

Global Financial Stability Report

Moving from Liquidity- to Growth-Driven Markets

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Chapter 3

HOW BIG IS THE IMPLICIT SUBSIDY FOR BANKS CONSIDERED TOO IMPORTANT TO FAIL?



International Monetary Fund

Summary

Government protection for too-important-to-fail (TITF) banks creates a variety of problems: an uneven playing field, excessive risk-taking, and large costs for the public sector. Because creditors of systemically important banks (SIBs) do not bear the full cost of failure, they are willing to provide funding without paying sufficient attention to the banks' risk profiles, thereby encouraging leverage and risk-taking. SIBs thus enjoy a competitive advantage over banks of lesser systemic importance and may engage in riskier activities, increasing systemic risk. Required fiscal outlays to bail out SIBs in the event of distress are often substantial.

The TITF problem has likely intensified in the wake of the financial crisis. When the crisis started in 2007, and especially in the wake of the financial turmoil that followed the collapse of Lehman Brothers in September 2008, governments intervened with large amounts of funds to support distressed banks and safeguard financial stability, leaving little uncertainty about their willingness to bail out failing SIBs. These developments reinforced incentives for banks to grow larger and, together with occasional government support for bank mergers, the banking sector in many countries has, indeed, become more concentrated.

In response, policymakers have launched ambitious financial reforms. They imposed higher capital buffers and strengthened the supervision of global systemically important banks (G-SIBs) to reduce the probability and cost of failure and contagion. They are working on improving domestic and cross-border resolution frameworks for large and complex financial institutions. In some countries, policymakers decided on structural measures to limit certain bank activities.

This chapter assesses how likely these policy efforts are to alleviate the TITF issue by investigating the evolution of funding cost advantages enjoyed by SIBs. The expectation of government support in case of distress represents an implicit public subsidy to those banks.

Subsidies rose across the board during the crisis but have since declined in most countries, as banks repair their balance sheets and financial reforms are put forward. Estimated subsidies remain more elevated in the euro area than in the United States, likely reflecting the different speed of balance sheet repair, as well as differences in the policy response to the problems in the banking sector. All in all, however, the expected probability that SIBs will be bailed out remains high in all regions.

Not all policy measures have been completed or implemented, and there is still scope for further strengthening of reforms. These reforms include enhancing capital requirements for SIBs or imposing a financial stability contribution based on the size of a bank's liabilities. Progress is also needed in facilitating the supervision and resolution of cross-border financial institutions. In these areas, international coordination is critical to avoid new distortions and negative cross-country spillovers, which may have increased due to country-specific policy reforms.

Introduction

[The too-big-to-fail issue] is not solved and gone; it's still here . . . it's a real problem and needs to be addressed if at all possible. . . . Too-big-to-fail was a major part of the source of the crisis. And we will not have successfully responded to the crisis if we don't address that problem successfully.

—Ben S. Bernanke, *Chairman, Federal Reserve Board, March 20, 2013*¹

The expectation that systemically important institutions can privatise gains and socialize losses encourages excessive private sector risk-taking and can be ruinous for public finances. . . . Firms and markets are beginning to adjust to authorities' determination to end too-big-to-fail. However, the problem is not yet solved.

—Mark Carney, *Chairman, Financial Stability Board, October 12, 2013*²

One of the most troubling legacies of the global financial crisis is the widely held notion that some banks are simply “too important to fail” (TITF). These banks are known as systemically important banks (SIBs) because of their size, complexity, and systemic interconnectedness.³ The TITF concept is based on the belief that the failure of SIBs would have such a negative impact on the financial system and the economy as a whole that the government would do whatever it takes to prevent such a failure. And given the often very large social costs of an SIB failure, in many cases such rescues are ex-post desirable, but they tend to entail large transfers from taxpayers (Laeven and Valencia, 2014).

The implicit government protection of these banks distorts prices and resource allocation. Because creditors of SIBs do not bear the full cost of failure, they

are willing to provide funding at a lower cost than warranted by the institutions' risk profiles. They also have little incentive to monitor and punish excessive risk-taking. SIBs then may take advantage of the lower funding costs to increase their leverage and engage in riskier activities. Banks may also seek to grow faster and larger than justified by economies of scale and scope to reap the benefits of the implicit funding subsidy granted to TITF institutions (Figure 3.1).

A SIB failure is likely to have large negative externalities, and the expectation of government protection exacerbates such externalities. Claimants to SIBs do not internalize the external effects of a failure on the financial system and the economy as a whole. This implies that risk-taking by SIBs, especially under government protection, can be socially excessive, thus creating a “risk externality” (Kocherlakota, 2010). The size of this externality depends on the size of the implicit funding subsidy given to SIBs, which this chapter quantifies.⁴

Policymakers have long recognized the dangers that SIBs pose to the financial system and to public sector balance sheets. Prior to the global financial crisis, however, policymakers sought to address this problem by relying on “constructive ambiguity” about the willingness of governments to intervene in a crisis. Still, by paying a premium for bonds issued by large banks, investors signaled their belief in some form of government protection in case of distress.

The crisis that erupted in the wake of the Lehman Brothers collapse in September 2008 compelled governments to intervene to maintain confidence in the banking sector and to prevent a collapse of the financial system. Governments provided support to distressed banks in various ways. For example, public transfers were used to recapitalize banks, while asset value guarantees protected balance sheets and supported mergers or takeovers. In some countries, system-wide programs were established for recapitalization, asset purchases, asset guarantees, and debt guarantees (Landier and Ueda, 2009; Stolz and Wedow, 2010).⁵ These actions left little uncertainty about the willingness of governments to support failing SIBs.

This chapter was written by Frederic Lambert and Kenichi Ueda (team leaders), Pragnan Deb, Dale Gray, and Pierpaolo Grippa. Research support was provided by Isabella Araujo Ribeiro, Sofiya Avramova, and Oksana Khadarina.

¹Transcript of press conference held after the March 20, 2013, meeting of the Federal Reserve's Open Market Committee, pp. 9–10, www.federalreserve.gov/monetarypolicy/fomcpresconf20130320.htm.

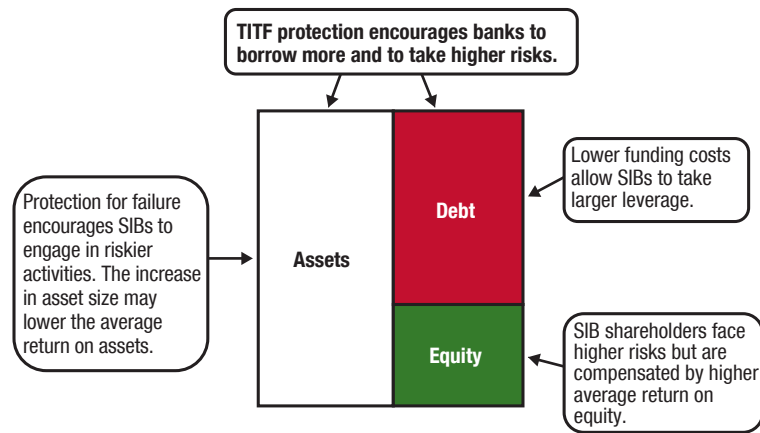
²Statement to the International Monetary and Financial Committee, p. 2, www.imf.org/External/AM/2013/imfc/statement/eng/FSB.pdf.

³See FSB (2010). This chapter uses the term “too important to fail” instead of “too big to fail” to emphasize that the size of a bank, typically measured by the value of its assets, does not capture other important reasons why its failure might create havoc. Those reasons include its connections with other financial institutions (“interconnectedness”), the difficulty of its resolution (“complexity”), and a lack of substitutes for the services it provides.

⁴The size, interconnectedness, complexity, and nonsubstitutability of SIBs are by themselves sources of externalities in the absence of any government protection, as the risks imposed by SIBs to the economy are not well reflected in the equity or bond prices of those institutions.

⁵In this chapter, central bank actions not targeted to specific banks are not considered to be bailouts.

Figure 3.1. Effects of Too-Important-to-Fail Protection on a Simplified Bank Balance Sheet



Source: IMF staff.

Note: SIB = systematically important bank; TITF = too important to fail.

Thus, countries emerged from the financial crisis with an even bigger problem: many banks were even larger than before and so were the implicit government guarantees. In addition, it became clear that these guarantees were not limited to large institutions. In some countries, smaller institutions with a high degree of interconnectedness, complexity, or political importance were also considered too important to fail, and sometimes they were “too many to fail.” In a few cases, including Ireland, governments provided near blanket guarantees to all banks’ liabilities, thereby indicating that no failure whatsoever was considered acceptable.

Some market participants dismiss the notion of a funding cost advantage as an exaggeration. It may exist in theory for banks deemed too important to fail, but is very small in practice, they contend, and the advantage has declined anyway as a result of recent regulatory reforms. Any existing differences in funding costs may reflect only genuine differences in risks and returns between large and small banks, this argument asserts.

Other studies that control for the characteristics and risks of banks have shown that funding subsidies have been sizable, especially during 2008–09.⁶ However,

most of these studies focused on the period up to 2009 or 2010, which preceded recent regulatory initiatives. Given the progress of financial reforms since 2010 (for example, Basel III reforms, the Dodd-Frank Act in the United States, and recent agreements on bank resolution in Europe), implicit TITF subsidies may have declined (Schäfer, Schnabel, and Weder di Mauro, 2013).

Identifying the evolution of TITF subsidies following recent policy reforms is the main objective of this chapter. The chapter focuses on the effects of government support measures and financial reforms to address the TITF issue, including higher capital requirements for SIBs, enhanced supervision, the development of recovery and resolution frameworks, and restrictions on bank size and activities. The chapter examines SIBs active at the global level (G-SIBs) as identified annually by the Financial Stability Board (FSB, 2013b), plus the three largest banks by asset size in each country studied (if these are not G-SIBs), subject to data availability. While the TITF problem is not limited to banks, this chapter does not examine systemically important nonbank financial firms, such as insurance corporations or central counterparty clearing houses (CCPs), because of limited data availability.

The results in this chapter show a divergence in the evolution of TITF subsidies across countries. In all

⁶See Ueda and Weder di Mauro (2013); Gray and Jobst (2013); Tsesmelidakis and Merton (2012); and Jacewitz and Pogach (2012).

advanced economies outside of Europe, subsidies have dropped from their crisis peaks but remain higher than before the crisis. According to one estimate, implicit subsidies rose again in 2012 in Europe, possibly reflecting the market turmoil around the sovereign debt crisis. The subsidies, however, had declined by late 2013. In the United States, subsidies fell much earlier, at the time of the discussion and passage of the Dodd-Frank Act, and have not increased substantially since then. Still, in the United States, the expected value of government guarantees for a distressed SIB appears higher than its precrisis level.

The estimated subsidies are large. In terms of the funding cost advantage in 2013, these subsidies are at least 15 or so basis points in the United States, 25–60 basis points in Japan, 20–60 basis points in the United Kingdom, and 60–90 basis points in the euro area. In dollar terms, if applied to banks' total liabilities (net of equity), the implicit subsidies given just to G-SIBs in 2011–12 represent around \$15–\$70 billion in the United States, \$25–\$110 billion in Japan, \$20–\$110 billion in the United Kingdom, and up to \$90–\$300 billion in the euro area.

Additional efforts are therefore necessary to deal with the TITF issue and move toward a situation in which the funding cost advantage associated with TITF no longer exists. Besides full implementation of Basel III, international coordination on both regulation and resolution regimes should be enhanced. Moreover, additional capital buffers, loss provisioning, or bank levies may be required to lower the probability that the TITF institutions become distressed and to reduce the burden on taxpayers.

Is the Too-Important-to-Fail Problem Growing?

In many countries, the value of assets in the banking sector relative to GDP has grown dramatically since 2000, while the number of banks has dropped (Figure 3.2). These trends are found in the euro area, Japan, the United Kingdom, and the United States as well as in several emerging market economies, including India and Russia. The growth in the value of assets has been particularly dramatic for the banks that are now at the top of the Financial Stability Board list of G-SIBs (Figure 3.3). As a consequence, concentration in the banking sector has increased in many countries, though less strikingly. The assets of the largest three banks represent at least 40 percent of total banking assets in the main advanced and

emerging market economies (Figure 3.4). In Canada, France, and Spain, the share exceeds 60 percent.

The high degree of concentration carries with it a high degree of potential systemic risk. The distress or failure of one of the top three banks in a country, for example, could destabilize that country's entire financial system, in part because its activities may not easily be replaced by other institutions, because it is likely to be highly interconnected with other banks, and because of the potential effect of the failure on confidence in the whole financial system.

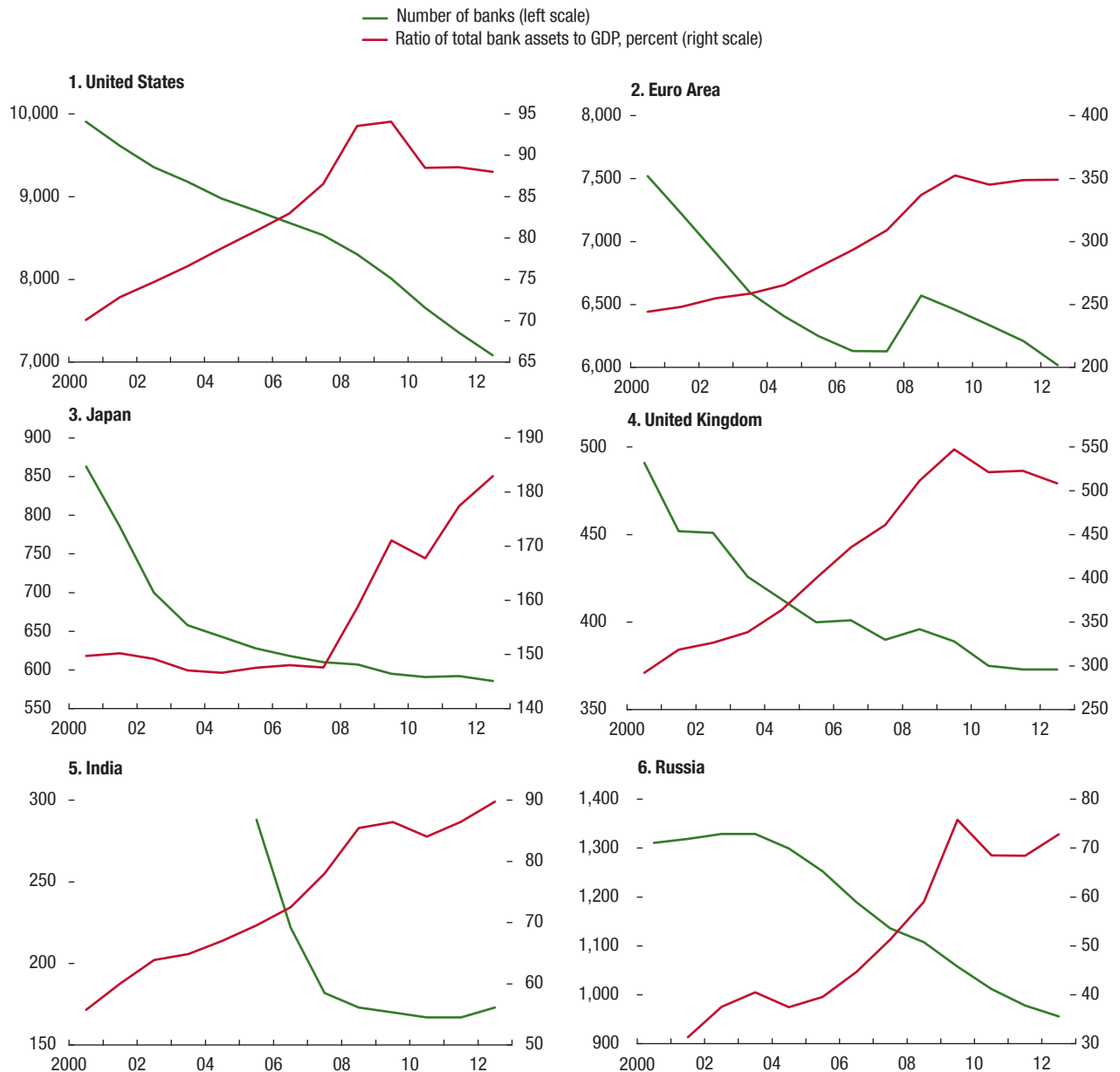
Governments and central banks often encouraged consolidation in the banking industry in an attempt to fight the financial crisis. In 2008, the U.S. government and Federal Reserve directly or indirectly supported three significant acquisitions: the purchases by JPMorgan Chase of investment bank and brokerage firm Bear Stearns and of Washington Mutual Bank, then the largest U.S. savings and loan association, and the purchase by Wells Fargo of Wachovia, then the fourth-largest U.S. bank holding company. In Japan, government measures in the aftermath of the banking crisis of the late 1990s coincided with a reduction by nearly one-fourth in the number of banks between 2000 and 2003 and the creation of three large banking groups. In some other countries (for example, members of the Gulf Cooperation Council), large banks have historically been created in part through public ownership.

Banks have become more interconnected with other financial institutions through an increasingly complex set of relationships, although the trend may have recently reversed. Box 3.1 depicts a complex and densely connected global banking network. Cross-border exposures are a source of difficulties in resolving institutions that engage in such international activities. These linkages have, however, declined since 2007, which may reflect banks' strategies to lower cross-border exposures amid the crisis and subsequent regulatory reforms.

Estimating Subsidy Values

The growth in the size, concentration, and interconnectedness of banks over the past decade potentially exacerbated the problems related to TITF financial institutions. However, as described in the next section, recent regulatory reforms may have eased the problem. This section assesses how the magnitude of the TITF problem has changed since the crisis and following the introduction of financial reforms. The focus is on SIBs, which are defined

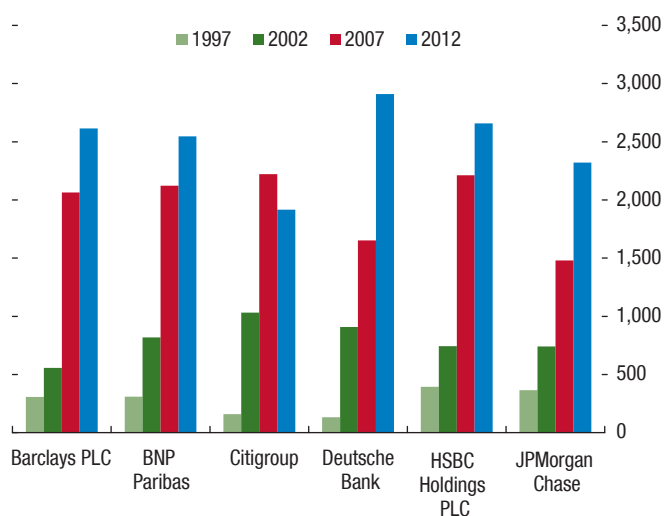
Figure 3.2. Changes in the Number of Banks and the Size of the Banking Sector



Sources: Bank of England; Bank of Japan; Bank of Russia; CEIC database; Deposit Insurance Corporation of Japan (DICJ); European Central Bank; Reserve Bank of India; U.S. Federal Deposit Insurance Corporation (FDIC); and IMF staff estimates.

Note: Number of banks refers to the following: for the United States, number of FDIC-insured commercial banks and savings institutions; for the euro area, the United Kingdom, and Russia, number of credit institutions; for Japan, number of DICJ-insured banks; and for India, number of commercial banks. The jump in the number of credit institutions in the euro area in 2008 corresponds to a change in the population of included banks in one member country.

Figure 3.3. Total Assets of Large Banks¹
(Billions of U.S. dollars)



Sources: IMF, International Financial Statistics database; Moody's CreditEdge; and IMF staff estimates.

¹Top global systemically important banks as of November 2013 (FSB, 2013b).

here as the G-SIBs identified by the FSB (2013b) plus the three largest banks by asset size in each country if these are not G-SIBs, subject to data availability (see Table 3.4 in Annex 3.1 for a list of SIBs in the sample).⁷

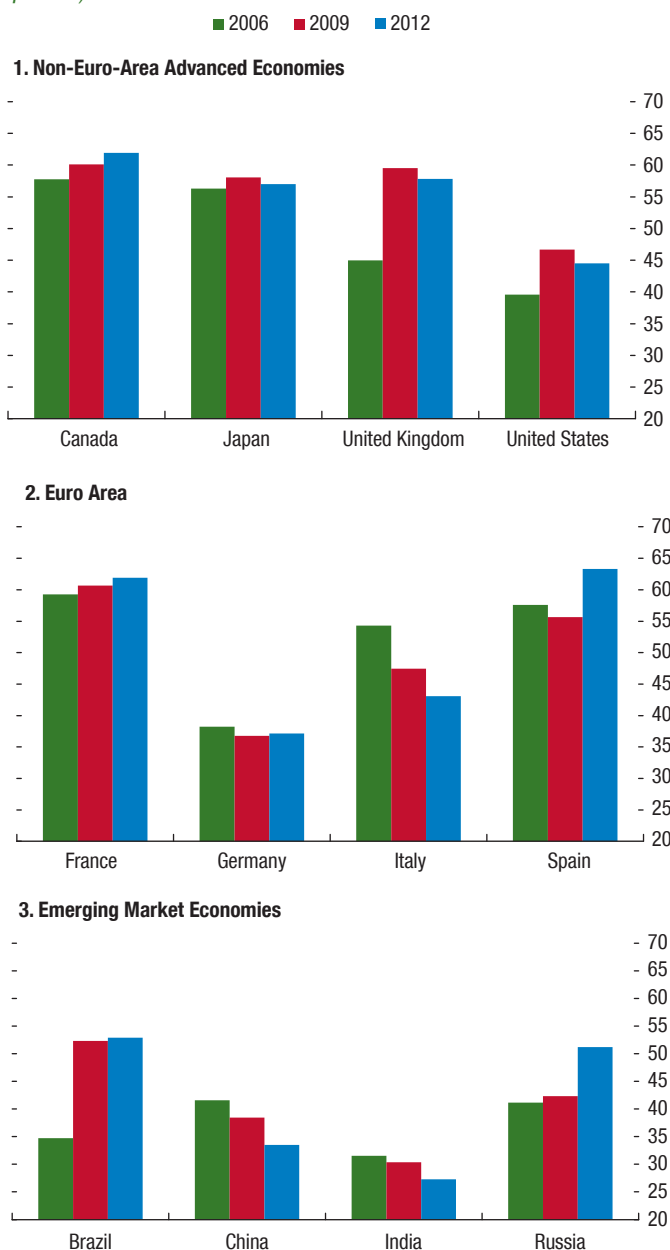
The section compares three separate approaches to assessing the implicit funding subsidy to SIBs: (1) a bond spread differential; (2) a contingent claims analysis (CCA) approach; and (3) a ratings-based approach. The first approach is often used by banks but is less reliable and can even be misleading, especially if the sample of banks is not carefully selected. While the other two approaches are not perfect, they deliver a more precise measure of the implicit subsidy to SIBs. The combination of these latter two approaches provides a consistent and robust picture of the changes in the implicit subsidy since 2005.

Bond Spread Differential

The first method simply compares bond yields of SIBs with those of other banks (hereafter, non-SIBs). This straightforward measure of the funding-cost advantage of SIBs can be computed as the difference between the spread over the London interbank offered rate (LIBOR)

⁷A proper identification of domestic systemically important banks (D-SIBs) would require detailed data not only on size but also on interconnectedness, complexity, and substitutability, which are not publicly available.

Figure 3.4. Concentration in the Banking Sector
(Assets of the three largest banks as a share of total banking assets; percent)



Sources: Bankscope; Bank of Japan; Bank of Russia; Canadian Office of the Superintendent of Financial Institutions; Central Bank of Brazil; China Banking Regulatory Commission; CEIC database; European Central Bank; Reserve Bank of India; U.S. Federal Deposit Insurance Corporation; and IMF staff estimates.
Note: For euro area countries, "total banking assets" refers to total assets of the monetary financial institutions, excluding the Eurosystem.

Box 3.1. Cross-Border Banking Linkages

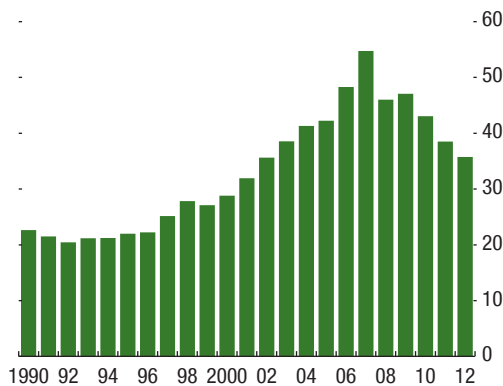
This box reviews the evolution of cross-border banking linkages in recent decades, highlighting the complexity of the global network of financial connections and the role of different countries in the network. It also discusses the benefits of global interconnectedness and the potential for cross-border spillovers.

Following a long-term upward trend and a steep downward adjustment during the global financial crisis, cross-border banking linkages remain significant. Cross-border banking claims, measured by Bank for International Settlements (BIS) locational banking statistics, have increased sharply since the mid-1990s, reaching more than half of global GDP in 2007 (Figure 3.1.1).¹ This phenomenon was spurred by widespread deregulation of banking activities, capital account liberalization, and financial innovation. The trend toward greater financial integration was reversed in the wake of the global financial crisis, however. The crisis triggered a process of bank deleveraging and restructuring and led to a gradual reduction in cross-border banking claims to about one-third of global GDP by 2012.

The authors of this box are Eugenio Cerutti and Camelia Minoiu.

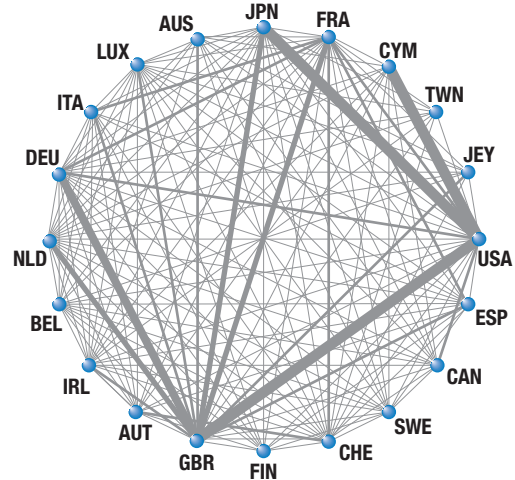
¹The analysis is based on BIS locational banking statistics by residence, which capture the activities of all international active offices in the reporting country regardless of the nationality of the parent bank. Banks record their positions on an unconsolidated basis, including those vis-à-vis their own offices in other countries.

Figure 3.1.1. Cross-Border Banking Linkages
(Percent of GDP)



Sources: Bank for International Settlements; IMF, World Economic Outlook database; and IMF staff estimates.

Figure 3.1.2. Global Banking Network: Core Countries



Sources: IMF staff estimates using Bank for International Settlements (BIS) locational banking statistics; and Cerutti and others (2014).

Note: The figure depicts the network of cross-border banking claims in 2012 for core countries (these are the 20 BIS-reporting countries with the highest stock of bilateral claims). Link width is proportional to the size of claims. AUS = Australia; AUT = Austria; BEL = Belgium; CAN = Canada; CHE = Switzerland; CYM = Cayman Islands; DEU = Germany; ESP = Spain; FIN = Finland; FRA = France; GBR = United Kingdom; IRL = Ireland; ITA = Italy; JEY = Jersey; JPN = Japan; LUX = Luxembourg; NLD = Netherlands; SWE = Sweden; TWN = Taiwan Province of China; USA = United States.

The global banking network generating these claims is very complex, with “core” banking systems playing a central role. A small number of banking systems (which we label “core”) hold the vast majority of cross-border banking claims (about 95 percent in 2012).² The banking activity underlying these claims is often accounted for by a few systematically important financial institutions that manage their global operations out of these jurisdictions. Seventeen of the 20 core countries we consider have recently been classified as jurisdictions with systemically important financial systems (IMF, 2013). As shown in Figure 3.1.2, the core banking systems are highly interconnected. While there is much heterogeneity in the size of claims—captured by the width of cross-country links—some of the most sizable banking activity occurs between the United States and the Cayman Islands, Japan, and United Kingdom.

²The core countries represent a subset of 20 BIS-reporting countries with the largest cross-border banking claims in 2012.

Box 3.1 (continued)

Cross-border banking linkages to non-core countries are relatively small, but they are large relative to the size of these economies (Cerutti and Ohnsorge, 2013).

A densely connected global banking network facilitates risk sharing but also opens the door to contagion and cross-border spillovers. Risk sharing is an important feature of densely interconnected financial networks, in that the losses of a distressed bank (or banking system) are borne by a large number of creditors. This means that the impact of negative shocks can more easily be absorbed in a denser network (Allen and Gale, 2000). But there are also costs

associated with high financial interconnectedness. For example, Hale, Minoiu, and Kapan (2013) document the importance of interbank linkages as conduits for the spread of financial crises internationally. Recent studies stress that network characteristics play a critical role in how contagion and spillovers unfold when negative shocks hit the system. So long as they are not very large, negative shocks to well-connected networks are not very destabilizing. However, beyond a certain point, a dense web of connections can serve as a mechanism for shock propagation and cross-border spillovers (Acemoglu, Ozdaglar, and Tahbaz-Salehi, 2013).

in the same currency for SIB bonds and the spread for non-SIB bonds.⁸ To control for country-specific factors (such as the level of interest rates), we calculate the average spread differentials at the country level. Country aggregates represent the simple average of the country estimates (Figure 3.5). This approach does not account for possible differences in fundamental characteristics between institutions that may drive the spread differential, such as their relative risk characteristics.

The results from this method suggest that, on average over 2003–13, the funding cost advantage of SIBs was about 25 basis points in advanced economies and about 125 basis points in emerging market economies. The funding cost advantage rose markedly during the crisis, peaking at around 250 basis points at the beginning of 2009. This peak was primarily driven by emerging market economies, where large portfolio outflows in late 2008 and early 2009 led to a surge in corporate bond spreads, whereas the spreads for SIBs (often state-owned banks) were relatively less affected. Among the advanced economies, the funding cost advantage since the crisis has been declining in the United States, and to a lesser extent in Japan, while it has significantly risen in Europe. Notably, it is negative in the United States during most of the past 10 years, which often leads to a claim that the TITF subsidy is negligible or even negative (Goldman Sachs, 2013).

⁸Comparing spreads over LIBOR at a similar time horizon allows for controlling for maturity differences between bonds, assuming that the term premium structure is the same for LIBOR and bank bond rates. An alternative is to look at credit default swap (CDS) spreads, which are theoretically the same as bond spreads over the risk-free rate. However, active and liquid CDS markets exist only for the largest banks in advanced economies.

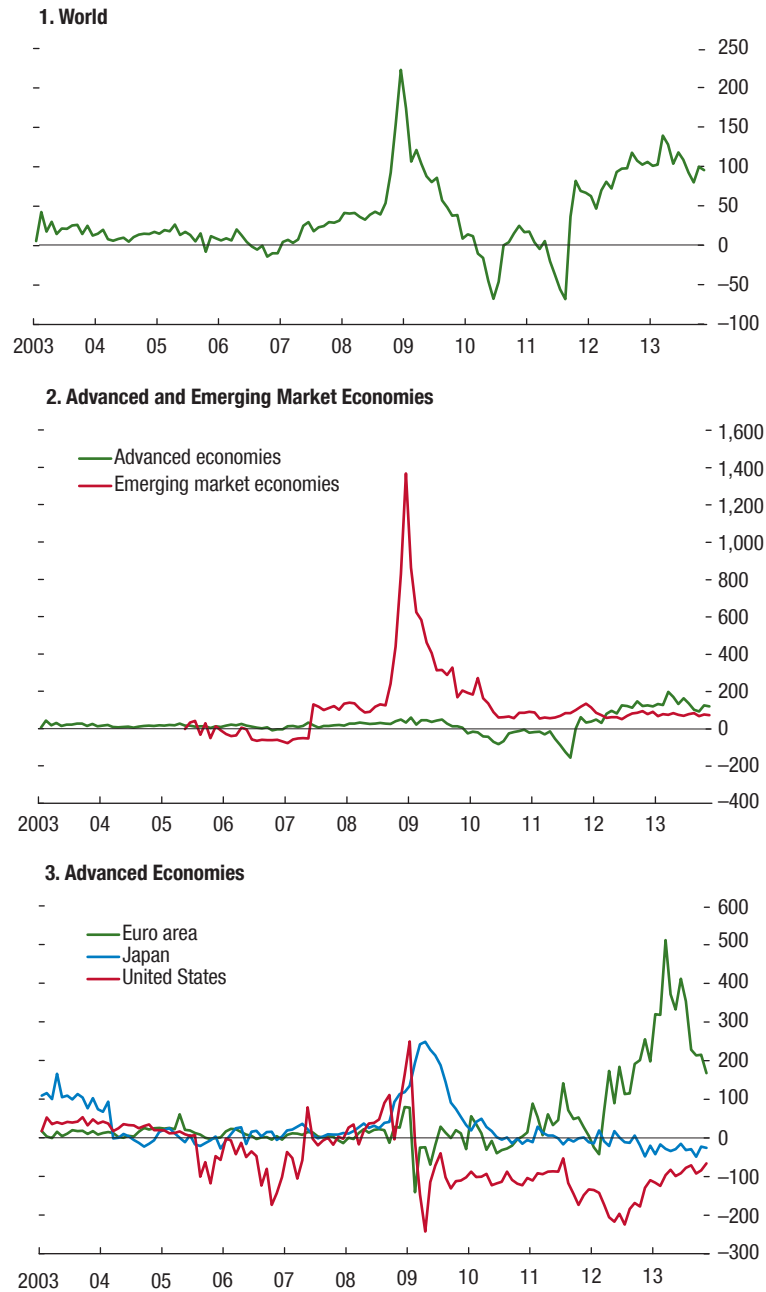
However, this simple spread comparison is misleading in three broad ways. First, it ignores the possibility of genuine economies of scale and scope: if being large implies higher returns with less risk, large banks should naturally enjoy lower funding costs (Box 3.2). Second, it ignores moral hazard, which may increase bond spreads of SIBs.⁹ And third, it may reflect differences in the characteristics of bonds issued by SIBs and non-SIBs.¹⁰ In particular, as Figure 3.6 shows, SIBs tend to issue longer maturity bonds, and this difference in maturity increased during the crisis. Also, SIBs generally have higher leverage compared to non-SIBs. Controlling for the leverage difference by restricting the sample of non-SIBs in the United States to banks with a leverage ratio similar to that of SIBs reveals that SIBs did enjoy a funding advantage (Figure 3.7).¹¹

⁹Counting on the government's intervention in case of distress, SIBs may take on more risk than optimal even compared to other banks with similar balance sheets. Hence, while the expectation of government support lowers the expected loss given default of bond holders, the probability of default itself may increase and offset part of the reduction in the overall risk. As a result, the total effect on observed bond spreads or spreads on credit default swaps would understate the benefits of the government protection.

¹⁰Bond characteristics can be different: SIBs usually issue various types of bonds with different maturities, coupon rates, options to retirement, and degrees of market liquidity. SIB bonds are more frequently issued and enjoy greater liquidity (Kroszner, 2013). Although comparing bond spreads rather than bond yields should limit any bias resulting from bond maturity differences, differences in liquidity are not accounted for.

¹¹The control group includes non-SIBs with a leverage ratio within one standard deviation of SIBs. Because in general only large banks issue bonds, non-SIBs in this sample are still quite large. Acharya, Anginer, and Warburton (2013) provide an estimate of the implicit subsidy based on bond spread differentials after controlling for bank and bond characteristics along with macroeconomic factors. They estimate that, in the U.S. bond market, SIBs enjoy funding cost advantages of 28 basis points, on average, over 1990–2010, peaking at more than 120 basis points in 2009.

Figure 3.5. Bond Spread Differential between Systemically Important Banks and Other Banks
(Basis points)



Sources: Moody's CreditEdge; and IMF staff estimates.

Note: The lines represent the funding cost advantage of systemically important banks (SIBs) relative to other banks. SIBs = systemically important banks, defined as G-SIBs plus the three largest banks by asset size in each country.

Box 3.2. Benefits and Risks of Large Banks

This box summarizes the main benefits and problems associated with large banks, some of which may be magnified by the too-important-to-fail (TITF) issue.

Larger financial institutions may bring some benefits as they may generate genuine economies of scale and scope. For instance, large banks can benefit from diversifying their investments across many sectors and geographical regions. Setting up an information technology system that handles mass transactions is a typical fixed cost that generates increasing returns to scale. An extensive ATM and branch network strengthens a bank's competitiveness vis-à-vis rival banks. Underwriting a large bond issue requires a global network of client investors.

Recent studies provide some evidence of economies of scale and scope in banking, with caveats. Wheelock and Wilson (2012) find increasing returns to scale for most U.S. banks over 1984–2006. This suggests that economies of scale might at least partially account for the growth in the average size of banks over that period. Yet, some of these economies of scale may be driven by TITF subsidies (Davies and Tracey, 2014). Following a different approach, Hughes and Mester (2013) still find sizable economies of scale, aside from the TITF subsidy. According to their estimates, the increase in cost following a 10 percent increase in output incurred by a bank with total assets above \$100 billion is about 20 percent lower than for the average bank in the United States. However, their assumption that all banks have production and cost functions of the same form might be too strong. The business models of large global banks and other banks are, indeed, quite different (Calomiris and Nissim, 2012).

Limits on bank activities have been shown to reduce competitive pressures and potentially to increase banks' monopolistic rents. This, for example, has been the case for the limits on branch banking imposed in the United States until the 1990s, with a resulting adverse effect on economic growth (Strahan, 2003). Similarly,

The authors of this box are Frederic Lambert and Kenichi Ueda.

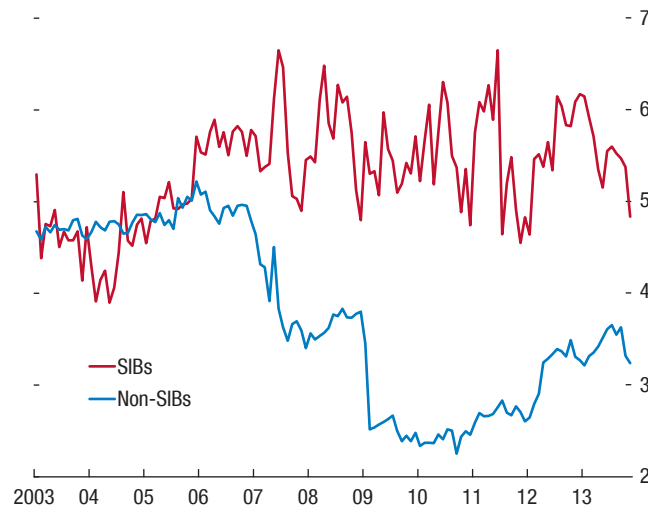
empirical studies have provided some evidence that emerging market economies can increase production efficiency by removing restrictions on banking activities, entry, or pricing (Abiad, Oomes, and Ueda, 2008).

However, a review of the literature on the effects of bank mergers and acquisitions on operating performance or shareholder value finds mixed results (Piloff and Santomero, 1998). Hughes and others (2003) find that internal growth generally leads to better performance than external acquisitions. Besides, banks with less entrenched management tend to benefit more from acquisitions than banks with more entrenched managers.

In terms of risks, although an increase in bank size may allow for greater diversification, the existing evidence of the risks of large banks compared to smaller ones is mixed. While Demsetz and Strahan (1997) find that both leverage ratios and the share of risky assets in banks' portfolios increase with size, Soussa (2000) argues that large U.K. banks do not take on more risk than small ones. By contrast, Dell'Ariccia, Laeven, and Suarez (2013) examine U.S. bank-loan-level data and find that bigger banks take on more risks. Other studies have found that more interconnected institutions had a higher likelihood of distress during the global financial crisis than others (Ötler-Robe and others, 2011).

To the extent that managers and employees also benefit from the TITF protection, labor markets may also be distorted. Because of the structure of compensation packages in the financial industry, particularly the use of stock options, managers and employees of large banks typically benefit as shareholders from lower funding costs and higher profitability. Because of the expectation of government support, existing compensation schemes may thus excessively reward short-term profitability and risk-taking. By offering artificially higher wages, large banks may also attract disproportionately more highly skilled people (Philippon and Reshef, 2012).

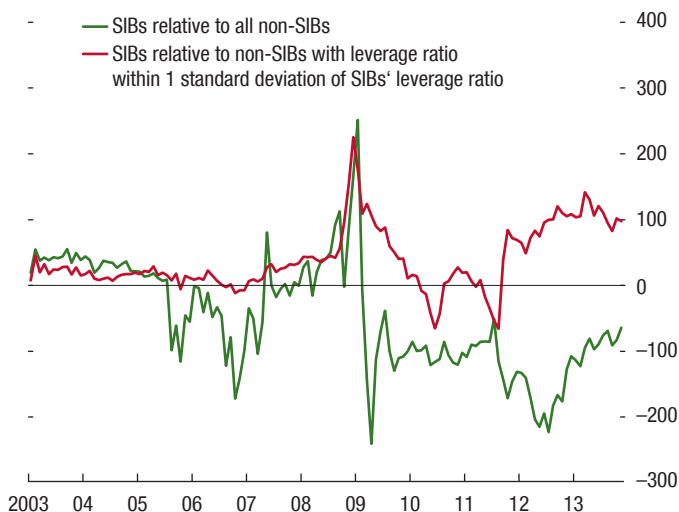
Figure 3.6. U.S. Banks' Average Bond Duration (Years)



Sources: Moody's CreditEdge; and IMF staff estimates.

Note: SIBs = systemically important banks, defined as G-SIBs plus the three largest banks by asset size.

Figure 3.7. Bond Spread Differential for U.S. Banks with Similar Leverage
(Basis points)



Sources: Moody's CreditEdge; and IMF staff estimates.

Note: The lines represent the funding cost advantage of SIBs relative to non-SIBs. SIBs = systemically important banks, defined as G-SIBs plus the three largest banks by asset size.

Contingent Claims Analysis Approach

The CCA approach to estimating TITF subsidies uses data on the price paid, known as the spread, for credit default swaps (CDS) on bank bonds. It compares observed CDS spreads with fair-value CDS spreads calculated from equity price information (see Annex 3.1). Observed CDS spreads take into account both the probability of bank distress and the likelihood and size of government support in case of distress.¹² Assuming that equity holders are wiped out in the event of default, equity prices contain information only on the probability of distress. The equity price information permits the calculation of a hypothetical "equity-market-implied" (fair-value) CDS spread, which disregards the possibility of government support.¹³ A larger expected loss implies a larger fair-value CDS spread. The difference between the observed and fair-value spreads provides a measure of the value of the government guarantee.¹⁴

By construction, this estimate of the TITF subsidy is not contaminated by other factors, such as the general size advantage of SIBs. This is because these factors should be incorporated in both the observed CDS spreads and the fair-value CDS spreads. However, a limitation of this approach is its reliance on observed CDS spreads and assumptions for estimating fair-value CDS spreads. Liquid and reliable CDS spreads are available only from 2005 onward and only for the largest banks, which limits the sample size.¹⁵ CDS prices often incorporate an illiquidity premium

¹²Investors often use CDS spreads as an indicator of the probability of distress of firms. This is because in normal times the loss given distress is assumed to be fixed, so that any change in CDS spreads is attributed to a change in the probability of distress. However, CDS spreads theoretically depend on both the probability of distress and the loss given distress.

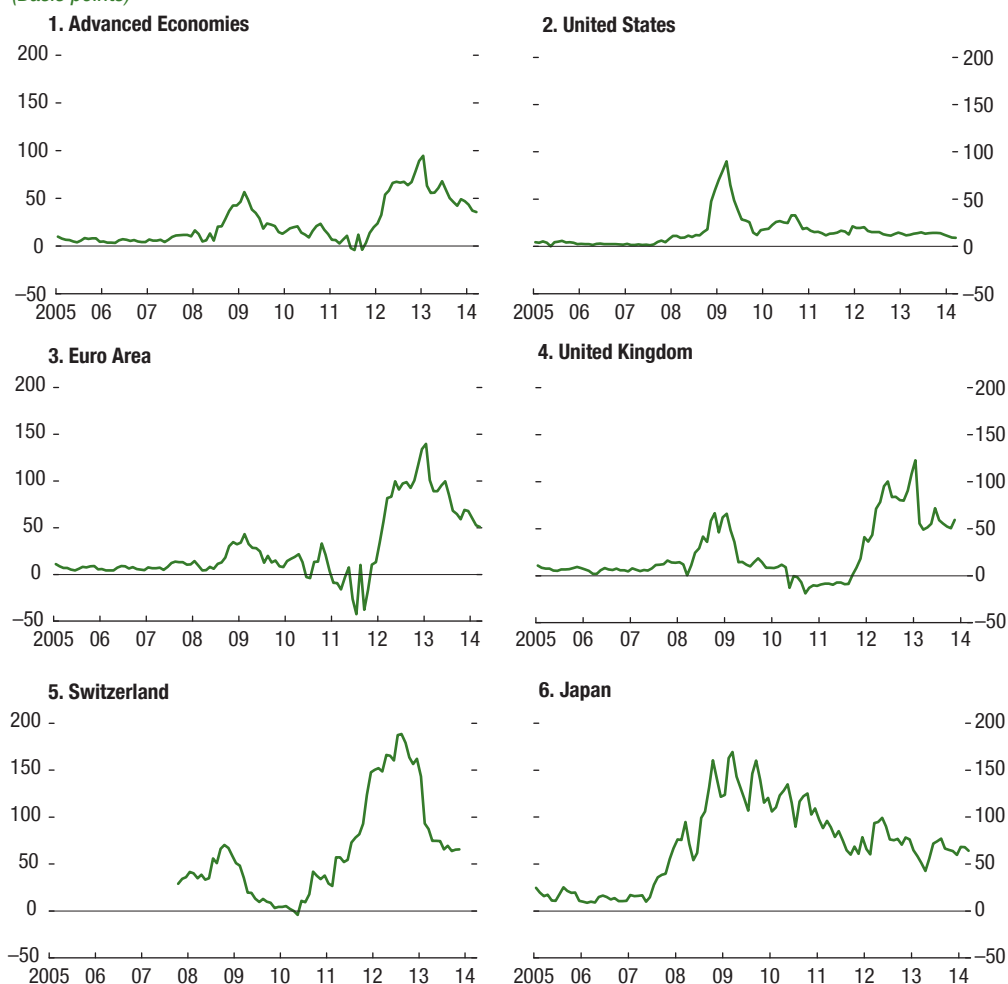
¹³The lower funding costs resulting from the expectation of government support likely imply higher profits in good times, which may raise equity prices (Kelly, Lustig, and van Nieuwerburgh, 2011). The CCA approach may thus underestimate the true subsidy value.

¹⁴See Gray and Malone (2012); Gray and Jobst (2013); Li, Qu, and Zhang (2011); and Schweikhard and Tsesmelidakis (2012).

¹⁵In times of crisis, the assumptions required to implement the CCA approach may be violated. Also, the CDS spread may not be efficiently priced. While the extent of such violations is difficult to measure empirically, the approach pursued here attempts to take the effect of sovereign stress into account at least partially by restricting the sample to banks with fair-value CDS spreads that are higher than the sovereign CDS spreads. The implicit assumption is that the sovereign CDS spreads de facto serve as a floor for the individual bank CDS spreads, and when the sovereign spread exceeds the estimated fair-value CDS spread, the banks' CDS spreads may not be indicative of TITF support. See Box 3.4 for more details on the bank-sovereign linkages.

Figure 3.8. Mean Implicit Subsidy for Systemically Important Banks Estimated with the Contingent Claims Analysis Approach

(Basis points)



Sources: Markit; Moody's CreditEdge; and IMF staff estimates.

Note: Systemically important banks are defined as G-SIBs plus the three largest banks by asset size in each country.

and a counterparty credit risk premium that may affect the results (Bao and Pan, 2013). Besides, during acute stress episodes, assumptions about the distress threshold and loss given distress may be violated. Finally, the method may provide only a lower bound for the subsidy estimates if equity holders may also be partially bailed out.¹⁶

¹⁶The probability of distress is computed assuming no bailout of equity holders. However, equity holders were bailed out to some extent during the crisis, such as through the Troubled Asset Relief Program (TARP) in the United States and the recapitalization of Lloyds Banking Group and Royal Bank of Scotland by the U.K. government.

The CCA approach estimates suggest that in the advanced economies, implicit subsidies for SIBs averaged around 30 basis points over the past nine years. The subsidies increased during the financial crisis, climbing to around 60 basis points in 2009, before declining somewhat (Figure 3.8). The spike in estimated subsidies in 2009 can be explained by heightened expectations of public bailouts following the disruptions provoked by the collapse of Lehman Brothers in mid-September 2008, although the severe market turmoil at that time might also have impeded efficient pricing of CDS. The subsidies have grown again over the past few years with the rise of European sovereign stress.

After the global financial crisis subsided, subsidies declined in the United States and Japan but rose in Europe during the sovereign debt crisis. In the United States, implicit subsidies dropped sharply from their 2009 peak to around 15 basis points. In Japan, the implicit subsidies also declined from their crisis peaks but remain relatively high at around 60 basis points.

By contrast, in Europe, the subsidies climbed markedly after an initial drop following the 2007–08 phase of the crisis. They have averaged around 90 basis points since 2012. The results for the European countries likely reflect the severe market turmoil around the sovereign debt crisis in the euro area in 2011–12, rather than a failure of the regulatory initiatives to solve the TITF problem. In particular, in Switzerland and the United Kingdom, the implicit subsidy was at its lowest level during the design period of financial reforms (November 2009–October 2010 in Switzerland, and January 2010–September 2011 in the United Kingdom). In the euro area, regulatory initiatives are still ongoing (as discussed in the next section).

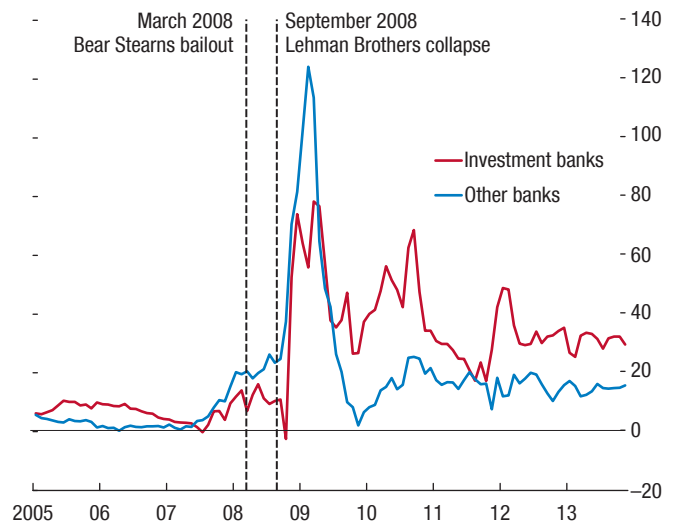
The implicit subsidies received by investment banks and other banks exhibit broadly similar patterns, with a few interesting differences. Figure 3.9 compares the subsidy estimates by type of bank in the United States. The implicit subsidy value received by investment banks rose after the bailout of Bear Stearns in March 2008, before dropping to zero in the month following the Lehman Brothers collapse. The increased subsidy value observed after 2009 may reflect the transformation of investment banks into traditional bank holding companies regulated by the Federal Reserve, while the heightened volatility after 2012 could result from the higher exposure of investment banks to euro area countries and their riskier profiles compared to other banks.

Ratings-Based Approach

The ratings-based approach exploits the fact that credit rating agencies typically provide a breakdown of the overall credit rating for each bank. The breakdown shows the fundamental standalone rating and an assessment of the government's (or parent company's) willingness to provide support.¹⁷ The estimation is carried out in two steps. First, the different ratings are used to estimate the overall rating uplift related to govern-

¹⁷Fitch Ratings discloses both its assessment of support and whether it comes from the government or the parent company.

Figure 3.9. Implicit Subsidy by Type of Bank in the United States
(Basis points)



Sources: Markit; Moody's CreditEdge; and IMF staff estimates.
Note: Estimated with the contingent claim analysis approach.
Investment banks comprise Morgan Stanley and Goldman Sachs.

ment support ratings while taking into account banks' fundamental factors and the government's capacity to support banks.¹⁸ Second, the rating uplift is translated into a funding cost spread based on the historical relationship between credit ratings and bond spreads.¹⁹ A potential drawback is that, since the agencies' assessment method is based on a statistical analysis of past bailout episodes (Moody's Investor Service, 2013), the ratings are often slow to reflect changes in financial policies.²⁰ This may explain the stability of the agencies' assessments of government support for the most recent period. Moreover, divergent views among credit rating agencies have recently emerged. For example,

¹⁸See Annex 3.2 and Ueda and Weder di Mauro (2013).

¹⁹Long panel datasets are used to estimate the historical relationship so as to smooth out the short-run fluctuations in risk sentiment and to alleviate the bias due to moral hazard (Box 3.3). The method thus yields an estimate of the long-run average value of TITF subsidies. This means that it does not take into account possible changes over time in the relationship between credit ratings and bond spreads.

²⁰Credit rating agencies have faced heavy criticism in the aftermath of the crisis for producing inaccurate and even "catastrophically misleading" assessments (Casey, 2009). However, what matters for purposes here is that markets use ratings in pricing debt instruments and that these ratings affect bond spreads on average over many years. Resti and Sironi (2005) provide evidence of a strongly significant relationship between corporate bond spreads and credit ratings.

Moody's markedly lowered the support component in its overall ratings of SIBs in November 2013.

The results based on this method suggest that although implicit subsidies have declined from their peaks during the financial crisis, they remain high (Figure 3.10).²¹ In line with the previous results, the ratings-based method finds that subsidies for U.S. SIBs have fallen to somewhat above their precrisis levels—to around 15 basis points. Moreover, subsidy estimates remain much higher than before the crisis for euro area banks. However, the ratings-based subsidies for U.K., Japanese, and Swiss banks are close to their precrisis levels, whereas the estimates in the CCA approach were much higher. This difference is likely due to the slow ratings adjustment mentioned earlier and the fact that long-run and support ratings are not much affected by short-run market turmoil; such turmoil may impede the efficient pricing of CDS and equity, the key elements used in the CCA approach.

The subsidy estimates are driven by both the probability that the SIBs become distressed and expectations regarding the size of a government bailout in the case of distress (Box 3.3). In most countries, the subsidy estimates have declined from their 2009 peaks as various policy reforms have been implemented and banks have become healthier. Yet, subsidy estimates remain much higher in the euro area than in the United States, likely reflecting the different speed of banks' balance sheet repairs, as well as perceived differences in policy frameworks for dealing with the TITF issue. In particular, while the expectation of a bailout in case of distress may be difficult to change, the probability of distress can be significantly lowered with better regulation and supervision, more capital and better fundamentals, and stronger fiscal positions of sovereigns. The ratings-based approach can disentangle the two effects.

The value of government support for a SIB already in distress has declined since 2010 but remains, on average, not far below its precrisis level, with a subsidy of around 60 basis points. The ratings-based approach is used to estimate SIBs' implied subsidy values conditional on the bank being distressed, that is, with a

rating just below investment grade (Figure 3.11).²² It shows almost unchanged expectations about the likelihood of government rescuing a distressed SIB. This further suggests that recent reforms in recovery and resolution plans, aimed at reducing potential bailout costs for a (hypothetical) SIB already in distress, may not yet be viewed as effective, or that the announcements to eschew bailouts are not considered to be credible. This seems to be especially the case for the United States, where the bailout expectations appear still higher than before the crisis. This is in contrast to the euro area, where they have slightly fallen. The difference, however, mainly stems from an increase in the bailout expectations for U.S. investment banks.

Summary

The results of the CCA and ratings-based approaches provide a broadly consistent picture. The TITF subsidies have declined from their crisis peaks but remain substantial, especially in Europe. Table 3.1 summarizes the advantages and shortcomings of the two estimation approaches, along with their results.

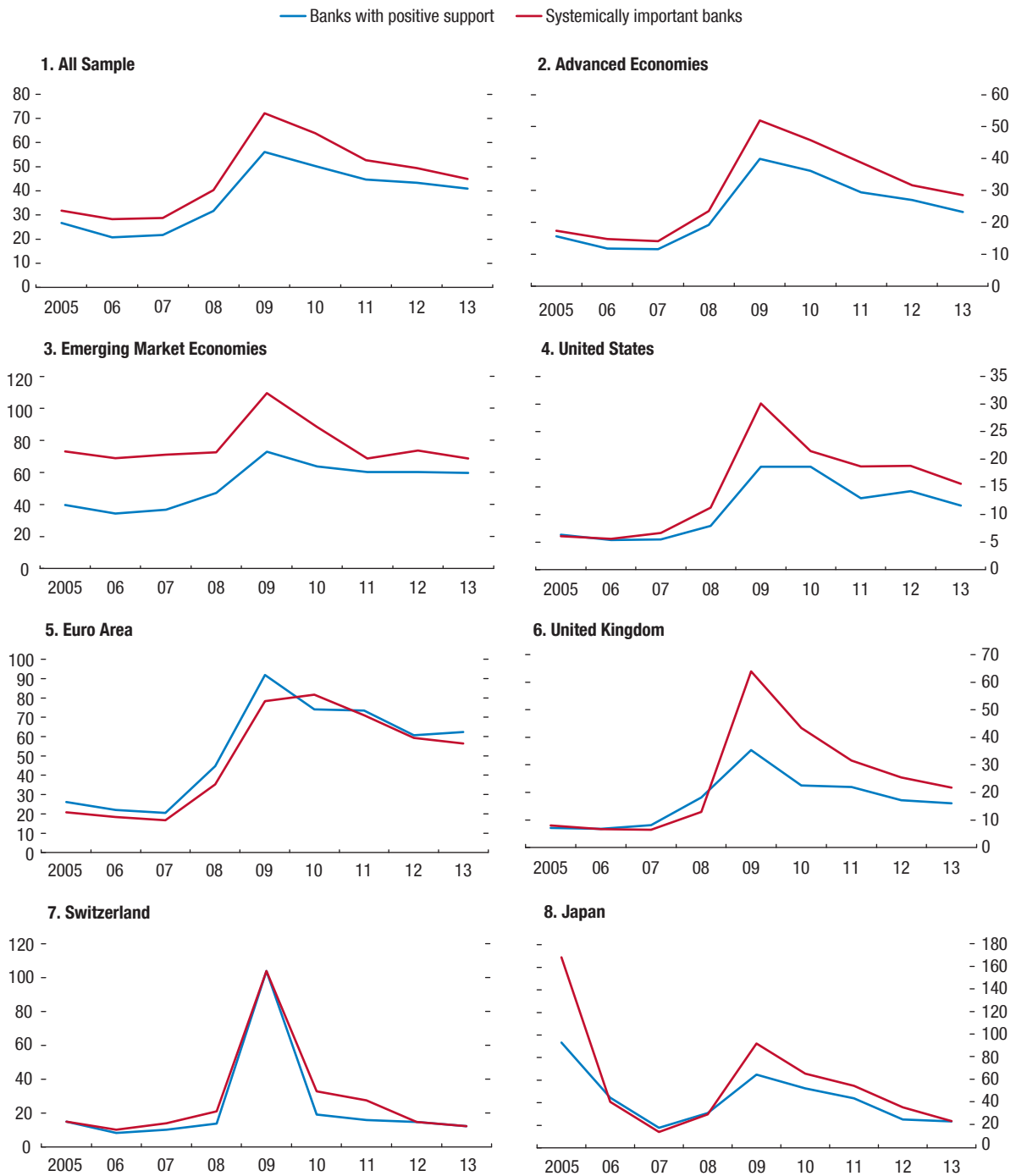
The dollar values of the implicit subsidies are sizable. The subsidy values in billions of dollars can be calculated for G-SIBs in a few countries using the funding cost advantage from the CCA and ratings-based methods (Figure 3.12).²³ Because of the methodological differences between the two approaches, the range of estimates is quite large and argues for caution when discussing these numbers. The subsidy values obtained from the CCA approach over 2011–12 are found to be around \$50 billion for the United States and Switzerland, around \$110 billion for Japan and the United Kingdom, and above \$300 billion for the euro area. Using the ratings-based approach, in the United States, the subsidies represent around \$15 billion for G-SIBs when using the historical relationship between rating

²²The phrase “just below investment grade” corresponds to the “C/D” assessment in the individual ratings by Fitch (roughly equivalent to “BB” on the overall rating scale), which was, for example, the rating given to Bank of America and Citigroup at the end of 2009 after a few upgrades from the trough after the collapse of Lehman Brothers.

²³The CCA approach allows for a direct computation of the subsidy value in dollars (see Annex 3.1). The calculation is made at the level of each bank and then summed up for all G-SIBs. For the ratings-based approach, the subsidy values in dollars are computed by multiplying the funding cost advantage in basis points by the sum of total liabilities (net of equity) of G-SIBs in each country, depending on the availability of balance sheet information.

²¹Figures 3.10 and 3.11 are derived from the most conservative estimate for the subsidy value among several possible econometric specifications. See Annex 3.2 for a detailed explanation of the estimation methodology. The majority of banks are not expected by rating agencies to receive support from the government. For those banks, the ratings-based approach implies an implicit subsidy of zero.

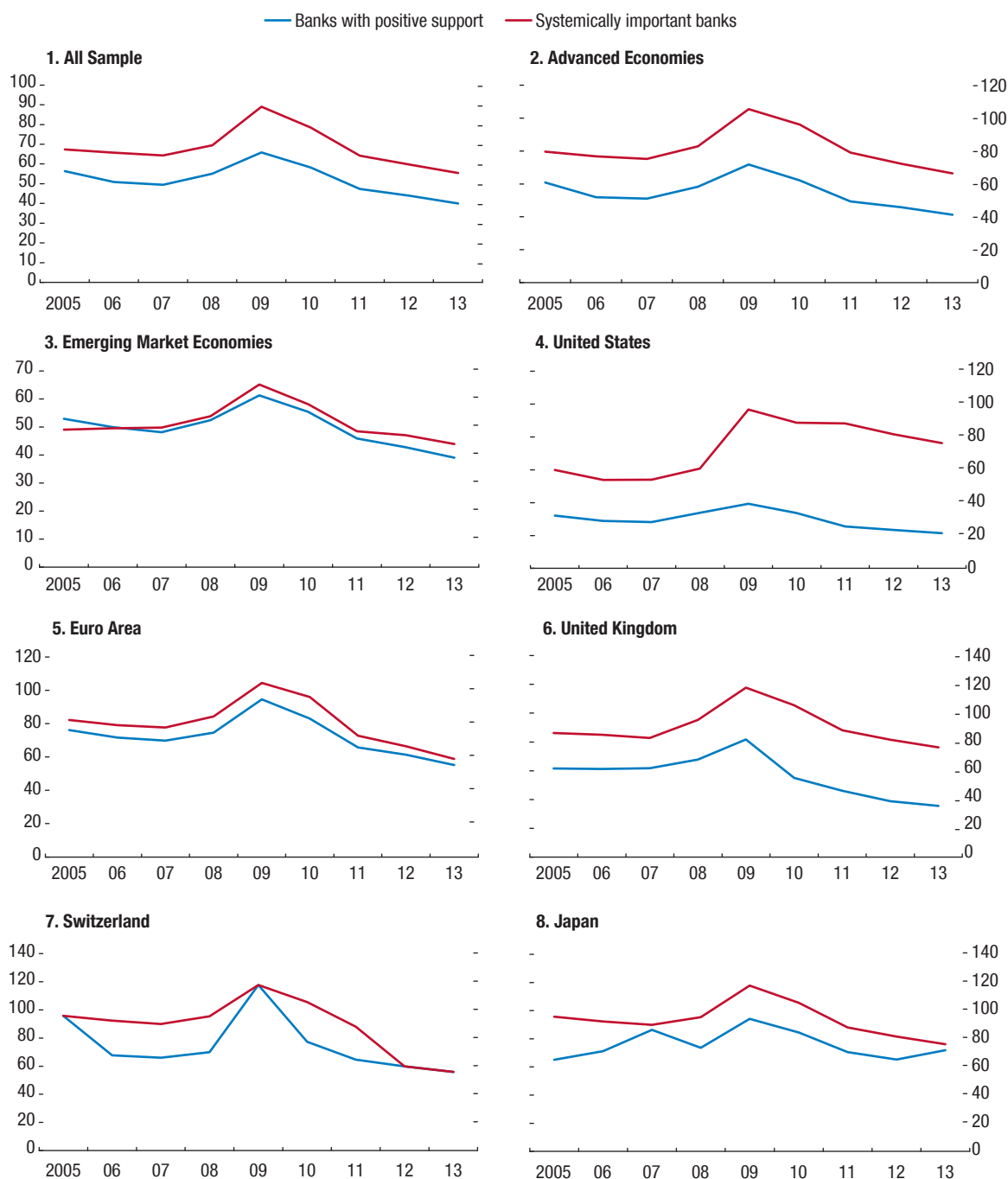
Figure 3.10. Average Subsidies Derived from Credit Ratings
(Basis points)



Sources: Bankscope; Fitch Research; and IMF staff estimates.

Note: The estimate of the rating uplift is based on all of the sample using rating information only. Systemically important banks are defined as G-SIBs plus the three largest banks by asset size in each country.

Figure 3.11. Subsidies Derived from Credit Ratings for a Bank Just Below Investment Grade
(Basis points)



Sources: Bankscope; Fitch Research; and IMF staff estimates.

Note: The estimate of the rating uplift is based on all of the sample using rating information only. Systemically important banks are defined as G-SIBs plus the three largest banks by asset size in each country. The data represent the value of government protection in case of distress.

Box 3.3. Estimating Implicit Too-Important-to-Fail Subsidies

This box compares the contingent claims analysis (CCA) and the ratings-based approaches for estimating too-important-to-fail (TITF) subsidies. In particular, it shows how the analyses differ in their treatment of the moral hazard issue, which is at the heart of the TITF problem.

Distressed systemically important banks are expected to be bailed out by the government with some probability. This probability is denoted by p in Figure 3.13 in the main text. It increases with the government's willingness to support distressed banks, which is denoted by x . Moreover, the loss incurred by the debt holders in the event of support S can be much smaller than the full loss L in the absence of support, depending on the terms of the bailout. The expected loss given distress $E(LGD)$ is theoretically equal to the lower loss given distress multiplied by the probability of a bailout, plus the loss in the absence of a bailout multiplied by the probability of no bailout, that is:

$$E(LGD) = p(x) S + (1-p(x)) L. \quad (3.3.1)$$

This expected loss given distress decreases with the government's willingness to support distressed banks.

The expected loss for debt holders depends not only on the expected loss given distress but also on the probability that a bank becomes distressed. It is the expected loss given distress $E(LGD)$ multiplied by the probability of distress q , that is, $q \times E(LGD)$. This corresponds to the credit spread, which is theoretically equal to the observed CDS spread:

$$\text{Credit spread} = q \times (p(x) S + (1-p(x)) L). \quad (3.3.2)$$

In the CCA approach, the fair-value credit spread, assuming no government support ($S=L$), is calculated from the equity price movements under specific assumptions about the default threshold and the full loss L .

The authors of this box are Frederic Lambert and Kenichi Ueda.

Both the CCA and the ratings-based approaches implicitly or explicitly control for the current fundamental characteristics of banks, such as profitability and indebtedness. These characteristics are denoted by F . The credit spread can then be written as $q(x|F) \times E(LGD)$, with the distress probability q depending on the government's willingness to support x given the bank's fundamentals F . Note that the bank's fundamentals are themselves a function of x in addition to economies of scale and scope y , and other factors z : $F(x, y, z)$. The willingness of the government to support distressed banks may influence fundamentals because, for example, protected banks can enjoy some monopolistic rents. This effect, however, is unlikely to be well captured in any estimation approaches, which therefore likely underestimate the true value of the subsidies.

The issue of moral hazard further complicates the estimation of the TITF subsidy. Because of expected government support, systematically important banks may be inclined to take on more risk. While a government's greater willingness x to bail out lowers the expected loss given distress $E(LGD)$, it may at the same time increase the probability of distress q , even with the same fundamentals. Therefore, the observed bond spread is not an accurate measure of the benefit of the protection. The CCA approach can eliminate the moral hazard bias by using credit default swap and equity price data for the same bank, except in the case when moral hazard makes the tail of the distribution of returns fatter (as was the case for some structured products whose losses became especially large during the crisis). This issue is minimized in the ratings-based approach. The effect of government support on overall risk (captured by the overall rating) is estimated while controlling for fundamentals that absorb the effect of moral hazard. Any remaining effect of moral hazard is further controlled for by delinking each bank's rating from its bond spread and instead using long-run panel estimates of the rating-spread relation.

Table 3.1. Summary of the Estimates of Implicit Subsidies

Estimation Method	Advantages	Shortcomings	Average Subsidy Value for SIBs (in 2013)
Contingent claims analysis approach			
Difference between the fair-value CDS spread computed from equity prices and the observed CDS spread	Controls for bank characteristics Controls for economies of scale and scope	CDS data available only for a limited number of banks CDS data may not be reliable during market turmoil Assumes equity holders are not bailed out	Euro area: Around 90 basis points Japan: Around 60 basis points United Kingdom: Around 60 basis points United States: Around 15 basis points
Ratings-based approach			
Estimation of rating uplift from government support, which is translated into a credit spread based on the historical relationship between credit ratings and bond spreads	Controls for bank characteristics Controls for economies of scale and scope Effect of moral hazard is limited	Relies on credit ratings Ratings are slow to adjust ¹	Euro area: Around 60 basis points (60 basis points for a distressed SIB) Japan: Around 25 basis points (75 basis points for a distressed SIB) United Kingdom: Around 20 basis points (75 basis points for a distressed SIB) United States: Around 15 basis points (75 basis points for a distressed SIB)

Source: IMF staff.

Note: CDS = credit default swap; SIBs = systemically important banks, defined as G-SIBs plus the three largest banks by asset size in each country. Basis points estimates are for a one-year period.

¹See Chapter 3 of the October 2010 *Global Financial Stability Report*, "The Uses and Abuses of Sovereign Credit Ratings."

uplifts and funding costs. However, using more recent estimates of this relationship (Acharya, Anginer, and Warburton, 2013), the value of protection increases to \$70 billion. Subsidy values lie between \$25 and \$45 billion in Japan, \$20 and \$60 billion in the United Kingdom, and \$5 and \$20 billion in Switzerland.²⁴ For the euro area banks, the estimated subsidy values are higher, around \$90 to \$100 billion. These estimates are broadly consistent with other results found in the literature (for example, Noss and Sowerbutts (2012) for the United Kingdom, and Tssemelidakis and Merton (2012) for the United States). Notably, in all the jurisdictions considered, with the exception of Switzerland, the protection values in 2011–12 are equal to or higher than the expected protection values before the crisis.

²⁴The changes in value over time mostly follow the changes in the estimates of the funding cost advantage but also reflect the increases and decreases in the size of the balance sheets of G-SIBs. These dollar values likely underestimate the true TITF subsidy values for at least two reasons. First, the estimates do not account for the large off-balance-sheet assets and liabilities of G-SIBs. Second, TITF institutions go beyond G-SIBs or the three largest banks in many countries. Conversely, including deposits in the liabilities may overestimate the subsidy value as deposits are covered by deposit insurance, and they account for about half of the liabilities of G-SIBs. Yet it has been shown that large banks also benefit from a funding cost advantage on deposits, especially uninsured ones (Jacewitz and Pogach, 2012).

The Effects of Specific Reforms

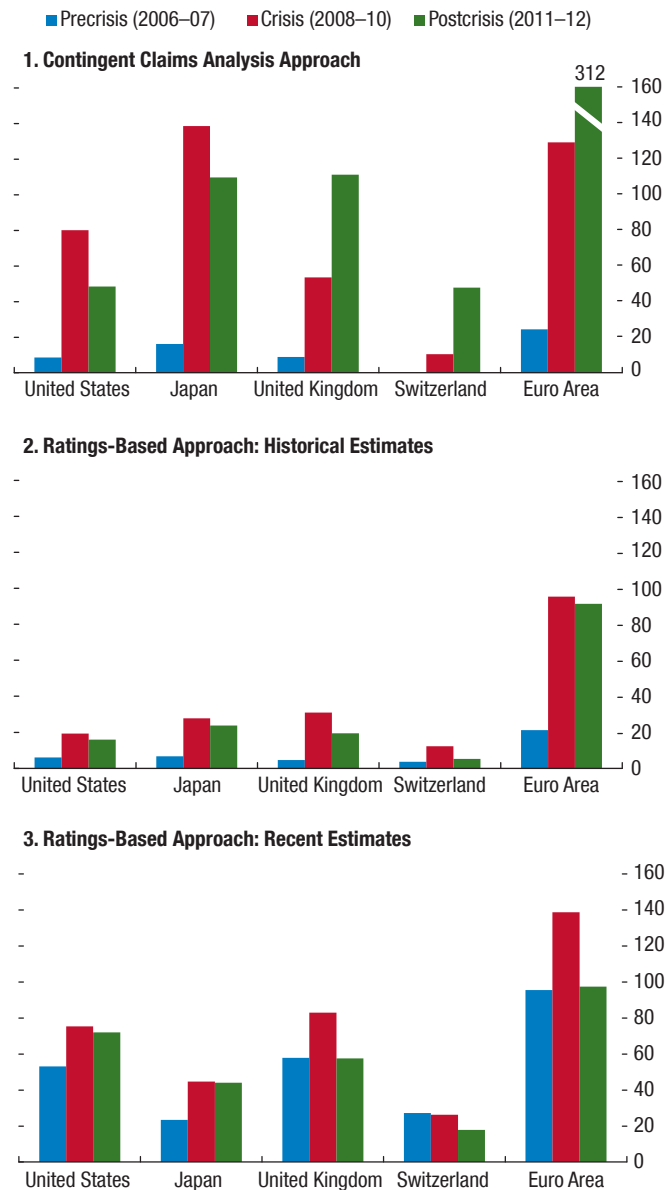
The effectiveness of specific policy measures can be evaluated by investigating the market reaction around the dates of key policy announcements.²⁵ We use CDS spreads and equity returns to gauge the market reaction to various policy initiatives in the euro area, Switzerland, the United Kingdom, and the United States. In this exercise, the sample is limited to G-SIBs, as these are more likely to be affected by regulatory initiatives than the top three domestic banks in each jurisdiction. However, this limits the size of the cross-sectional sample, particularly in the case of Switzerland, which has only two G-SIBs.

As expected, early proposals and initial announcements of reform initiatives usually have a larger market impact than the final approval and implementation of the initiatives (Table 3.2). This outcome is to be expected because markets already incorporate the likely impact of the reforms before they are actually implemented.

The announcement of the Volcker Rule seems to have affected G-SIBs in all jurisdictions considered.

²⁵This section largely follows Schäfer, Schnabel, and Weder di Mauro (2013) but considers a few additional, more recent, events. See also the event study in IMF (2010), which covers the key crisis events. In particular, the purchase of Bear Stearns by JPMorgan Chase protected creditors but (almost) wiped out shareholders. That day, financial sector equity prices abnormally fell but CDS spreads did not. Bank CDS spreads went up on the day of the Lehman Brothers' collapse.

Figure 3.12. Implicit Subsidy Values for Global Systemically Important Banks
(Billions of U.S. dollars)



Sources: Bankscope; Fitch Research; Markit; and IMF staff estimates.

Note: The estimate of the implicit subsidy value for Switzerland in the contingent claims analysis approach for the precrisis period is not available. Historical estimates for the ratings-based approaches use the relationship between ratings and bond spreads estimates by Soussa (2000) for each rating over the period 1920–99. Recent estimates rely on average ratings-bond spreads' relationship estimates for all banks by Acharya and others (2013) over 1990–2010.

G-SIBs in all the jurisdictions under consideration are active in the U.S. market. Their CDS spreads significantly increased, indicating that the perception of government support declined. At the same time, equity returns fell, implying that the announcement was

seen as negative for SIBs' profitability. The European Union bail-in requirements decreased CDS spreads in the euro area and, to a lesser extent, in the United Kingdom.²⁶

Country-specific results show that the main reform initiatives had an effect on markets. In the United States, the presentation of the reform bill by President Obama led to a significant increase in CDS spreads, as it reduced the expectation of government support to G-SIBs. Conversely, the new leverage ratio requirements significantly reduced CDS spreads, as they are expected to lower G-SIBs' probability of distress. In the United Kingdom, the release of the Vickers proposal had a significant positive effect on CDS spreads. In the euro area, the European Commission's proposal for a Deposit Guarantee and Recovery and Resolution Directive had a significant positive impact on G-SIBs' equity returns, but the Single Resolution Mechanism did not. However, the Eurogroup's approval of the European Financial Stability Facility's assistance (subsequently taken over by the European Stability Mechanism) for recapitalizing Spanish banks reduced the equity value of G-SIBs in the euro area, likely because the envisaged scheme (indirect recapitalization through the Spanish government and not directly by a European institution) was not viewed as breaking the bank-sovereign link. Finally, in Switzerland, the most significant event was the release of the report and recommendations of the "too-big-to-fail commission."

Policy Discussion

As noted at the outset of this chapter in the quotes from Federal Reserve Chairman Ben Bernanke and Financial Stability Board Chairman Mark Carney, the too-important-to-fail issue "is not solved and gone." Although progress is under way—especially in the United States—the subsidy estimates suggest that the TITF issue is still very much alive. TITF subsidies remain substantial in Europe, even if they have declined from their peaks. Moreover, the TITF subsidy appears to be widespread: other large banks that are not classified as SIBs are not much different from SIBs

²⁶The interpretation of this result is complicated. A bail-in requirement by itself may imply an increase in CDS spreads, as it implies higher losses for creditors affected by the bail-in than under full government bailouts. However, creditors have also more incentives to scrutinize issuers and to monitor their activities, and this would reduce moral hazard. This, in turn, should lower the CDS spread.

Box 3.4. Banks and Sovereign Linkages

This box discusses the linkages between the banking sector and the sovereign and the effects banking crises may have on governments' fiscal positions.

Large distressed financial institutions can destabilize the government's fiscal position and increase sovereign risk. The potential for large financial institutions to seriously affect a government's financial position should be a factor in the design of policies to deal with the too-important-to-fail (TITF) issue.

Several channels of two-way risk transmission exist between financial institutions and sovereigns. Transmission of financial sector risk to sovereigns can arise from financial support to distressed systemically important financial institutions (SIFIs) through (1) debt guarantees, (2) direct capital injections, and/or (3) asset purchases or asset guarantees. Channels of transmission of sovereign risk to the financial sector include (1) higher sovereign risk that can lower the market value of banks' sovereign debt holdings; (2) higher sovereign borrowing costs that can increase banks' funding costs; and (3) in cases of high sovereign risk, the deterioration of perceived sovereign creditworthiness that can reduce the government's ability to provide a credible backstop to large SIFIs.¹

The perception that sovereigns may need to bail out large financial institutions via debt guarantees or capital injections can lead to increases in sovereign

spreads. The activation of debt guarantees directly raises fiscal costs, which in extreme situations can lead to a sovereign debt crisis, as occurred recently in Ireland (Gray, Merton, and Bodie, 2008). Indeed, in serious situations the financial institution may be "too big to save." Destabilization spirals can occur when the value of banks' holdings of government debt declines, worsening banks' financial positions; this, in turn, increases government contingent liabilities to banks, thus worsening the government's creditworthiness with further negative feedbacks to financial institutions (Gray and Malone, 2012; Gray and others, 2013).

These multiple channels of two-way risk transmission from financial institutions to sovereigns have important implications for measures to target the TITF problem. The potential for large financial institutions to seriously affect a government's financial position should be a factor in the design of policies to deal with the TITF issue (see Box 3.5). It also points to the need to analyze, including in stress-testing exercises, the possibility of distressed financial institutions adversely affecting sovereign risk and the government's fiscal situation, and the risk of triggering a "destabilizing spiral." The transmission channels further reinforce the need to adopt a comprehensive approach to the design of TITF policies, macroprudential policies, and current methods to compute capital requirements. For example, the current prudential practice of zero risk-weights for all government debt masks the potential build-up of bank-sovereign risk.

The author of this box is Dale Gray.

¹See the April 2010 *Global Financial Stability Report* (GFSR); and Caruana and Avdjiev (2012).

in terms of the subsidies they receive. The presence of an implicit subsidy for the other banks suggests that they may also be considered TITF.

Policy Options

Policymakers have essentially four options in addressing the TITF issue: (1) restrict bank size and activities to prevent institutions from becoming too important to fail, (2) reduce the probability that a SIB becomes distressed, (3) lower the probability of a bailout if a bank becomes distressed, and (4) minimize public transfers in the case of bank restructuring.²⁷ Each of these policies corresponds to a node in the event tree depicted in

Figure 3.13: first, a bank may or may not be classified as systemically important; second, if systemically important, it may or may not become distressed; third, if distressed, it may or may not obtain public support; and fourth, in the case of public support, losses incurred by claimants may be reduced in various proportions. Table 3.3 provides a summary of the various policy measures that are discussed in more detail below.

Policies to restrict the size and scope of banks can reduce interconnectedness and complexity and limit the number of SIBs. As discussed in Viñals and others (2013), such policies can be useful in managing risks that are difficult to measure and address through other tools. Activities that are too complex for their risk to be accurately measured and too complex to be effectively resolved may require outright separation.

²⁷See similar discussions in Ötcher-Robe and others (2011).

Table 3.2. Event Study

Events	Date	Abnormal Returns			
		CDS Spreads (Basis points)	Equity Returns (Percent)		
		Constant Mean	Constant Mean	Market Model	
United States					
Blueprint of the reform bill presented by President Obama	June 17, 2009	36.36**	-0.0286***	-0.0241***	
Announcement of the Volcker Rule	Jan. 21, 2010	12.53***	-0.0366***	-0.0307**	
U.S. banks set to lose lobby fight on swaps	June 11, 2010	25.24***	0.0078	-0.0011	
Dodd-Frank Act signed by President Obama	July 21, 2010	-2.28	-0.0182	-0.0033	
New leverage ratio requirement adopted	July 9, 2013	-10.38***	0.0062	-0.0022	
United Kingdom					
Announcement of the Volcker Rule in the United States	Jan. 21, 2010	10.98***	-0.0478**	-0.0379**	
Appointment of the Vickers Commission	June 16, 2010	-8.26**	0.0082	0.0014	
Barclays warns to leave the U.K. in case of a bank break-up	Aug. 5, 2010	-7.08**	-0.0140	-0.0042	
Publication of the Vickers Report	Sep. 12, 2011	30.30***	-0.0686***	-0.0271*	
E.U. statutory bail-in requirement	Aug. 1, 2013	-7.14*	0.0338*	0.0246	
Euro Area					
Announcement of the Volcker Rule in the United States	Jan. 21, 2010	12.10***	-0.0258***	-0.0230***	
Commission Proposal for Bank Recovery and Resolution Directive	June 6, 2012	-4.73*	-0.0205***	-0.0123***	
Commission Proposal for Deposit Guarantee Scheme	July 12, 2012	11.25**	0.0425***	0.0234***	
Eurogroup's approval for Spanish bank recapitalization	July 20, 2012	2.65	-0.0440***	-0.0438***	
Commission Proposal for Single Resolution Mechanism	July 10, 2013	-0.42	-0.0038	-0.0034	
E.U. statutory bail-in requirement	Aug. 1, 2013	-15.29***	0.0309**	0.0318**	
Switzerland					
Appointment of the "too-big-to-fail commission"	Nov. 4, 2009	1.17	0.0392	0.0184	
Announcement of the Volcker Rule in the United States	Jan. 21, 2010	11.10*	-0.0119**	-0.0087**	
Press conference on preliminary too-big-to-fail report	Apr. 22, 2010	23.69	-0.0301	-0.0152	
Press conference presenting final report on too-big-to-fail	Oct. 4, 2010	-6.85*	0.0305*	0.0190*	
E.U. statutory bail-in requirement	Aug. 1, 2013	-2.63	0.0286*	0.0224	

Source: IMF staff estimates.

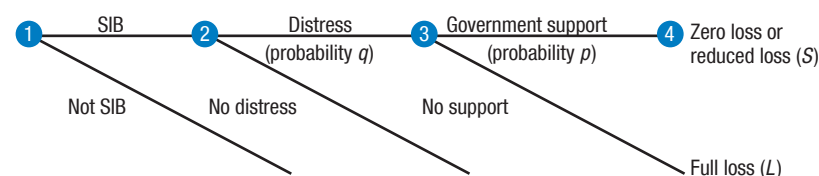
Note: ***, **, * = statistically significant at the 1, 5, and 10 percent levels. The event date is defined as the day of the policy event or the closest date in case the announcement was made on a date for which market data are not available. CDS spreads and abnormal returns in the constant mean model are estimated based on a two-week window prior to the event. The market model is estimated on a six-month sample period before the event. Since G-SIBs generally make up a large share of overall stock indices, a nonfinancial index or an industrial index is used (when the nonfinancial index is not available). Note that the estimates from the market model should be considered as a lower bound of the effects of the policy announcements as policy initiatives likely have some impact on nonfinancial corporates through the credit channel. CDS = credit default swap; E.U. = European Union; G-SIB = global systemically important bank.

However, measures to limit the size and scope of banks also entail costs. First, the empirical evidence supports (albeit weakly) the existence of economies of scale and scope in the banking industry (see Box 3.2). Market liquidity, efficiency, and risk management capacity are likely to decline when banks' activities are curtailed. Second, restrictions on the activities of banks may create monopolistic rents with an adverse effect on economic growth. Furthermore, the implementation of restrictions on bank size and scope poses substantial policy challenges. In particular, risks may migrate to less regulated activities. Finally, the fact that many smaller banks were bailed out during the recent crisis suggests that size restrictions are not a panacea.

Strengthening the resilience of SIBs remains a key strategy to enhance financial stability, and it has been central to international policy initiatives to tackle the TITF problem. The Basel III reform package increased

the quantity and quality of capital as well as the liquidity of banks, thereby making them more solid. In addition, the systemically important financial institutions (SIFIs) framework introduced additional capital requirements for SIBs, with a surcharge for G-SIBs that ranges from 1 percent to 3.5 percent of risk-weighted assets, depending on their degree of systemic importance. Several countries, including Singapore and Switzerland, have adopted tougher capital requirements, and the United States has announced a more stringent leverage ratio for large banks. The initiatives on the regulatory side are complemented by efforts to enhance the effectiveness and intensity of supervision of SIBs (Box 3.5).

Completely excluding the possibility of government support for SIBs may be neither credible nor always socially desirable. Despite all efforts to limit the number of SIBs and to prevent them from becoming

Figure 3.13. Event Tree of Government Policies to Deal with Systemically Important Banks

Source: IMF staff.

Note: SIB = systemically important bank.

Table 3.3. Summary of Policy Measures

Policy Measure (at key nodes in Figure 3.13)	Expected Effects	Risks/Issues
Structural measures: size or activity restrictions (node 1)	<ul style="list-style-type: none"> Prevents banks from becoming too important to fail. Facilitates an orderly resolution, hence reduces the probability of bailout and thereby the implicit subsidy. 	<ul style="list-style-type: none"> May reduce genuine economies of scale and scope and imply efficiency losses. Difficult to assess the “right” size. Risk of regulatory arbitrage. Risks can migrate to less regulated activities.
Increase loss-absorption capacity (node 2)	<ul style="list-style-type: none"> Reduces the probability of distress. Reduces incentives to become systemically important. Reduces the implicit subsidy. 	<ul style="list-style-type: none"> Risk of regulatory arbitrage. Risks can migrate to less regulated activities (shadow banking). Difficult to calibrate the required capital buffers.
Enhance supervision of systemically important banks (node 2)	<ul style="list-style-type: none"> Reduces the probability of distress. 	<ul style="list-style-type: none"> Limited effect on the implicit subsidy. Does not solve the too-important-to-fail issue.
Enhance transparency and disclosure requirements (node 3)	<ul style="list-style-type: none"> Reduces unnecessary bailouts, as everyone can better assess the soundness of a bank and the systemic implications of its failure. 	<ul style="list-style-type: none"> Limited effect on the implicit subsidy.
Increase bail-in powers (node 4)	<ul style="list-style-type: none"> Facilitates resolution. Reduces the cost of bailout if one is needed. Offsets part or all of the implicit subsidy. 	<ul style="list-style-type: none"> Needs to be accompanied by progress on transparency and information-sharing. Risk of uncoordinated national initiatives.
Bank contribution to resolution funds (node 4)	<ul style="list-style-type: none"> Offsets part or all of the implicit subsidy. If well designed (for example, a progressive levy), reduces banks’ incentives to become systemically important. Having such funds available increases the willingness of authorities to engage in resolution, in turn, reducing the likelihood of bailout. 	<ul style="list-style-type: none"> Regulatory arbitrage in the absence of international coordination. Needs a levy high enough to fully offset the subsidy.

Source: IMF staff.

distressed, governments cannot prepare for all scenarios. In some cases, allowing a SIB to fail in disorderly fashion could impose large costs on its customers, other banks, and the economy in general. Moreover, in some circumstances, a public recapitalization of SIBs may be an effective way to alleviate the problem of debt overhang, as weak banks may not lend to profitable projects.²⁸ For such reasons, governments will

have trouble convincing creditors of SIBs, ex ante, that they will not be bailed out in case of failure.²⁹

Policies focusing on improving disclosure and transparency requirements of banks can help to reduce the probability of government support. Better information mitigates uncertainties about the quality of banks’ assets during crises. The recent crisis showed that when they lack precise information about which banks are

²⁸See Myers (1977) and Chapter 2 of the October 2013 GFSR.

²⁹This is known in the academic literature as the “time-inconsistency” problem, which refers to the fact that promises, even in the form of legislation, can be reversed in the future when they become inconvenient (Stern and Feldman, 2004; and Chari and Kehoe, 2013).

Box 3.5. Recent Policy Initiatives Addressing the Too-Important-to-Fail Issue

This box summarizes the recent policy initiatives taken by governments to address the too-important-to-fail issue.

Global initiatives to address the too-important-to-fail issue have been coordinated by the Financial Stability Board (FSB, 2010). The overarching policy framework for global systemically important financial institutions (G-SIFIs) is organized along four pillars: (1) identification, (2) higher loss absorbency capacity, (3) more intense supervision, and (4) improved resolvability. While some of these policies are well advanced—for example, the identification of global systemically important banks (G-SIBs) and related capital surcharges—others are progressing at a slower pace. In particular, the slow implementation of resolution frameworks in line with the FSB’s *Key Attributes of Effective Resolution Regimes* reflects legal and operational complexities and challenges. Similar frameworks are being designed for domestic systemically important banks (D-SIBs).

To lower the probability that a G-SIB or a D-SIB will become distressed, capital buffers have been raised. More specifically, minimum regulatory capital requirements are to be supplemented by capital surcharges. The identification methodology devised by the Basel Committee on Banking Supervision (BCBS) produces yearly updates of the G-SIBs, to which capital surcharges from 1 to 3.5 percent are applied on top of the Basel III requirements (that is, a 7 percent level of common equity and a 10.5 percent level minimum capital requirement, including in both cases a capital conservation buffer). Some major countries have introduced even stricter regimes than Basel III. For example, in June 2013, the United States announced a version of the leverage ratio requirement that is stricter than the Basel III level of 3 percent: 5 percent for large bank holding companies and 6 percent for their Federal Deposit Insurance Corporation–insured subsidiaries. Switzerland asks for SIBs to maintain a total capital adequacy ratio of up to 19 percent, of which 10 percent needs to be common equity, while the rest has to be covered by contingent convertible capital instruments. Australia, Canada, and Singapore, among the countries that have already adopted a comprehensive D-SIB framework so far, also require major banks to maintain common equity ratios 1 percent higher (2 percent higher for Singapore) than those required by Basel III.

The initiatives on the regulatory side are complemented by efforts to reinforce the intensity and

effectiveness of supervision. In the past few months, the FSB has provided guidance on the interaction between supervisors and financial institutions. A thorough investigation of the roots of persisting weaknesses in supervisory practices (specifically in terms of supervisory independence and resources) has been launched in collaboration with the IMF, drawing from the recent experience of the IMF and the World Bank with the Financial Sector Assessment Program. The revised Joint Forum Principles for the Supervision of Financial Conglomerates (2012) also aim at reinforcing the supervisory approaches to mixed financial groups in a way that captures the full spectrum of groupwide activities and risks, including all risks from entities within the group (whether regulated or unregulated) that may have a significant impact on the financial position of the group.¹

Reforms have also been directed toward reducing the need for a bailout in case of distress. Several policies have been pursued to lower counterparty risks, for example, through the centralization of large shares of over-the-counter (OTC) derivative transactions at central counterparties (CCPs) and through margin requirements and increased capital charges on non-centralized OTC transactions. In addition, transparency and disclosure requirements are further enhanced to mitigate any uncertainties on asset quality and counterparty risks (for example, by the U.S. Office of Financial Research). At the international level, the new proposed framework for measuring and controlling large exposures affects SIBs indirectly, by establishing “hard” (that is, Pillar 1) limits constraining the large exposures of all banks, and directly, by proposing a tighter limit for inter-G-SIB exposures.

Resolution and recovery plans have been established to reduce the cost of bailouts, potentially leading to a lower probability of such events. Significant improvements of the resolution powers and tools have been implemented in Australia, Canada, France, Germany, Japan, the Netherlands, Spain, Switzerland, the United Kingdom, and the United States. Bail-in powers have been introduced in France, Portugal, Slovenia,

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¹The Joint Forum was established in 1996 under the aegis of the BCBS, the International Organization of Securities Commissions (IOSCO), and the International Association of Insurance Supervisors (IAIS) to deal with issues common to the banking, securities, and insurance sectors, including the regulation of financial conglomerates.

Box 3.5 (continued)

Switzerland, and the United Kingdom, while other countries such as Canada are currently designing the relevant frameworks. For U.S. banks, under the single-point-of-entry approach envisaged in the Dodd-Frank Act, a government-supported bridge bank would swiftly replace the distressed bank holding companies, while keeping intact operational subsidiaries (such as a deposit-taking bank or a brokerage firm) (Tarullo, 2013; Dudley, 2013). The agreed European Union's Bank Recovery and Resolution Directive would also provide for a bail-in tool, while new state aid rules require that junior creditors be bailed in before exceptional government stabilization tools are used. To prefund the bailout costs and to lower banks' incentives to become too large, several European countries have adopted bank levies on liabilities.

Progress continues on making the global resolution framework for G-SIBs operational, albeit at a slower pace. Crisis management groups are operational for all G-SIBs and outlined in the resolution strategies. However, the introduction of institution-specific cooperation arrangements is proving more difficult, as many countries need to remove legal constraints to information-sharing with foreign authorities, and as there are significant operational complexities. These

stem from wide cross-country variations in legal and organizational requirements, operating models, and funding structures. A key challenge is to ensure that the adequacy of the loss-absorbing capacity (which may take the form of equity, subordinated debt, senior unsecured debt, and other unsecured uninsured liabilities) is conducive to orderly resolution (FSB, 2013a).

Structural measures to limit bank activities have so far been pursued individually by a few major countries. In the United States, the Volcker Rule in the Dodd-Frank Act prevents deposit-taking institutions and their group firms from engaging in proprietary trading, with a few exceptions such as for market-making purposes. The recent E.U. Commission proposal, which is a modified version of the recommendations by the E.U. expert group (the Liikanen group), also seeks to prevent deposit-taking institutions and any entity within the same financial group from engaging in proprietary trading except for market-making activities. The central recommendation by the Vickers Commission in the United Kingdom allows deposit-taking institutions to conduct only simple operations and requires most of the investment banking activities to be handled separately, although possibly within the same group.

in need of support, governments sometimes need to provide support to all SIBs, even fundamentally sound ones (Landier and Ueda, 2009). Also, without information on counterparty exposures, governments tend to assume the worst-case scenario and end up rescuing some institutions whose failure would not have triggered a systemic crisis. To be useful, disclosures and information releases need to be granular, consistent, and comparable across SIBs.

Effective recovery and resolution plans are crucial to reduce the cost of bailouts and could also bring down the probability of support. Having SIBs prepare individual, tailor-made recovery and resolution plans, such as those being implemented in the United States and in Europe, reduces uncertainties about what creditors, depositors, and other economic agents can expect in the case of failure. These plans ensure that financial and operational structures of SIBs are periodically reassessed to allow for a potential resolution with the least impact on functions that are critical for financial stability (see Box 3.5). The aim of these plans (follow-

ing, for example, the single-point-of-entry approach in the United States and the bail-in requirement in the European Union) is to shift the burden of resolving banks largely to the private sector.³⁰

Bank levies can be collected to explicitly or implicitly fund bank resolution and also, if linked to liabilities, to lower banks' incentives to become too large. Given the difficulty of completely ruling out bailouts in practice, some level of government protection, and thus some positive subsidy, may be unavoidable. Bank levies can allow governments to recoup part of it. Levies may also help reduce the incentives for banks to seek TITF status and lower the negative externality associated with it, especially if they are progressive—

³⁰However, the bail-in efforts need to establish an appropriate balance between the rights of private stakeholders and the public policy interest of preserving financial stability. At the same time, the increased issuances of covered bonds, which create claims that are senior even to those of insured depositors, threaten the effectiveness of the bail-in approach (see Chapter 3 of the October 2013 GFSR; and Zhou and others, 2012).

for example, if they increase with asset size or liabilities. In line with the IMF's recommendations (IMF, 2010), bank levies were adopted by several European countries, including Germany, Sweden, and the United Kingdom since 2008 (Gottlieb, Impavido, and Ivanova, 2012), and those appeared to help reduce bank leverage (Devereux, Johannesen, and Vella, 2013).

The Way Forward

The implicit funding subsidies estimated in this chapter show a high level of expected government support but also reflect the sounder balance sheets of SIBs since the onset of the crisis. Given the increase in the concentration of banks in many countries, it would not have been surprising if the implied TITF subsidy had gone up. Instead, the subsidy went down from its peak and is now back to its precrisis level, except perhaps for the euro area. However, the estimates from the ratings-based approach suggest that the level of government protection for a distressed SIB is still high everywhere, a finding consistent with the time-inconsistency problem associated with eschewing bailouts. The subsidy estimate for the average SIB has gone down, especially in the United States. This at least partially reflects tighter regulations and more effective supervision.

The implication is that policies should focus mainly on further reducing the probability of distress at TITF institutions and possibly on prefunding or recouping taxpayers' costs from such banks. The estimates suggest that preventive measures have worked well in lowering the subsidy value; therefore, strengthening capital buffers or, more generally, increasing the loss absorbency of banks, including through provisioning, could go far toward reducing the probability of distress. Dynamic provisioning and countercyclical capital buffers could also enhance the resilience of SIBs.

The subsidy estimates could be used to calibrate the capital surcharge that would effectively offset the funding cost advantage of SIBs and reduce the probability of distress. An example of such a calibration is provided in Box 3.6. The exercise relies on estimated relationships among banks' funding costs, market capitalization, and the regulatory capital level; these are likely to vary over time, particularly during episodes of financial turmoil, and make the calibration particularly

challenging. An alternative approach relates capital surcharges to a bank's contribution to systemic risk (Chan-Lau, 2010). However, this presupposes that the contribution to systemic risk is relatively stable.

Loss allocation to banks through resolution funds can help reduce the perceived unfair funding cost advantage of SIBs. In a simple calibration for an ex-ante funded resolution fund, an assumption that a crisis occurs only once every 30 years implies a contribution by SIBs of around 15–30 basis points of their liabilities (net of equity and deposits), in the absence of other reforms in other areas.³¹ Compared to this estimate, the size of the levies currently in place appears small.

International coordination is essential to prevent regulatory arbitrage and make cross-border resolution effective. International coordination efforts have already allowed for the identification of G-SIBs and for an agreement on related capital surcharges. However, in other areas, such as the implementation of resolution frameworks or structural reforms, countries have adopted policies without much coordination. These solo initiatives, even though individually justifiable, could add unnecessary complexity to the regulation and consolidated supervision of large cross-border institutions and encourage new forms of regulatory arbitrage. In the case of resolving cross-border banks, local initiatives may well end up being mutually destructive. For example, attempts to ring-fence the assets of failed internationally active banks are considered a factor behind the increasing financial fragmentation in Europe (see the October 2013 GFSR). Also, the legal systems in some countries are not fully compatible with the single-point-of-entry approach of the Dodd-Frank Act. Further progress on information sharing for resolution purposes and the harmonization and improvement of resolution regimes are necessary to solve the TITF problem.³²

³¹The calculation assumes a subsidy of 60–100 basis points for three of the 30 years and a subsidy of 10–20 basis points for the other 27 years. More sophisticated approaches could also be devised, for example, by conditioning the levy on banks' capital ratios.

³²For a more comprehensive discussion of the challenges in improving resolution regimes, see Claessens, Herring, and Schoemaker (2010).

Box 3.6. Higher Loss Absorbency for Systemically Important Banks in Australia

This box presents the results of the calibration exercise of capital requirements for the largest domestic systemically important banks (D-SIBs) conducted during the 2012 Financial Sector Assessment Program for Australia.

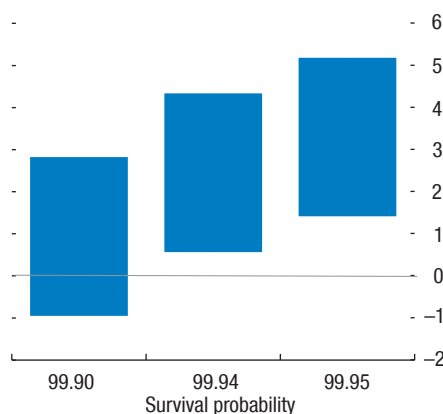
The contingent claims analysis (CCA) approach discussed in this chapter was used by IMF staff in the 2012 Financial Sector Assessment Program for Australia (IMF, 2012) to estimate the additional capital required for the four largest D-SIBs. A higher minimum capital requirement for SIBs, in addition to heightened supervision and a credible resolution framework, mitigates systemic risk by providing higher loss absorbency that reduces the likelihood of a SIB becoming insolvent. How much additional capital is necessary depends on the acceptable probability of default of the SIBs, and this may be estimated by using the CCA approach described in Annex 3.1. The Australian assessment used the expected default frequency obtained from Moody's CreditEdge as an estimate of default probabilities.

To determine a desired probability of survival, the key is to find a robust relationship between the estimated default probability and the market-capitalization-to-assets ratio. A power function was found to be a relatively robust fit for the top four Australian banks based on daily data from June 2011 to June 2012.

The market value of assets and regulatory risk-weighted assets should coincide if the supervisor's view of risk weights is close to the market's view. Furthermore, abstracting from the discount offered at the time of additional equity issuance, one assumes that additional capital can be raised at the current market value of equity. With these two assumptions, the marginal change in the market-capitalization-to-assets ratio and in the Tier 1 regulatory-capital ratio can be deemed equal for the additional equity raised. For Australia, the reported Tier 1 capital ratio and

The authors of this box are Luc Everaert and Xiaoyong Wu.

Figure 3.6.1. Additional Tier 1 Capital Requirements for Systemic Banks
(Percent of risk-weighted assets)



Sources: Moody's CreditEdge; and IMF staff estimates.

the market-capitalization-to-assets ratio were very similar at 10.1 percent and 9.4 percent, respectively, in 2011; the ratio between the two was used to adjust the Tier 1 capital equivalent of the market capital requirements.

This exercise suggests, as an illustration, that maintaining a one-year-ahead probability of 99.9 percent of not defaulting on any payment would require the four major banks to hold additional Tier 1 capital ranging from -0.9 to 2.8 percent of risk-weighted assets (RWA) at the end of 2011. If the goal were to achieve a 99.95 percent probability of no default, additional Tier 1 capital ranging from 1.4 to 5.2 percent of RWA would be necessary. This would require all large banks to fund themselves with more capital—some by a small amount, others by a more substantial amount. The actual amount of loss absorbency required would be determined by the regulator's risk tolerance.

Annex 3.1. The Contingent Claims Analysis Approach

In the risk-adjusted balance sheets used for contingent claims analysis (CCA), the total market value of a bank's assets, A , is equal to the sum of its equity market value, E , and its risky debt value, D . Equity and debt derive their value from the unobserved asset value. The value of risky debt is equal to the default-free debt minus the expected loss due to default. The asset value is stochastic and may fall below the value of outstanding liabilities that constitutes a default barrier B , at horizon T . As pointed out by Merton (1974), the value of equity can be seen as the value of an implicit call option on the assets, with an exercise price equal to the default barrier B . The expected loss due to default can be calculated as

the value of an implicit put option on the assets, A , with an exercise price equal to B . The value of the implicit put option will be called the expected loss value (ELV).

The calibration of the model uses the value of equity, the volatility of equity, and the distress barrier as inputs into two equations in order to calculate the implied asset value A and the implied asset volatility σ_A .³³ Equity and equity volatility reflect forecasts of market participants and provide forward-looking information. The implied asset value and volatility can then be used with the other parameters to calculate risk indicators such as the spreads, the ELV, default probabilities, and other risk indicators. The fair-value credit default swap (FVCDS) is calculated using a loss given default (LGD) that is the average LGD for the

The author of this annex is Dale Gray.

³³See Merton (1974); Gray, Merton, and Bodie (2008); and Gray and Malone (2008 and 2012).

Table 3.4. Sample of Systemically Important Banks (as of 2012)

Bank Names		
ABN AMRO Holding N.V.	Credit Suisse Group*	National Australia Bank Limited
Allied Irish Banks PLC	Criteria CaixaCorp, S.A.	National Bank of Abu Dhabi
Australia and New Zealand Banking Group	Danske Bank A/S	National Bank of Greece, S.A.
Banca Monte dei Paschi di Siena S.p.A.	DBS Group Holdings Ltd.	Natixis*
Banco Bilbao Vizcaya Argentaria S.A.*	Depfa Bank PLC	Nordea Bank AB*
Banco BPI, S.A.	Deutsche Bank AG*	OKO Bank PLC
Banco Bradesco S.A.	Dexia**	Oversea-Chinese Banking Corporation
Banco Comercial Portugues, S.A.	DNB ASA	Public Bank Berhad (The)
Banco de Chile	Emirates NBD PJSC	Raiffeisen International Bank
Banco de Oro Universal Bank	Erste Bank Der Osterreichischen Sparkassen AG	Riyad Bank
Banco do Brasil S.A.	Espirito Santo Financial Group S.A.	Royal Bank of Canada
Banco Espirito S.A. into S.A.	First Gulf Bank PJSC	Royal Bank of Scotland Group PLC*
Banco Latinoamericano De Exportaciones, S.A.	Glitnir Banki hf	Samba Financial Group
Bancolombia S.A.	Goldman Sachs Group Inc.*	Santander Central Hispano S.A.*
Bangkok Bank Public Company Limited	Hang Seng Bank Limited	Sberbank Rosseii
Bank Austria	HSBC Holdings PLC*	Siam Commercial Bank Public Co Ltd
Bank Hapoalim B.M.	ICICI Bank Limited	Skandinaviska Enskilda Banken
Bank of America Corp.*	ING Groep N.V.*	Société Générale S.A.*
Bank of Baroda	Intesa Sanpaolo S.p.A.	Standard Chartered PLC*
Bank of China Limited*	JPMorgan Chase*	State Bank of India
Bank of East Asia Limited (The)	JSC VTB Bank	State Street Corp.*
Bank of Ireland	Jyske Bank A/S	Sumitomo Mitsui Financial Group Inc.*
Bank of New York *	Kaupthing Bank HF	Svenska Handelsbanken AB
Bank of Nova Scotia	KBC Group NV	Sydbank A.S.
Barclays PLC*	Krung Thai Bank Public Company Ltd.	Toronto Dominion Bank
Bayerische Hypo- und Vereinsbank AG	Landsbanki Islands HF	Türkiye Garanti Bankası A.S.
BNP Paribas*	Lloyds TSB Group PLC**	Türkiye İş Bankası A.S.
BRE Bank S.A.	Malayan Banking Berhad	UBS AG*
Cathay Financial Holding Company Ltd.	Mega Financial Holding Company	Unicredito Italiano S.p.A.*
China Construction Bank Corp	Metropolitan Bank and Trust Company	United Overseas Bank Limited
Citigroup Inc.*	Mitsubishi UFJ Financial Group*	Wells Fargo & Co.*
Commercial Bank of Qatar	Mizuho Financial Group*	Westpac Banking Corporation
Commerzbank AG**	Morgan Stanley*	
Crédit Agricole S.A.*	Moscow Municipal Bank	

Source: IMF staff.

Note: Systemically important banks are defined as the G-SIBs identified by the Financial Stability Board plus the three largest banks by asset size in each country if these are not G-SIBs, subject to data availability.

* G-SIBs as identified by the Financial Stability Board in 2013. When the group is not listed, the largest quoted entity is used.

** Banks previously identified by the Financial Stability Board as G-SIBs.

banking sector as a whole. This chapter uses FVCDS computed by Moody's CreditEdge.

During the recent crisis the estimated FVCDS was frequently observed to be higher than the observed CDS of banks, presumably due to the depressing effect of implicit and explicit guarantees under the plausible assumption that equity holders do not benefit from such guarantees, but debt holders do. The relationship between the credit spread and the ELV is:

$$spread = -\frac{1}{T} \ln\left(1 - \frac{ELV}{Be^{-rT}}\right), \quad (3.1)$$

where r denotes the risk-free rate. The difference between the ELV derived from the CCA (using equity information) and the ELVCDS backed out from observed CDS spreads is the market-implied government guarantee (see Gray and others, 2013, Appendix 1, for details).

Annex 3.2. The Ratings-Based Approach

The overall credit rating of banks is explained by their fundamentals, reflected in the standalone rating, and by the expectation of support either by the government or by the parent firm, if any. Fitch Ratings discloses both components. The overall rating, the Long-Term Credit Rating (LT), ranges from AAA (best rating) to D. LT Ratings are assigned numerical values from 1 to 16 in the regression below, with 16 denoting the highest rating. For the standalone rating, until 2011, Fitch used the Individual Ratings (INDV), whose scale runs from A to E with gradations such as A/B or B/C. These are converted into numerical values from 1 to 11, with 11 denoting the highest rating. Since 2011, Fitch has produced a Viability Rating whose scale is the same as for the overall rating (Fitch Ratings, 2011). As for the support expectation, Fitch provides a Support Rating (SUPP) with values running from 1 to 5, with 1 indicating the highest support probability. For consistency with other numerical values, the order is inverted in the regression. Lastly, Fitch also discloses a Support Rating Floor, which is given whenever the support is expected to come from the government. The absence of Support Rating Floor implies that the support comes from the parent company.

Because ratings are categorical variables, an ordered probit estimation is used to estimate the effect of government support on the probability for a given bank of getting a certain rating (the so-called rating uplift). Fundamental variables (FUNDA)—the common equity ratio and the return on assets—are used in the benchmark regression to control for a bank's standalone strength without relying on the assessment of the credit rating agency. Balance sheet data for listed firms and major nonlisted firms are obtained from Bankscope. Because the data are available only for listed and major nonlisted firms, most subsidiaries are excluded from the sample. The sovereign rating (SOVR) of the country where the bank is located is included as a control for the macroeconomic environment and the ability of the government to provide support in case of distress beyond Fitch's own evaluation of the support rating.

The probability for bank i in country k to receive the overall rating x is expressed as:

$$\begin{aligned} \text{prob}(LT_{ik} = x) = & F(\alpha \text{SUPP}_{ik} + \beta \text{FUNDA}_{ik} \\ & + \gamma \text{SOVR}_{ik} \leq \text{cut}_x) \\ & - F(\alpha \text{SUPP}_{ik} + \beta \text{FUNDA}_{ik} \\ & + \gamma \text{SOVR}_{ik} \leq \text{cut}_{x-1}), \end{aligned} \quad (3.2)$$

The author of this annex is Kenichi Ueda.

for LT rating x between 2 (B) and 15 (AA+), with F denoting the normal cumulative density. The coefficient of interest is α on the Support Rating. This procedure provides the coefficient estimate as well as each *cut*, which determines the threshold below which a bank obtains a specific rating. For the lowest rating 1 (B⁻) in the sample, it is

$$\text{prob}(LT_{ik} = 1) = F(\alpha \text{SUPP}_{ik} + \beta \text{FUNDA}_{ik} + \gamma \text{SOVR}_{ik} \leq \text{cut}_1), \quad (3.3)$$

and for the highest rating 16 (AAA), it is

$$\text{prob}(LT_{ik} = 16) = 1 - F(\alpha \text{SUPP}_{ik} + \beta \text{FUNDA}_{ik} + \gamma \text{SOVR}_{ik} \leq \text{cut}_{15}). \quad (3.4)$$

Table 3.5 shows the results from the benchmark regression with the average cut, which is simply the highest cut estimate minus the lowest cut estimate divided by the total number of cuts. It also provides the unit impact of the support rating on the overall rating. Impact estimates slightly increased in 2008–09 but have declined since. The table shows results for an estimation using all countries in the sample. As a robustness check, the same estimation is carried out using different country subsamples: banks in G20 countries, banks in advanced countries, banks in developing countries, U.S. banks, and banks in the European Union. The results are similar, except for banks in developing countries (Table 3.6).

Table 3.6 also reports the estimates for the unit impact of government support on the overall rating based on the regression using the standalone rating by Fitch, instead of balance sheet information, as a proxy for banks' fundamental strength. The estimated impacts are slightly lower, in particular in the last three years. These results are used to draw the panels in Figures 3.10 and 3.11 in the main text, as they produce the most conservative estimates for the subsidy values and because balance sheet data, contrary to rating information, are not yet available for 2013.

The average support for each sample of banks is multiplied by the unit impact of the support to yield the average rating uplift. The rating uplift is then translated into a funding cost advantage based on Soussa's (2000) estimate of the average annualized interest rate differentials for different credit ratings over 1920–99. According to Soussa's table, when a bank issues a five-year bond, a three-notch rating increase translates into a funding cost advantage of 5–128 basis points, depending on the riskiness of the institution:

5–8 basis points for an A rated bank, 23 basis points for a BBB rated bank, 61 basis points for a BB rated bank, and 128 basis points for a B rated bank. The structural subsidy values for banks just below investment grade correspond to the case for a BB rated bank before support. The subsidy values for the average bank

in each year are computed by averaging the funding cost advantage across banks in the sample in each year.³⁴

³⁴Although the database is different, the sample of SIBs almost coincides with the one used in the CCA approach (Table 3.4).

Table 3.5. Benchmark Credit-Rating Estimation Results to Explain the Overall Ratings

	2005	2006	2007	2008	2009	2010	2011	2012
Support rating	0.6200***	0.5967***	0.6413***	0.6637***	0.6646***	0.6435***	0.6192***	0.6190***
Sovereign rating	0.3672***	0.3317***	0.3329***	0.3552***	0.2983***	0.2600***	0.2510***	0.2616***
Common equity ratio	-2.5824	-1.8227**	-1.1043	-1.5912*	0.7913	-0.7454	-0.1346	-0.8212
Return on asset	0.2049**	-0.0447	-0.0210	0.1223**	0.1403***	0.0663**	0.1739***	0.0947***
Average cut ¹	0.582	0.584	0.584	0.618	0.560	0.545	0.530	0.585
Observations ²	172	286	307	285	281	331	378	384
R squared	0.281	0.25	0.261	0.285	0.267	0.246	0.233	0.244
Unit rating uplift from "support" on "overall rating" ³	1.06	1.02	1.10	1.07	1.19	1.18	1.17	1.06

Sources: Bankscope; Fitch Ratings; and IMF staff estimates.

Note: ***, **, * = statistically significant at the 1, 5, and 10 percent levels. Ordered probit estimation is conducted. The dependent variable is the overall long-term rating. Balance sheet information is from Bankscope database, which covers most listed banks and other major banks.

¹The estimation produces a constant term for each rating level, called cut1 to cut15. The average cut is calculated by the difference between the top cut and the bottom cut, divided by the total number of cuts. The average cut implies how many "points" are necessary to make the cut for the next rating level.

²The sample includes all banks with support expectation from the government. For major financial groups, the sample includes either the core banking entity or the holding company, depending on available data.

³The rating uplift is obtained as the coefficient for support the rating divided by the average cut.

Table 3.6. Unit Rating Uplift: Robustness for Different Samples

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Balance sheet info-based controls ¹									
All countries	1.06	1.02	1.10	1.07	1.19	1.18	1.17	1.06	n.a.
All countries, full sample ²	0.92	0.95	1.04	1.06	1.30	1.25	1.22	1.06	n.a.
G20 members	1.01	1.07	1.16	1.03	1.22	1.24	1.19	1.06	n.a.
Advanced economies	0.97	0.99	1.02	0.97	1.14	1.08	1.00	1.03	n.a.
Emerging market economies	1.84	1.68	1.72	1.71	1.77	1.59	1.55	1.48	n.a.
United States	0.98	0.92	1.09	0.74	1.54	1.72	1.59	1.06	n.a.
European Union	1.23	1.27	1.23	1.21	1.44	1.02	1.07	1.08	n.a.
Memorandum: Rating info only, all countries	0.94	0.91	0.88	0.94	1.16	1.04	0.87	0.80	0.75

Sources: Bankscope; Fitch Ratings; and IMF staff estimates.

¹For each regression, the sample corresponds to the one specified in the first column. Except for the memorandum item, only banks with balance sheet information are used. For major financial groups, the sample includes either the core banking entity or the holding company, depending on available data.

²Except for this full sample case, samples include only banks with support expectation from the government. The full sample results might be biased by the inclusion of parent-subsidiary pairs.

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