality and effectiveness of financial sector supervision and are an innovation that should "spread internationally as best practice."

fail to provide the horizontal comparison of banks available in a stress test. Stress tests also provide a simple and understandable metric with which to evaluate the capital adequacy of banks, namely, a comparison of the capital ratio under adverse conditions with the capital hurdle rate. And where stress tests are paired with remedial actions to eliminate undercapitalization, they provide an integrated solution to the banking problem at hand.

Forging agreement on an international bank regulatory regime requires painstaking negotiation with a large group of countries. Moving from Basel I (1988) to Basel II (2004) took over a decade, and securing agreement on Basel III took an additional six years. But countries are able to set the design of their own stress tests unilaterally and, where they feel it is necessary, to adopt metrics for bank capital that go beyond the Basel regulatory minimums. They can also customize the scenarios in stress tests to reflect their own structural characteristics and vulnerabilities. Thus, emerging Asian economies may be interested in stress scenarios different from those in US and EU-wide stress tests, including credit and housing booms, a further simultaneous growth slowdown in the PRC and the euro area, the capital flow implications of US monetary policy tightening, and the possibility of reserve-currency liquidity shortages (for the dollar and the euro), like those that occurred in 2007–08. Similarly, if they wish to run a liquidity stress test assuming a more rapid phase-in of liquidity coverage ratio than is envisaged under Basel III, they are free to do so. That flexibility is attractive.

2. Despite the potential of stress tests to contribute to financial stability, their effectiveness in practice depends on the institutional framework and the design. Asian emerging economies should accordingly evaluate their stress test design and framework in light of best practice.⁷⁶

In terms of coverage, the participating financial institutions should account for a substantial part of the system's assets. If the country has a financial system not dominated by banks, it should assess how fragilities in the nonbank sector and in systemically important nonbanks could affect the banking system. The supervisor coordinating the tests should have the authority to obtain the necessary private data inputs from the banks and the capacity to evaluate independently the quality of those inputs and the impact of the shocks assumed in the scenarios on bank capital. Over time, supervisors should develop their own suite of models to guard

76. A worthwhile project for the future would be to create a regional stress test "scorecard" for emerging Asian economies, where each economy's stress testing framework could be evaluated against the best practice guidelines outlined in this chapter. After looking through the latest financial stability reports published by emerging Asian central banks and the IMF FSAPs published for these economies over the 2011–14 period, I do not believe that such a scorecard could be constructed from the published materials currently available. However, the IMF, perhaps working in collaboration with the ADB, the Chiang Mai Initiative Multilateralization (CMIM) secretariat, the BIS's Hong Kong, China office, and national authorities, could obtain the necessary inputs and publish the results.

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. The test coordinators must also have the political independence to call the results of the tests as they see them. If markets perceive that the tests are “rigged” to produce overly optimistic or politically convenient outcomes, publication is not likely to bolster confidence. The scenarios should address the major risks facing the economy and the banking system. It is not helpful to rule out certain scenarios just because they are counter to current policy objectives. Likewise, scenarios that cover only a minor part of the relevant risk exposures will lack credibility. In short, stress tests are not likely to be reassuring if they don’t contain much stress. 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 within the wider capital planning process of banks—is a good one that merits serious consideration in other jurisdictions.

There is considerable diversity across emerging and developing Asia in the quality of banking supervision. A major challenge for the region will be to ensure that stress tests run by national bank supervisors are independent and transparent. The challenge is reflected in a 2011 FSB/IMF/World Bank study (FSB et al. 2011)—prepared for G-20 ministers and governors—that reported that emerging and developing Asia ranked lowest among all developing-country regions in compliance with the independence, accountability, and transparency provisions of the Basel Core Principles for Banking Supervision.⁷⁷

3. Bank stress tests are important for crisis prevention. Much of the 2009–14 stress test experience in the United States and the European Union has, in contrast, been for crisis management. Stress tests performed 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 practically all the economies that subsequently underwent systemic banking crises in 2007–09. Two corrective measures are called for:

First, supervisors should draw more heavily on the empirical literature on early warning models of banking crises and integrate that analysis into the stress testing exercise. These are top-down, dual-threshold models that find that banking system vulnerability is greatest when there is 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 recent decades, including the 2007–09 episodes. Fortunately, this is an easy fix. These are parsimonious models that can be estimated and evaluated in any

77. Another challenge for some countries in the region is to deal with the legal liability of bank supervisors, which can deter them from doing their job; see chapter 3 by William Cline in this volume.

economy with a decent time series on credit aggregates and on property prices. Given the BIS's (2014) recent warning that red lights are currently flashing a danger signal for the PRC plus a group of five Asian emerging economies, it would seem prudent to see that this issue is carefully evaluated in current and future stress tests.

The second fix is not so easy. It involves getting enough feedback, contagion, and amplification effects into the modeling of the financial sector during a crisis so that a seemingly moderate shock to the banking system can produce the kind of real economy and bank capital effects that are observed in an actual severe crisis. Even though they are hard to model, runs by nonbank creditors, rapid changes in haircuts on collateral, marked shifts in expectations after credit events that are viewed either as changing the “rules of the game” (like the failure of Lehman Brothers) or as uncovering a heretofore unappreciated vulnerability among a wider set of financial institutions, surges in short selling, and watershed changes in government guarantees and interventions are part and parcel of the dynamics of severe crises. Note that (a) when Fed Chairman Bernanke (2007) testified to Congress in 2007 about the subprime crisis, he estimated that it would generate total losses in the neighborhood of \$50 to \$100 billion; but (b) when he recently gave testimony in an AIG court case,⁷⁸ his appraisal was different: “September and October of 2008 was the worst financial crisis in global history . . . of the 13 most important financial institutions in the United States, 12 were at risk of failure within a period of a week or two.” The question for stress test architects and model makers is how to make their models generate a transition from (a) to (b) in the course of, say, a year or two. This is not a technical sideshow. In stress modeling, it is the main event.

4. When banking supervisors make the determination that banks need to reach a higher capital ratio, it is important for economic growth that they translate that higher capital target into an absolute amount of capital. Put simply, the target must be expressed in terms of the numerator of the capital ratio. If, instead, the supervisors allow banks to choose how they will achieve the higher capital ratio, there is a good chance that they will opt to make much of the adjustment by cutting back on loans, by engaging in fire sales of assets, and by manipulating risk weights. These methods of lowering the denominator of the capital ratio—even if they seem to be the lowest-cost option to banks themselves—will not be the lowest-cost option for the macroeconomy. They will be contractionary.
5. Regarding the bank capital metric that would convey the most useful diagnostic information in stress tests, Basel III rightfully put a lot of focus

78. Pedro Nicolaci da Costa, “Bernanke: 2008 Meltdown Was Worse than the Great Depression,” *Wall Street Journal, Real Time Economics*, August 26, 2014, <http://blogs.wsj.com/economics/2014/08/26/2008-meltdown-was-worse-than-great-depression-bernanke-says/> (accessed on January 26, 2015).

on the numerator in bank capital ratios and helped to move the system in the direction of higher-quality capital. Unfortunately, Basel III did not do enough for the denominator.

The evidence is by now strong that leverage ratios are a better indicator of bank solvency and of bank fragility among large banks than the risk-weighted measures. With hindsight, it should have been obvious early in the global economic and financial crisis that measures of bank capital based on risk-weighted assets just did not smell right. Practically all the largest US financial institutions that ran into trouble during the crisis had risk-weighted capital measures that allowed them to be classified as “well capitalized” on their last reports, whereas low leverage ratios were simultaneously pointing to very thin capital cushions (Hoenig 2012). In Europe, the story was similar. The bank with the highest CT1 capital ratio (over 20 percent) in the 2011 EU-wide stress test, Irish Life and Permanent, had to be placed in a government restructuring plan in 2012 (Verstergaard and Retana 2013). Dexia likewise passed the 2011 test with flying colors, only to fail several months later. Moreover, subsequent analysis by Verstergaard and Retana (2013) demonstrated that the early warning properties of CT1 capital in identifying subsequent bank failures (after the 2011 EU-wide stress test) were inferior to a leverage ratio. Econometric analysis on a wider sample of large international banks has reached the same qualitative conclusion (Blundell-Wignall and Roulet 2012). Moreover, the risk-based measures of bank capital create an uneven playing field internationally and domestically (between large and small banks), and they correlate less well (than do leverage ratios) with market-based measures of bank health.

If Basel III were to be redesigned from scratch, it would make much more sense to make the leverage ratio the dominant bank capital metric. But it is not necessary to recall Basel III (before it is even phased in fully) or to seek to negotiate a Basel III.5 to do so. This is where the flexibility of national and regionwide stress tests comes in handy. Because bank stress tests are becoming the binding constraint on banks’ capital plans in many jurisdictions, the same result can be reached by making leverage ratio(s) the key metric in these tests. That flexibility in stress tests would also allow one to move away from sole reliance on a T1 measure of leverage toward two leverage metrics, where the second one would be a “tangible” leverage ratio (Hoenig 2012).

Asian emerging economies could be part of the leading edge of a reform to begin relying on more meaningful measures of bank capital adequacy. Asian emerging economies are either on track or even ahead of schedule in meeting Basel III leverage requirements. Greater reliance on a leverage requirement would also lessen the implicit penalty that the region faces because its ratio of RWA/TA is higher than that of European banks. Going farther, the Asian region is also well placed to lead the charge on downplaying T1 leverage in favor of a tangible leverage ratio. In this connection, a recent IMF *Global Financial Stability Report* (IMF 2014a) compares

tangible leverage ratios—corrected for international accounting differences (IFRS vs. US GAAP)—in large banks across regions. That comparison reveals that emerging Asia and advanced Asia had average tangible leverage ratios of 5.8 percent and 6.0 percent, respectively, which are higher than the averages for North America (4.5 percent) and the euro area (3.6 percent). Less ambitiously, emerging Asia could still contribute to reform bank capital metrics by agreeing to include at least one leverage ratio in all future supervisor-led stress tests conducted in the region.

6. Finally, when designing bank stress tests, considerable thought should be given not only to how to define the capital ratio but also to how high to set the capital hurdle rate and to how that hurdle rate should relate to longer-term plans to set appropriate capital standards. Three different approaches to answering the question of how high to set minimum regulatory requirements for bank capital have been reviewed in this chapter. The review demonstrated that the optimal level of the capital ratio is likely to be far above the minimum ratios set out under Basel III and the actual capital ratios currently prevailing around the world. Without pretending to much precision, the review of the available evidence suggests that bank regulators and supervisors ought to pursue a goal of increasing the minimum (tangible) leverage ratio to roughly 15 percent, or about five times higher than the Basel III standard and more than three times as high as the level currently prevailing in the United States and the European Union.

Although this chapter has argued against relying on risk-based measures of capital, the gap between optimal ratios and where we are today with risk-based capital would be almost as wide. That is, the optimal level for CET1 ratios is probably in the 20 to 25 percent plus ballpark, versus a Basel III minimum (inclusive of the capital conservation buffer and the surcharges for systemically important banks) of, say, 11 percent and actual ratios of roughly 12 percent or so as well.

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