

SUMMARY

Funding structures matter for financial stability. In particular, overreliance by some banks on certain types of wholesale funding—especially by U.S. and European banks—contributed to the global financial crisis. Most banks have recently made their funding structures more resilient by raising their capital adequacy ratios and reducing their dependence on short-term wholesale funding. However, some distressed banks remain vulnerable because their equity capital levels are inadequate and they are highly dependent on central bank funds.

This chapter examines how bank funding structures have changed over time—especially in the run-up to the crisis—and how these structures affect financial stability. The analysis considers banks in a number of advanced and emerging market economies and includes systemically important banks. The analysis shows that healthy banks rely more on equity and less on debt (especially short-term debt) and have more diversified funding structures with lower loan-to-deposit ratios. Adequate capital buffers reduce a bank's probability of default and support financial stability. Therefore, Basel III capital regulations that aim to raise the quantity and quality of capital should continue to be a mainstay of the reform efforts. Basel III liquidity regulations will also play a role by reducing banks' overreliance on short-term wholesale funding, which has proven detrimental to financial stability.

Current reform efforts are aimed at reducing financial instability, but there can be tension among some key regulatory reforms that affect bank funding structures. As this chapter shows, such tension can arise, on the one hand, from pressures to use more secured funding (thereby raising levels of asset encumbrance) as well as deposits and, on the other hand, from bank-resolution initiatives (including the introduction of bail-in powers and the prospects for additional depositor preference) that are designed to reduce the burden on taxpayers while also protecting depositors. A numerical example examines funding costs under various scenarios. The analysis suggests that the effects may not be large under current conditions but that they depend importantly on the share of protected creditors and the size of equity buffers.

Careful implementation of the reform efforts can help mitigate potential trade-offs so as to ensure that the financial stability benefits are realized. In particular, Basel III and over-the-counter (OTC) derivatives reforms should be implemented as planned. However, policymakers will want to monitor the increased demand for collateral (including from new liquidity standards and OTC derivatives reforms) to ensure that there are enough unencumbered assets to meaningfully attract senior unsecured creditors. Going forward, limits on asset encumbrance or minimum proportions of bail-in debt relative to assets may be required so that a sufficiently large proportion of unsecured debt is preserved to absorb losses when bank capital is exhausted as an important protection against future use of taxpayer funds. The introduction of such changes, however, will need to be mindful of funding market conditions to ensure that they are not introduced during periods of funding difficulties.

Introduction

The global financial crisis revealed the risks to financial stability arising from banks' reliance on certain types of wholesale funding.¹ Before the financial crisis, many U.S. and European banks relied on wholesale debt funding to expand asset growth. Since the crisis, these private market funds have diminished in size, whereas collateralized borrowing, including covered bond issuance and central bank funding, has risen (especially in Europe). Counterparty risk has prompted the growing use of secured funding, pushing up the share of assets pledged as collateral for liabilities (termed "asset encumbrance"). At the same time, new regulations are being proposed or implemented that aim to make financial systems safer (including Basel III capital and liquidity regulations and over-the-counter [OTC] derivatives reforms) and to improve bank resolution mechanisms (for example, bail-in powers and depositor preference). This chapter examines funding market developments and the implications of the reform efforts for bank funding structures and their costs.

Against this backdrop, this chapter examines the following questions:

- What determines bank funding structures, and how have they changed?
- How did funding structures relate to banks' stability in the run-up to the crisis? Have bank funding structures changed so as to improve financial stability since the crisis began?
- How will key regulatory initiatives affect bank funding structures? What are the potential tensions among the initiatives, if any?
- Considering the outcomes of various reforms, how will funding costs likely develop?

The analysis shows that banks have diverse, but slow-to-change, funding patterns. Larger banks in advanced economies, excluding Japan, rely more on wholesale funding, whereas those in Japan and most emerging market economies fund themselves primarily

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¹See Chapter 2 of the October 2010 *Global Financial Stability Report* (GFSR) for developments in bank funding markets during the global financial crisis. Berkmen and others (2012) and Chapter 4 of the October 2012 GFSR show that banks that funded themselves with nondeposit liabilities fared worse during the financial crisis, and their countries experienced weaker growth outcomes.

with deposits. Also, banks that face higher currency volatility, stronger regulatory frameworks, and stricter disclosure requirements rely less on wholesale funding.

Banks' funding structures affect their stability, and although most banks have improved their funding structures since the crisis began, distressed banks remain vulnerable. More equity and less debt (in particular less short-term debt), lower loan-to-deposit ratios, and more diversified funding structures improve banks' stability. Since the crisis began, banks around the world have raised their capital adequacy ratios, reduced wholesale funding, and in some cases raised more deposits, all of which have improved their stability. However, distressed banks' funding structures have not similarly improved, and they continue to be vulnerable.

There are potential tensions among some regulatory reforms, including regulations designed to increase resilience to short-term liquidity shocks, measures to improve crisis management, and proposals to facilitate bank resolutions without the use of taxpayer support. Increasing banks' equity capital, as intended by Basel III capital regulations, reduces the cost of any type of debt by increasing loss-absorbing buffers before any debt holders face losses, and Basel III liquidity regulations should help maintain liquidity buffers. Both measures should improve financial stability. However, continuing weakness in bank funding markets (particularly in Europe), OTC derivatives reforms, and some aspects of Basel III liquidity regulation may encumber more assets, thereby increasing unsecured bondholders' potential losses. Unsecured bondholders may also face larger losses if (1) a country introduces new depositor preferences for bank closures (in which case some or all retail depositors will be paid ahead of other unsecured creditors), and (2) the bondholders are bailed in when a bank is restructured (that is, they assume more of the losses than do creditors that cannot be bailed in). When the risk of losses rises (including from the fear of being bailed in), the costs of unsecured debt also rise because this class of investors will require higher returns (holding all else constant). To the extent that the possibility of bail-in removes the too-big-to-fail perception for systemically important institutions, some of the implicit funding subsidy that they have received may be removed, potentially raising overall funding costs to more appropriate levels. However, some banks may find it difficult to issue enough senior unsecured debt to ensure this market discipline role, and if holders of this class of debt are less tolerant when bank distress is imminent, then financial instability may ensue. Despite this proviso, overall, the introduction of bail-in powers alongside greater transpar-

ency is likely to make funding costs better reflect the risks of banking and hence enhance financial stability.

A numerical exercise shows that some funding structure configurations (including equity) and the order of creditor seniority can substantially alter the cost of debt—perhaps in unanticipated ways. Capitalization and the riskiness of bank assets have a quantitatively large effect on the cost of bank debt. The share of preferred deposits and liabilities exempted from being bailed in (including secured borrowing) is also an important driver of the cost of unsecured (bail-in) debt, which rises disproportionately more than increases in these other components in the funding structure.

There are two key policy messages from the analysis:

- Funding structures matter for financial stability because a healthy funding structure lowers the probability that a bank will fall into distress. Adequate capital buffers reduce the probability of default and, all else equal, improve the chances that depositors and debt holders are repaid their funds. Hence, Basel III capital regulations aimed at raising the quantity and quality of capital should continue to be the mainstay of the reform effort. The Basel III liquidity regulations will also play a role by reducing the use of short-term wholesale funding—a component of funding that the analysis shows to be detrimental to financial stability.

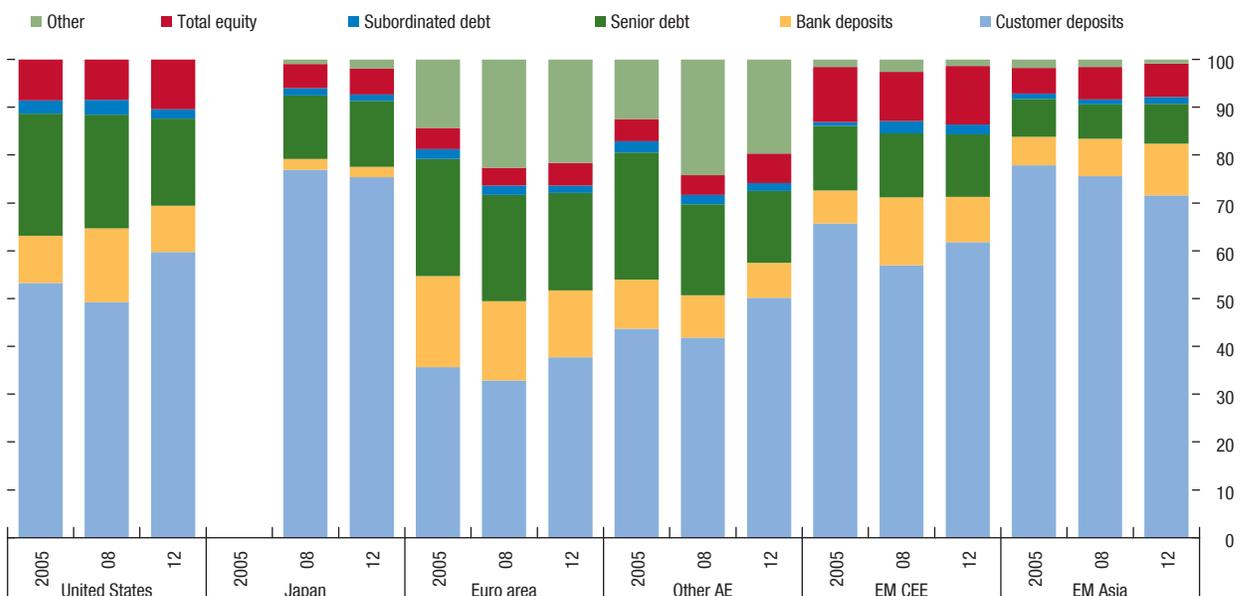
- Regulatory reforms can affect bank funding structures both positively and negatively, so, these reforms need to be calibrated carefully. Policymakers must be particularly watchful to ensure that the reforms—including OTC derivatives reforms—do not encourage banks to issue or hold certain types of securities that excessively encumber assets. Incentives arising from regulations that may lead to the overuse of secured funding can be contained by introducing a maximum proportion of encumbered assets. To reap the benefits of the resolution reforms, policymakers will need to ensure that the amount of bail-in debt is sufficient to induce these debt holders to exercise market discipline and thereby to encourage safer banking. Hence, a minimum bail-in requirement may be necessary.

Bank Funding Structures: Determinants and Recent Developments

What Determines Bank Funding Structures?

The empirical analysis shows that banks have very diverse funding structures and that, in general, these change only gradually. Modern banks use various forms of funding instruments other than deposits (Box 3.1). These vary substantially across banks and regions (Figures 3.1 and 3.2). Advanced economies, except Japan,

Figure 3.1. Banks' Liability Structures across Major Economies and Regions
(Percent)



Sources: Bank of Japan; SNL Financial; and IMF staff estimates.

Note: "Other" includes financial and accounting liabilities, such as derivatives liabilities, insurance liabilities, noncurrent liabilities, accounts payable and accrued expenses, deferred taxes and tax liabilities, and other provisions. Japan data for 2005 omitted due to data limitations. AE = advanced economies; CEE = central and eastern Europe; EM = emerging market economies. For region coverage, refer to Table 3.2.

Box 3.1. Typology of Bank Funding

Bank funding sources can be distinguished by investor type, instrument type, and priority (Figure 3.1.1).

Customer deposits are the main funding source for banks that have traditional deposit-taking and loan-making business models.

- Deposits payable at par and “on demand” carry the most liquidity risk because of their maturity mismatch with longer-term loans, and they could be subject to runs. However, in practice, retail deposits are relatively stable, particularly if covered by a credible deposit guarantee scheme.
- Other types of deposits can be less stable, including uninsured deposits, foreign currency deposits, deposits collected through Internet banking, and those collected from nonresidents, corporations, money market funds, and high-net-worth individuals.¹

Wholesale funds are often used for investments in financial assets, including those used in the bank’s proprietary trading.

- Assets secured as collateral (and thus “encumbered”) are designated for paying secured creditors first. Senior unsecured wholesale funds may rank equal to depositors or below depositors in countries with depositor preference.
- Short-term unsecured funds include some interbank loans, commercial paper (CP), and wholesale certificates of deposit (CDs). These funds can be volatile during

¹Uninsured deposits include those eligible for a deposit guarantee scheme, but exclude covered deposits (for example, retail deposits exceeding the maximum coverage) and ineligible deposits.

- times of distress. For example, the cost of interbank loans (for example, the London interbank offered rate) rose dramatically, and the issuance of CP and CDs dropped sharply following the Lehman Brothers failure.
- Short-term secured funds include repurchase agreements (repos), swaps, and asset-backed commercial paper. These were considered safe before the crisis, but suffered a run in its early stages. Reuse of collateral (rehypothecation) also contributed to increasing the interconnectedness among financial institutions that were using repos.
- Long-term funds include bonds and various forms of securitization (including covered bonds and private-label mortgage-backed securities). These instruments are less likely to cause immediate funding difficulties. *Capital*, as defined by Basel III, absorbs incurred losses before any other creditors (see BCBS, 2010a for details).
- Regulatory capital includes common equity and certain types of subordinated debt. The highest quality (that with the highest loss-absorbing capacity) is known as common equity Tier 1 (CET1) capital, which is mostly in the form of common equity. Certain types of subordinated debt, which are paid after other debt holders, also qualify as additional Tier 1 or Tier 2 capital, including contingent convertible debt (CoCos), preferred shares, and perpetual bonds.²

²Preferred shares are senior to common equity and usually carry no voting rights, but receive dividends before common equity. CoCos are bonds that would be converted into common equity when the regulatory capital ratio reaches a prespecified threshold. See Pazarbasioglu and others (2011) on the economic rationale for introducing CoCos. See Barclays (2013) for a list of existing CoCos and their structures.

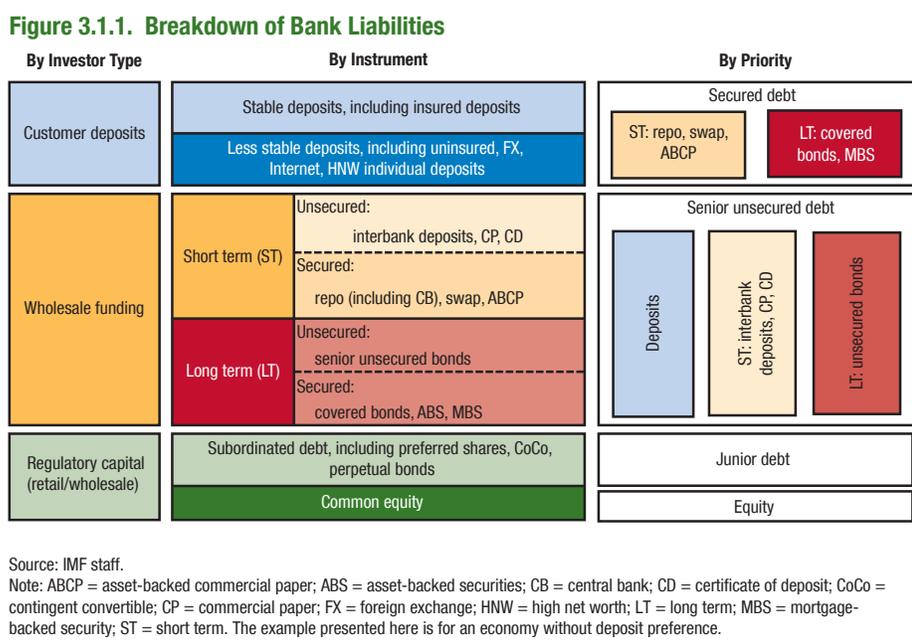
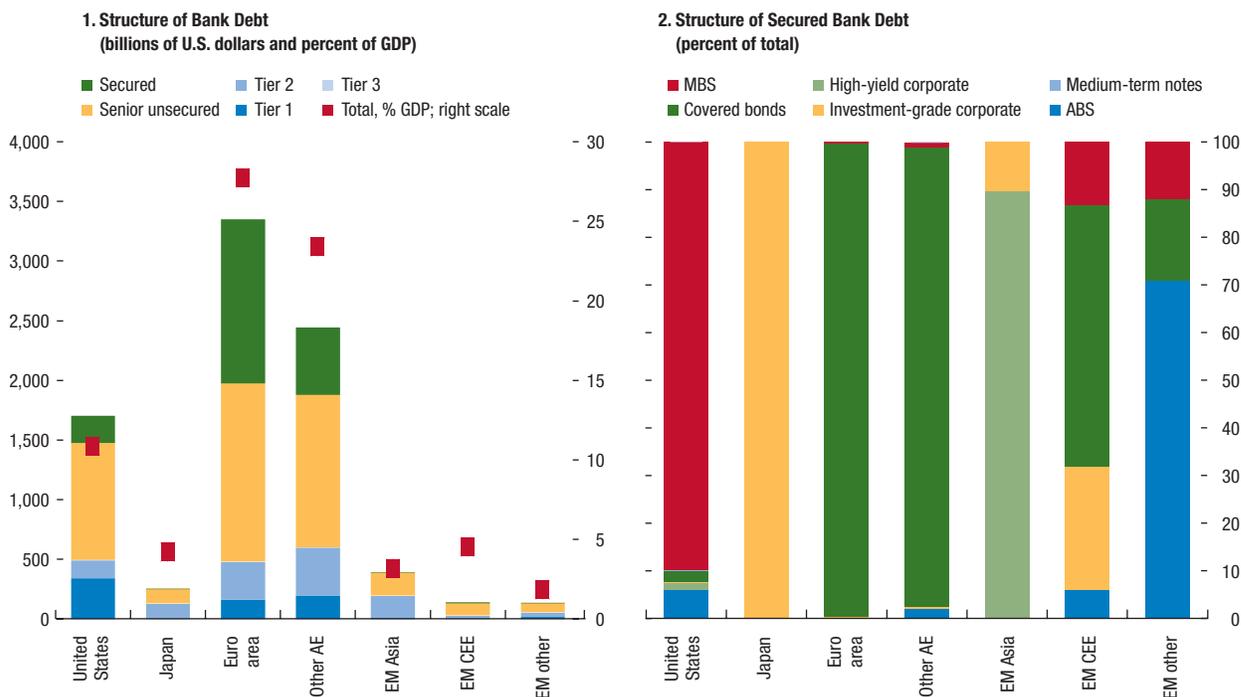


Figure 3.2. Banks' Long-Term Wholesale Funding across Major Economies and Regions: Outstanding as of July 31, 2013



Sources: Dealogic; IMF, World Economic Outlook database; and IMF staff calculations. Note: ABS = asset-backed securities; AE = advanced economies; CEE = central and eastern Europe; EM = emerging market economies; MBS = mortgage-backed securities.

typically rely more on wholesale funding; Japan, by contrast, has an ample retail deposit base. Even for wholesale funding, there is significant variation among banks, with a few (the 90th percentile) using a preponderance of noncore funding (debt as a proportion of equity and deposits—Figures 3.3 and 3.4). Banks in emerging market economies also fund themselves primarily with retail deposits and are much more homogeneous in their use of various funding instruments than advanced economy banks. European banks are the largest issuers of bank bonds, especially covered bonds, both in absolute terms and relative to GDP.² Despite some movements in non-core versus core funding instruments, on average, bank funding structures change only gradually over time.

To better understand how banks choose their funding structures and thus how they can be made more resilient, we examine the factors influencing these structures between 1990 and 2012. The composition of the liability structure (equity, nondeposit liabilities, and deposits) as well as the loan-to-deposit ratio (an

²U.S. banks in the SNL Financial sample include only deposit-taking institutions, thus excluding broker dealers and various shadow banks. See Chapter 1 of this report for more information on shadow banks.

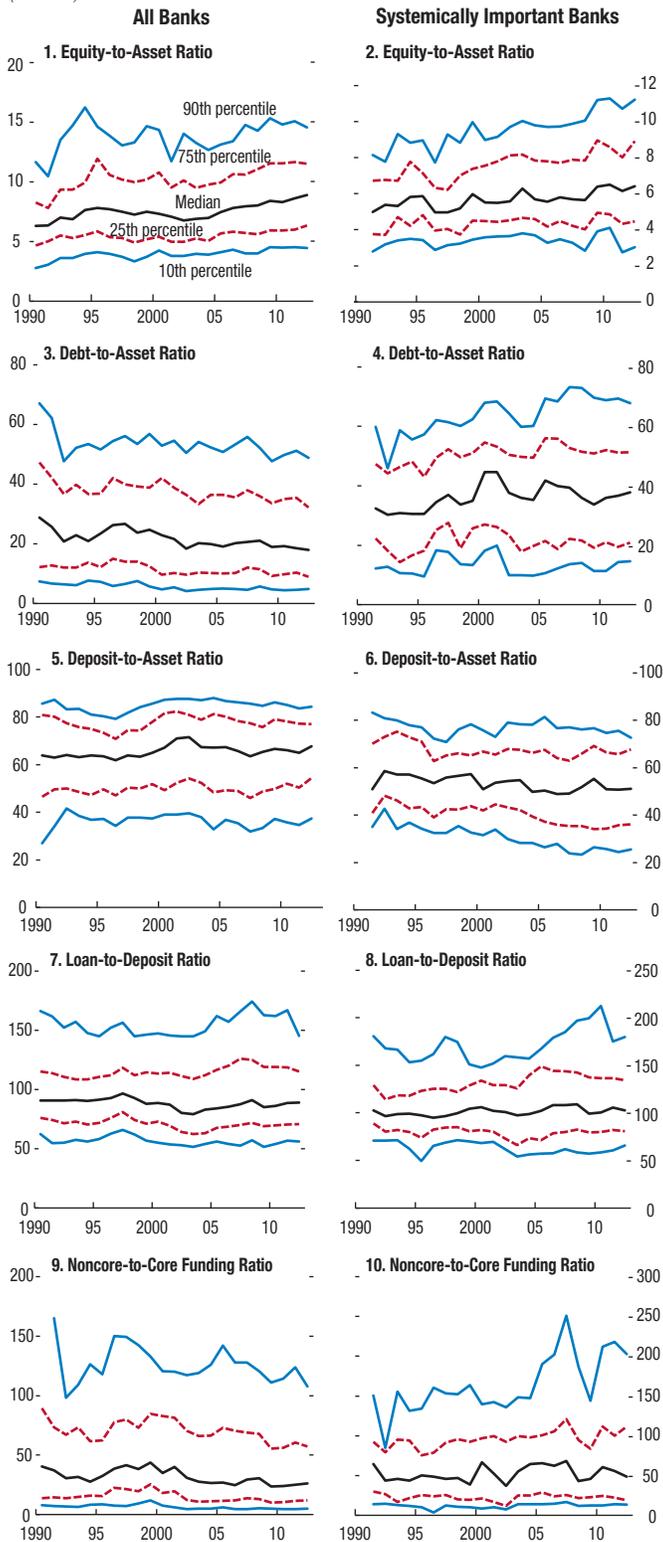
indication of the need for wholesale funding) are studied for 751 banks, applying a dynamic panel regression with bank-specific fixed effects for a large set of countries (see Annex 3.1 for details).³ The roles of bank-specific factors are examined along with country-level macroeconomic, financial market, and regulatory and institutional factors. The sample is also split between advanced economies and emerging market economies and across specific periods. Systemically important banks are considered separately.⁴

In line with earlier studies, the empirical evidence suggests that bank funding is affected mainly by bank-specific factors and to a lesser extent by macrofinancial

³Some studies look at different specifications of funding, expressing total liabilities or deposit and nondeposit liabilities as shares of banks' market value (that is, more as indicators or components of market leverage). However, this approach neglects the role of equity as a separate funding instrument. In addition, using market value restricts the analysis to listed banks.

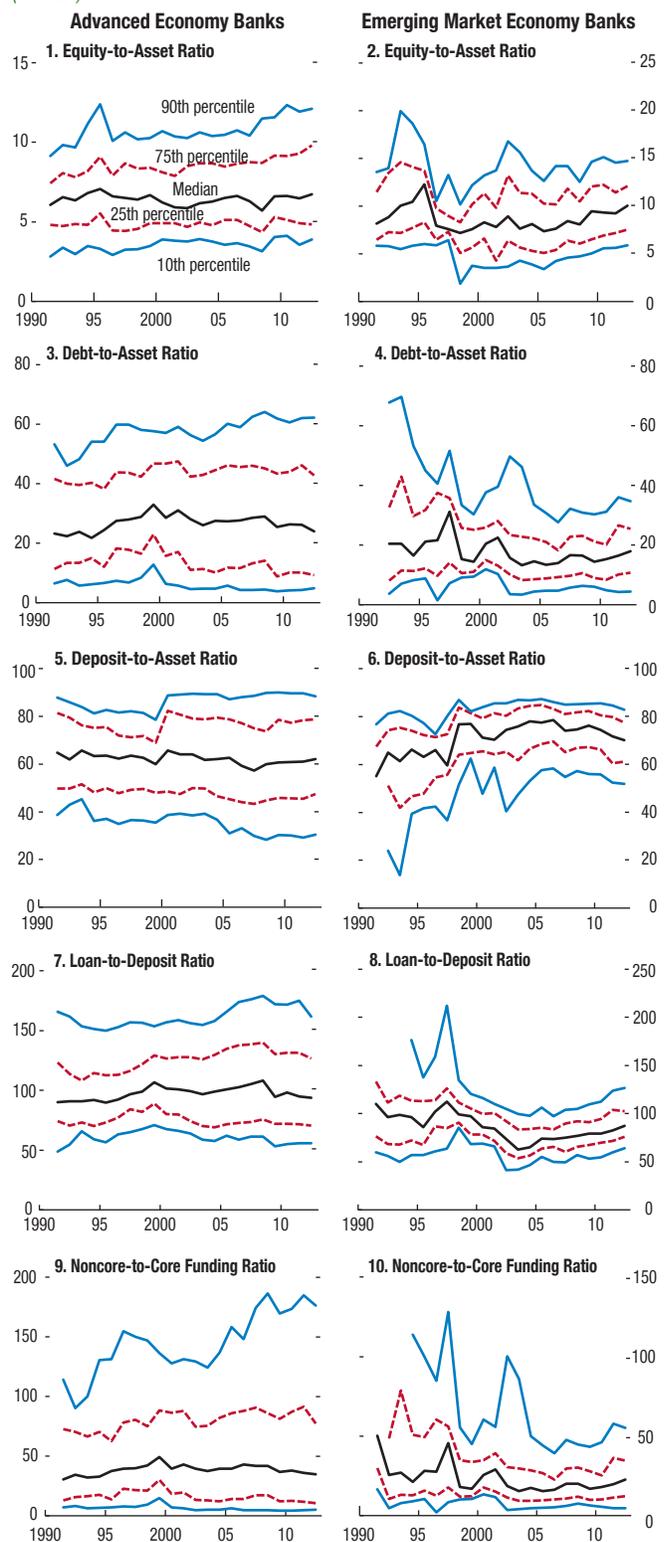
⁴The subsample comprises 27 global and 84 domestic systemically important banks (global systemically important banks—G-SIBs—and domestic systemically important banks—D-SIBs—respectively). The G-SIBs are those chosen by the Financial Stability Board (2012b), and the selection of D-SIBs is based on whether a bank's total assets are close to or exceed 20 percent of GDP.

Figure 3.3. Evolution of Bank Funding Structures, Global and Systemically Important Banks (Percent)



Sources: Bloomberg, L.P.; and IMF staff estimates.
 Note: Figures show the median (black line), interquartile range (red dashed lines), and upper and lower decile (blue solid lines) of the distribution of the share of equity, debt, and deposits as percentages of total assets and the loan-to-deposit and noncore-to-core funding ratios (in percent). The latter ratio is defined as debt to equity and deposits.

Figure 3.4. Evolution of Bank Funding Structures, Advanced and Emerging Market Economies (Percent)



Sources: Bloomberg, L.P.; and IMF staff estimates.
 Note: Figures show the median (black line), interquartile range (red dashed lines), and upper and lower decile (blue solid lines) of the distribution of the share of equity, debt, and deposits as percentages of total assets and the loan-to-deposit and noncore-to-core funding ratios (in percent). The latter ratio is defined as debt to equity and deposits.

and market variables.⁵ Institutional factors also seem to play a role. The key results are illustrated graphically in Figure 3.5:⁶

- *Bank-level factors matter most, but regulation also plays a role.* Bank-specific fixed effects and past funding structure choices dominate the results. In contrast to previous studies, this analysis finds that proxies for the general regulatory environment (including nonfinancial factors such as the “rule of law”) influence bank funding structures.^{7,8} On average, over all countries and the entire sample period, countries with higher-quality regulations are associated with banks that have more deposit and less debt funding. Banks in advanced economies with higher disclosure requirements (holding all else constant) tend to have higher deposit-to-asset ratios and lower loan-to-deposit ratios.
- *Capital structures are generally highly persistent, but the speed of adjustment varies across time and countries.* Capital structures appear to be changing, but only slowly. Equity funding tends to adjust faster than debt and deposit funding. However, since 2007, banks have adjusted at a faster and more similar pace across all types of funding.
- *Asset size plays an important role.* Large banks generally take on more debt (perhaps because investors are more familiar with them) and fund using less equity and deposits.
- *More traditional, safer banks depend less on wholesale funding.* Banks with more securities and tangible assets and those that pay dividends rely less on wholesale funding (that is, have lower loan-to-deposit ratios).

⁵Existing studies show that a firm’s size and profitability, whether it pays dividends, its cash flow volatility (as a measure of risk), and its “tangibility” matter for bank funding. Tangibility for financial firms (such as banks) refers to the value of securities, cash and funds due from banks, fixed assets, and other tangible assets.

⁶See Gudmundsson and Valckx (forthcoming) for further regional analysis.

⁷Based on the World Bank’s Doing Business Indicators of regulatory quality, effectiveness of governance, rule of law, and voice and accountability, two principal components are derived that reflect the level of regulation and disclosure. This interpretation is based on correlations and signs with other legal, regulatory, and institutional characteristics.

⁸This conclusion was based on the large impact of bank fixed effects on the explanatory power of the model (measured by R^2) and on the difference in speed of adjustment (1 minus the coefficient of the lagged dependent variable) in a specification with and without fixed effects, similar to Gropp and Heider (2010). Unlike Gropp and Heider (2010), in this study regulatory factors appear to help explain the variation in funding structures.

Bank Funding before and after the Global Financial Crisis

Focusing on developments just before the crisis, banks, especially in Europe, relied largely on low-cost wholesale funding to expand investments (Box 3.2). U.S. banks rapidly increased interbank loans (unsecured debt and secured repos; Figure 3.6) and issued securitized products, albeit from a lower base than their European counterparts. Japanese banks, however, needed little wholesale funding given their ample deposit base. Emerging market economy banks, especially those in central Europe, saw some erosion of their customer deposits in favor of interbank deposits but maintained higher capital ratios (see Figures 3.1 and 3.7).

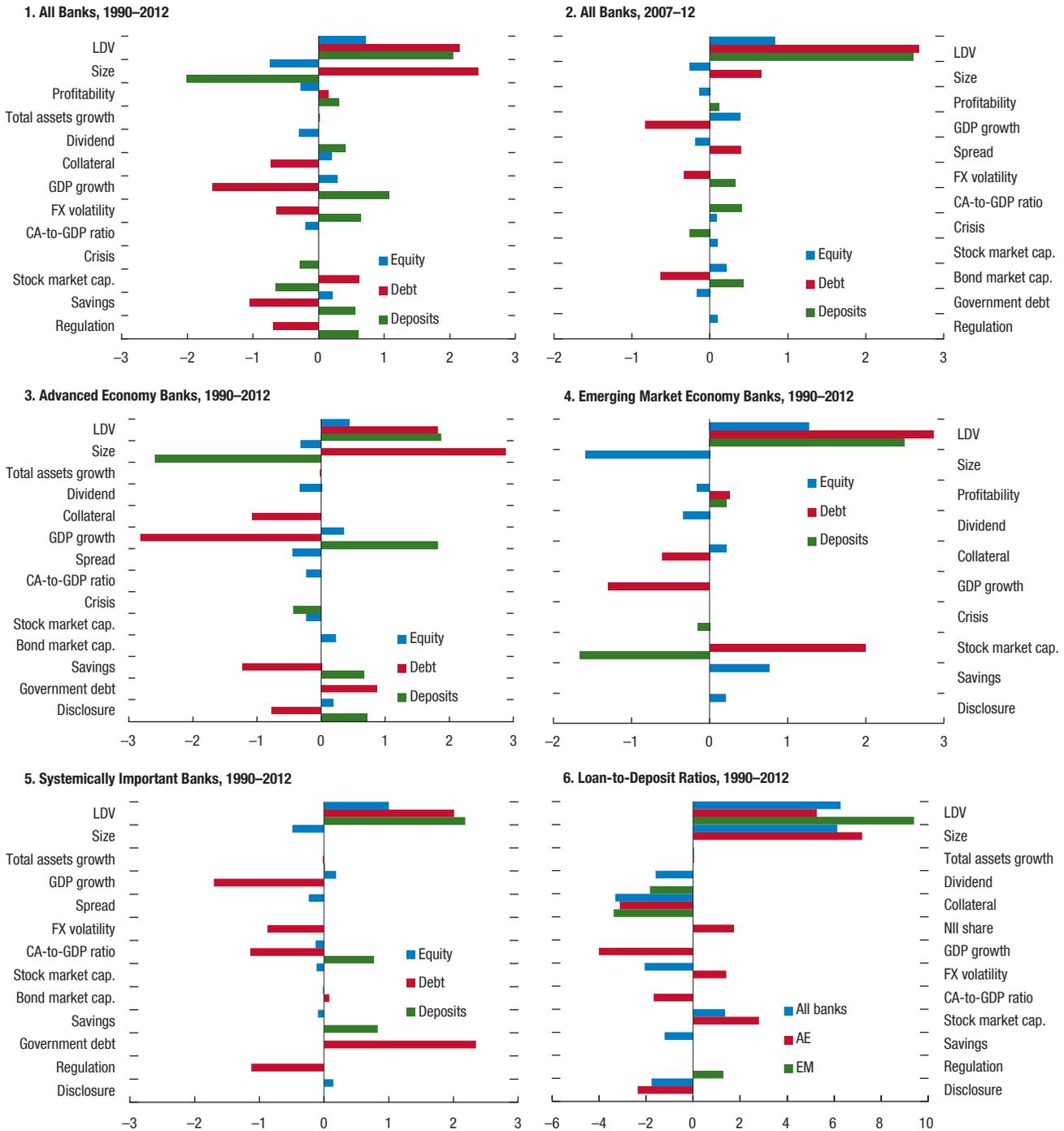
The global financial crisis caused substantial stress in wholesale funding markets, forcing banks to adjust their funding models. In particular, many banks had to rely on central bank funding to survive systemic liquidity shortages. For banks that had relied on dollar-based funding, currency swap lines were provided by the Federal Reserve to relieve U.S. dollar liquidity shortages abroad.⁹ Banks in all regions recapitalized, often with government support (see Figure 3.7). Financial fragmentation and bank deleveraging have also affected cross-border bank funding patterns. In particular, there was a significant decline in foreigners’ investments in bank-issued debt securities located in the stressed euro area countries of Ireland, Italy, Portugal, and Spain, while banks in core euro area countries generally experienced the opposite. Changes appear to be smaller in non-euro-area advanced economies (Box 3.3).

Some diverging regional trends are noteworthy:

- In Europe, for many banks there continues to be limited access to private short-term wholesale and interbank markets. As a substitute, banks have become more reliant on European Central Bank (ECB) funding and on covered bond issuance, which increases asset encumbrance (Figure 3.8), especially during periods of stress (Figure 3.9, panel 1). Notably, about 30 percent of covered bonds issued by European banks are retained by the issuers for potential use as collateral for ECB facilities (Figure 3.9).
- U.S. banks have reduced their reliance on secured (for example, private-label mortgage-backed securities) and unsecured funding, replacing it with deposits and

⁹ See Chapter 3 of the April 2013 GFSR on central bank liquidity support since the crisis.

Figure 3.5. Determinants of Bank Funding
(Relative sizes of factors; percentage points)



Sources: Bloomberg, L.P.; and IMF staff estimates.

Note: CA = current account; cap. = capitalization; FX = foreign exchange; LDV = lagged-dependent variable; NII share = net interest income in percent of operating income. Regulation and disclosure are the first and second principal component scores, derived from four World Bank indicators of regulatory and institutional quality. See Table 3.3 for further details on factors and their definitions. Figures show the economic relevance of bank characteristics and macrofinancial and regulatory factors on bank funding through equity, deposits, and debt (as a percent of total assets), and on loan-to-deposit ratios (panel 6) based on panel estimations for all banks, advanced economy banks, emerging market economy banks (from developing Asia and central and eastern Europe), and global and domestic systemically important banks. Economic relevance is computed as coefficients multiplied by 1 standard deviation of each variable (averaged across banks). Variables shown are chosen using the general-to-specific selection method, which starts with a general regression model and narrows it down to a model with only significant variables. See Annex 3.1 for further details on data and estimation results.

Box 3.2. What the Crisis Taught Us about Bank Funding

This box summarizes the leading current research on bank funding sources and capital structures, focusing on their role for financial stability. The literature demonstrates that bank wholesale funding does not provide sufficient market discipline and is unstable during crises.

Since the 1990s, banks have increasingly used wholesale funding—repurchase agreements (repos), brokered deposits, interbank loans, and commercial paper—to supplement retail deposits (Feldman and Schmidt, 2001). The precrisis literature generally suggested that this trend was advantageous. Unlike retail depositors, the providers of wholesale funding were thought to be “sophisticated,” that is, able to monitor and discipline risky banks (Calomiris and Kahn, 1991; Rochet and Tirole, 1996; Flannery, 1998; Calomiris, 1999) because they were not protected by (explicit) deposit insurance schemes.

Yet the crisis revealed wholesale funding to be a major source of instability. In particular:

- Banks attracted wholesale funds at short maturities because they are cheaper than at longer maturities. Wholesale providers of funding did not adequately monitor banks because they knew they could withdraw at a hint of negative news by not rolling over their funding. During the crisis, collective withdrawals triggered generalized funding disruptions (Huang and Ratnovski, 2011; Brunnermeier and Oehmke, 2013).
- Banks attracted wholesale funding on a secured basis—against the collateral of securitized debt and other assets for repo transactions. Sudden concerns about the quality of collateral led to a freeze of repo funding markets (“a run on repo,” as described by Gorton and Metrick, 2012).
- Wholesale funding made the financial system (not just the banking system) more interconnected because both bank and nonbank financial institutions provided liquidity to each other. The interbank market proved to be particularly fragile.

The author of this box is Lev Ratnovski.

During the crisis, banks hoarded liquidity because of perceived credit and liquidity risks (including their own inability to monitor risks) (Heider, Hoerova, and Holthausen, 2009; Farhi and Tirole, 2012).

- Wholesale funding created complex interactions between bank assets and liabilities, such that a fall in asset values could compromise banks’ ability to obtain funds. Hence, a funding freeze could lead to asset fire sales to generate liquidity. As an alternative, banks may be encouraged to securitize assets, but may continue to hold them on the balance sheet—instead of selling off the new securities—to pledge them in repos for an additional source of funding (Acharya, Gale, and Yorulmazer, 2011; Brunnermeier and Pedersen, 2009; Shin, 2009a).
- At a macroeconomic level, variations in the value of collateral and margin requested, and other funding market conditions, became a major determinant of bank leverage and banks’ ability to extend credit (Geanakoplos, 2009; Adrian and Shin, 2010), creating larger boom and bust cycles.
- Many empirical studies show that the reliance on wholesale funding was a major source of bank vulnerability during the crisis (Huang and Ratnovski, 2009; Shin, 2009b; Demirgüç-Kunt and Huizinga, 2010; Goldsmith-Pinkham and Yorulmazer, 2010; Bologna, 2011; Vazquez and Federico, 2012).

In sum, the literature suggests that bank wholesale funding has become an inherent feature of the modern financial system. It can be explained as a response to financial innovation and a buildup of excess savings in some countries’ corporate sectors (so-called cash pools) as well as by increases in official reserves of many emerging market economies. However, the literature highlights that wholesale funding is associated with some problematic properties, specifically a lack of sufficient market discipline and instability in crises. An important conclusion is that any regulation designed to counter potential downside risks to wholesale funding will need to account for potential trade-offs.

equity (see Figure 3.6). The share of net repo funding for U.S. banks declined from about 8 percent of total liabilities in 2008 to 2 percent in 2013.

- In Asian and central and eastern European emerging market economies and in Japan, banks have slightly increased wholesale funding since the crisis began while expanding their balance sheets, but these funding categories remain proportionately less than in Europe or the United States. While Japanese banks primarily rely on deposits at home, they are increasingly relying on wholesale funding abroad.

Are Bank Funding Structures Relevant to Financial Stability?

Can funding structures that are likely to improve financial stability be empirically identified? The relationship between bank funding characteristics and bank distress is examined for a broad group of countries from 1990 through 2012 (see Annex 3.1). The characteristics included in the analysis are the stability of the structure (amount of short-term debt subject to rollover risk), diversity (concentration of banks' funding via debt, equity, and deposits), asset-liability mismatches (loan-to-deposit funding gap), and leverage (debt and equity relative to total assets), in line with Le Leslé (2012). Three separate variables are used to check the sensitivity of the funding structures to various definitions of bank distress: a balance sheet measure of risk (low z-scores),¹⁰ an asset-price-based indicator (low price-to-book ratio), and bank equity analysts' rating (buy or sell) recommendations.

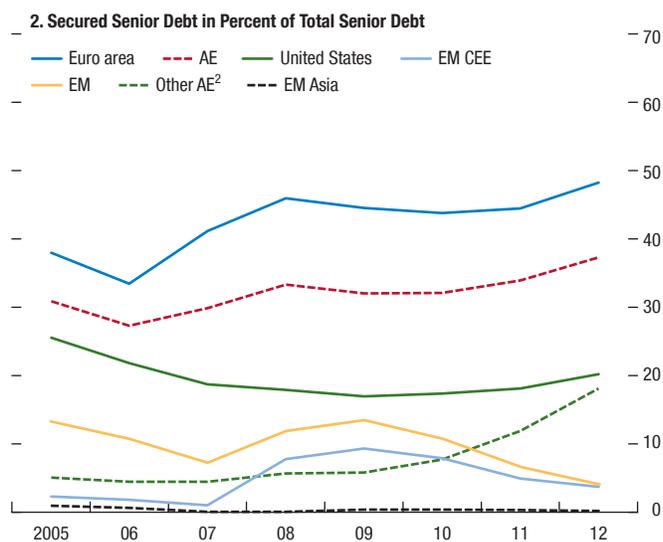
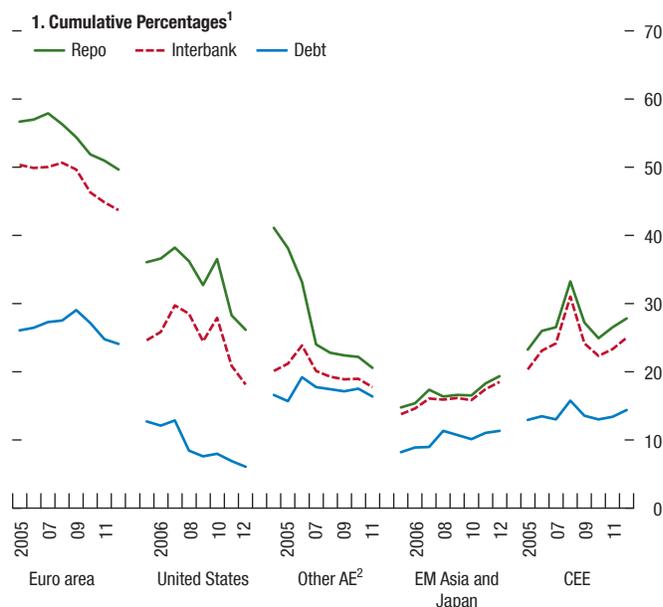
As expected, funding characteristics matter for bank distress (Figure 3.10). The results support the view that overall banking-sector stability requires that funding structures be stable, diversified, and involve less leverage. Limiting the mismatch between loans and deposits, which reduces the need for wholesale funding, is also important—a finding that is in line with the literature on this topic (see Box 3.2).¹¹ More specifically:

- Better capitalization (a higher equity-to-asset ratio) contributes to bank stability for both advanced

¹⁰The z-score is defined as the equity-to-asset ratio plus return on assets (ROA), divided by the standard deviation of ROA. It is a measure of the risk-adjusted ROA, and the higher the z-score, the more resilient the bank. Chapter 3 of the April 2013 GFSR also found positive results using z-scores as a measure of bank-level risk.

¹¹See Annex 3.1 for additional results and the economic magnitudes of the effects.

Figure 3.6. Wholesale Bank Funding



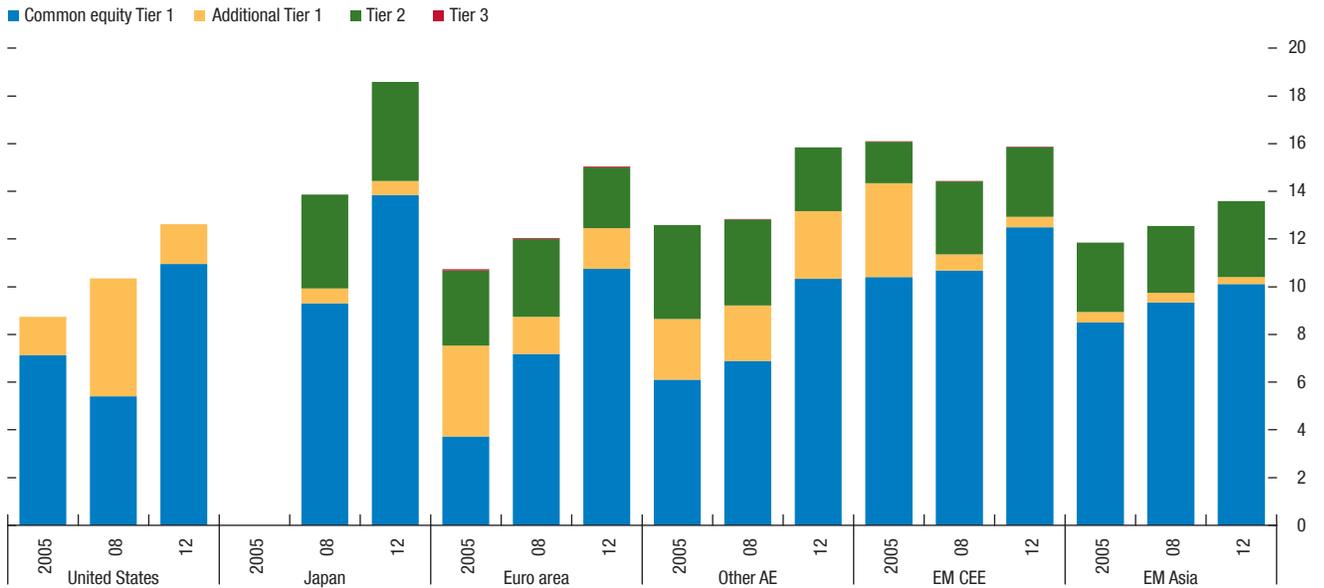
Sources: Dealogic; SNL Financial; and IMF staff estimates.

Note: AE = advanced economies; CEE = central and eastern Europe; EM = emerging market economies.

¹Debt, interbank liabilities, and repurchase agreements (repos) as cumulative percent of wholesale funding plus customer deposits.

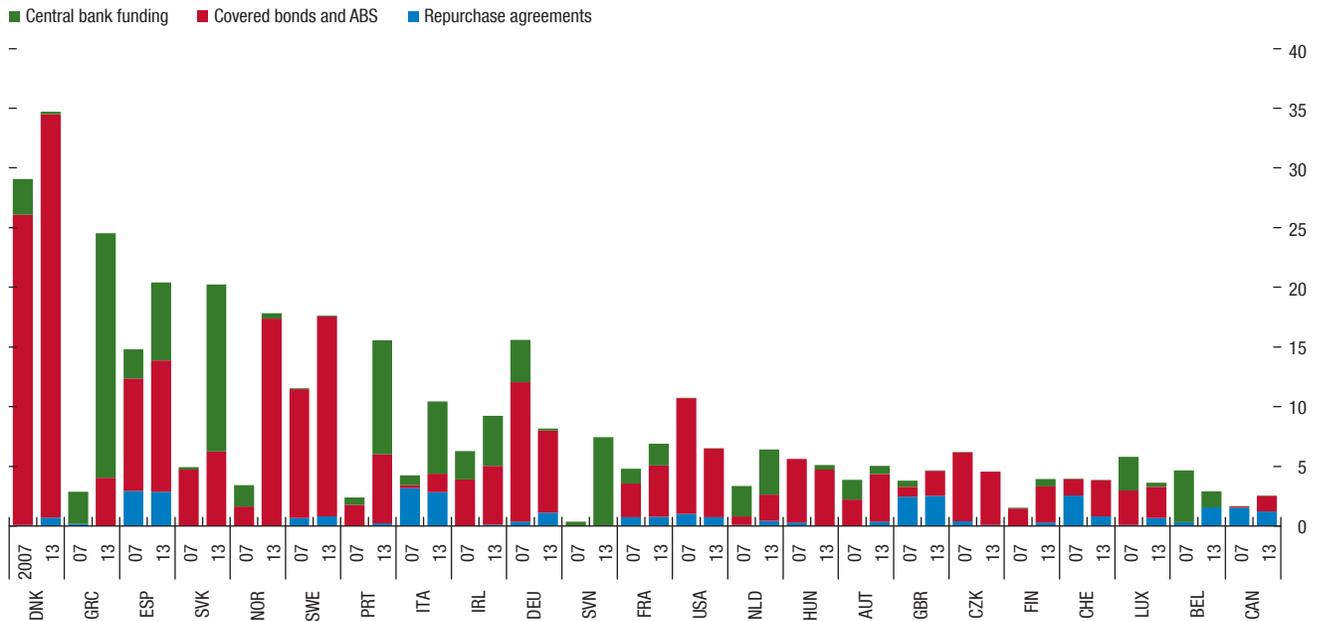
²Other AE excludes European Union, Norway, and the United States.

Figure 3.7. Regulatory Capital Ratios across Major Economies and Regions
(Percent of risk-weighted assets)



Sources: SNL Financial; and IMF staff estimates.
Note: Japan data for 2005 omitted due to data limitations. AE = advanced economies; CEE = central and eastern Europe; EM = emerging market economies.

Figure 3.8. Asset Encumbrance: December 2007 and June 2013
(Percent of total bank assets)



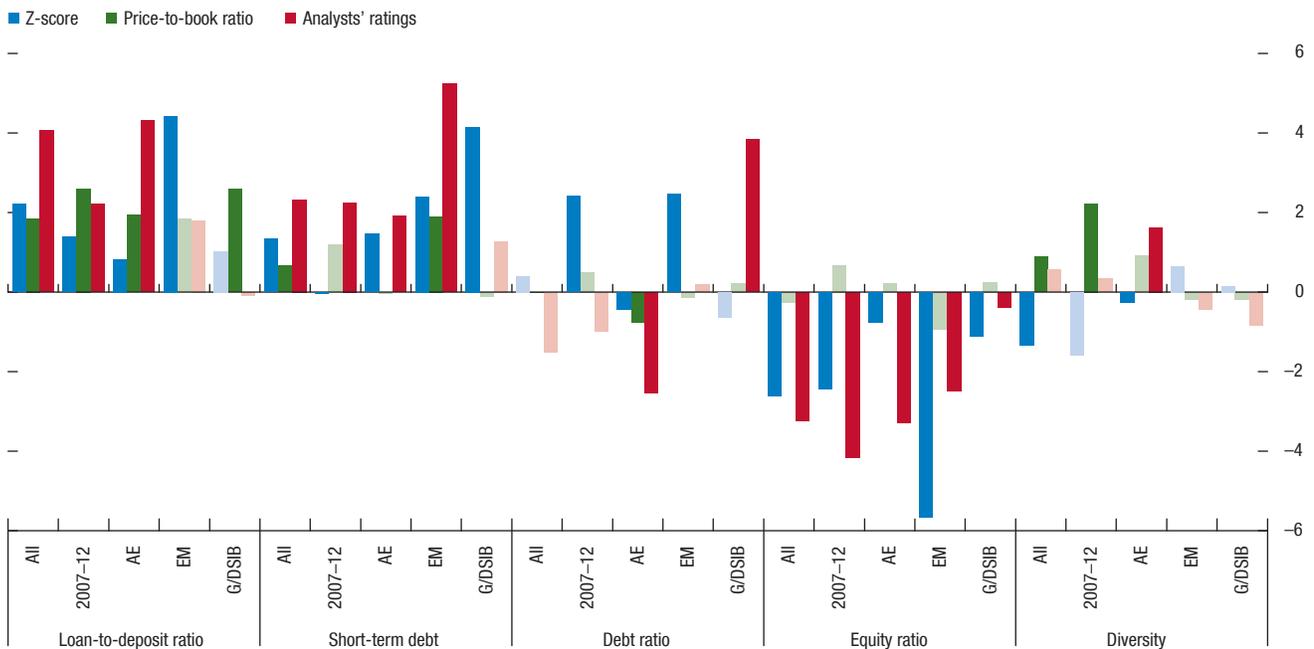
Sources: European Central Bank; European Covered Bond Council; Haver Analytics; and IMF staff estimates.
Note: ABS = asset-backed securities; AUT = Austria; BEL = Belgium; CAN = Canada; CHE = Switzerland; CZK = Czech Republic; DEU = Germany; DNK = Denmark; ESP = Spain; FIN = Finland; FRA = France; GBR = United Kingdom; GRC = Greece; HUN = Hungary; IRL = Ireland; ITA = Italy; LUX = Luxembourg; NLD = Netherlands; NOR = Norway; PRT = Portugal; SVK = Slovak Republic; SVN = Slovenia; SWE = Sweden; USA = United States.

Figure 3.9. Share of Retained Bank-Covered Bonds in Europe



Sources: Dealogic; and IMF staff estimates.
Note: The sample includes public and private sector banks, but excludes agency bonds. For 2013, the data are annualized using data through the end of July.

Figure 3.10. Contribution of Funding Characteristics to Bank Distress
(Relative size of factors; percentage points)



Sources: Bloomberg, L.P.; and IMF staff estimates.
Note: AE = advanced economies; EM = emerging market economies; G/DSIB = global and domestic systemically important banks. Figure shows the economic significance of bank funding characteristics, evaluated at 1 standard deviation away from the variable's mean, on the probability of distress specified under alternative distress models and samples. Bank distress is a dummy variable, defined either as a z-score below 3, price-to-book ratio below 0.5, or average analyst ratings of 2.5 or lower. G/DSIB is a subsample consisting of systemically important banks: G-SIBs are from Financial Stability Board (2012b), and D-SIBs are banks whose assets account for close to or exceed 20 percent of GDP. Lighter-shaded bars denote nonsignificant effects. See Annex 3.1 for further details. The emerging market economy sample contains banks from developing Asia and central and eastern Europe.

Box 3.3. Changes in Cross-Border Bank Funding Sources

Since the global financial crisis began, financial fragmentation and bank deleveraging have affected cross-border bank funding patterns. In particular, foreigners' investments in debt securities of banks located in stressed euro area countries have declined significantly; banks in core euro area countries have generally experienced the opposite. Changes appear to be smaller in non-euro-area advanced economies.¹

In the euro area, foreign investors can be differentiated between core and stressed economies, reflecting financial segmentation and ongoing bank deleveraging.

The authors of this box are Serkan Arslanalp and Takahiro Tsuda.

¹The estimation methodology is based on Arslanalp and Tsuda (2012). Total debt securities issued by banks are from the Bank for International Settlements (BIS) Debt Securities database, and foreign holdings of those securities are from the IMF-World Bank Quarterly External Debt Statistics. The BIS debt securities statistics include debt securities issued by all financial corporations, not just depository corporations. The foreign share of bank debt may, therefore, be understated in countries in which nonbank financial corporations issue a large amount of debt. Both databases are based on the residency principle in relation to the issuer and holder of debt. The analysis covers selected advanced economies for which long-term data are available. The Fitch sample includes the 10 largest U.S. prime money market funds with total exposure of \$654 billion as of the end of April 2013, representing 46 percent of total U.S. prime money market fund assets.

In 2004, foreign holdings of bank debt securities accounted for 40 percent of the total for France, Germany, and Spain, whereas holdings for Italy were about 10 percent (Figure 3.3.1). The financial fragmentation and bank deleveraging in some stressed euro area countries has led to a decline of foreign holdings for Italy and Spain. This declining path has been associated with steady increases of foreign holdings for France and Germany. This divergent trend has eased since the European Central Bank's announcement of Outright Monetary Transactions in September 2012, which has helped mitigate tail risks.

Despite the high variation in foreign holding patterns across countries outside the euro area, the foreign investor base for bank debt securities has been quite stable (Figure 3.3.2). For instance, Korea has had very low foreign holdings (about 10 percent) relative to the total size of bank debt securities, whereas more than 50 percent of Sweden's bank debt securities have been held by foreigners. Yet in both countries, changes over time have been small, with a modest increase of foreign holdings in recent years.

A similar picture emerges from public disclosures of large U.S. money market funds. Before the global financial crisis, U.S. money market fund allocations to European banks represented about half their total exposure to banks, based on Fitch Ratings' sample of

Figure 3.3.1. Euro Area: Foreign Holding of Bank Debt Securities
(Percent of total)

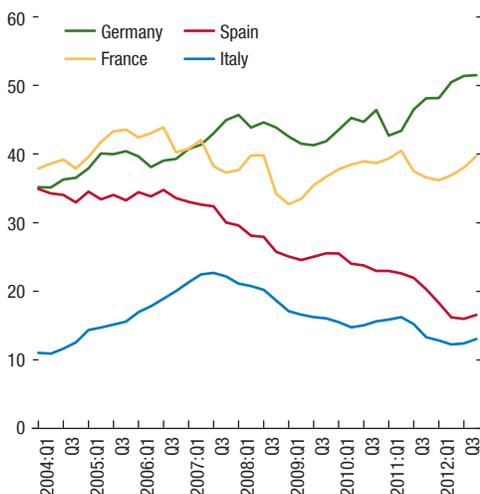
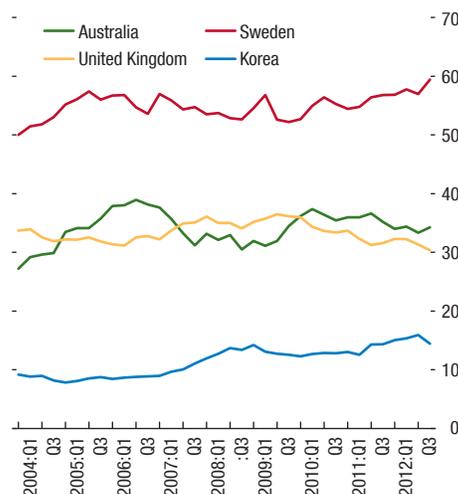
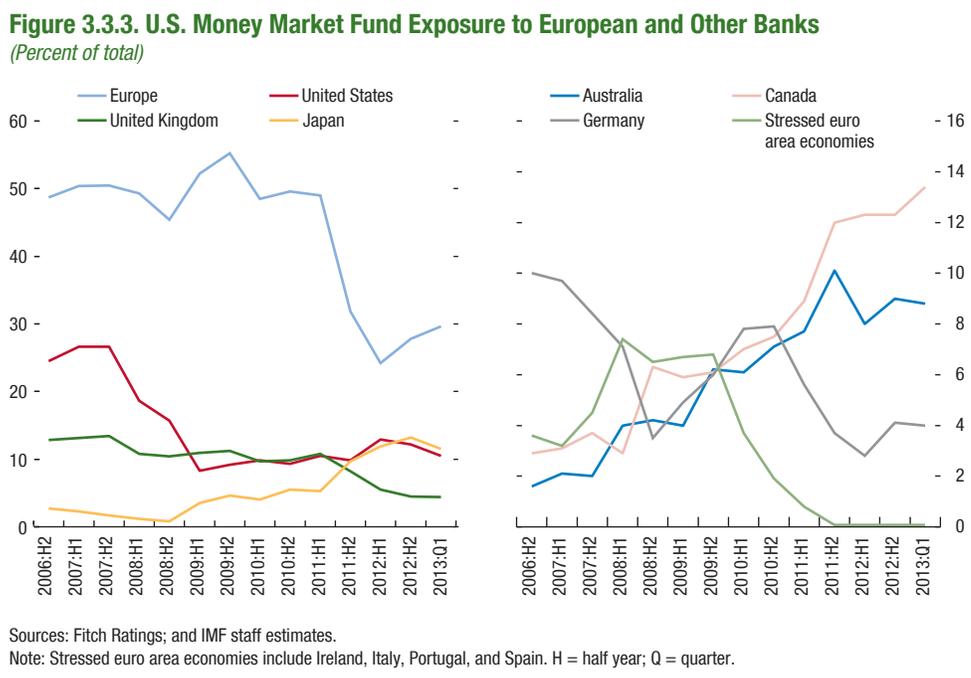


Figure 3.3.2. Non-Euro Area: Foreign Holding of Bank Debt Securities
(Percent of total)



Sources: Bank for International Settlements; IMF/World Bank, Quarterly External Debt Statistics; and IMF staff estimates.

Box 3.3. (continued)



U.S. money market funds (Figure 3.3.3). This share declined rapidly starting in 2010, as U.S. money market funds stopped funding banks in Ireland, Italy, Portugal, as well as Spain, and reduced their allocation to core euro area banks, although the latter have

rebounded recently. Meanwhile, U.S. money market funds continue to increase allocations to Australian, Canadian, and Japanese banks, which combined represent about one-third of their total exposure to banks.

economy and emerging market economy banks, except for the case in which distress is measured by the price-to-book ratio. For systemically important banks, the effect of better capitalization is much smaller, possibly reflecting their too-big-to-fail status during the sample period.¹²

- Debt, in particular short-term debt, harms bank stability. Higher reliance on short-term debt is associated with an increase in bank distress. Higher debt ratios are also correlated with an increase in bank distress, especially in the recent period (2007–12),

for emerging market economy banks and for systemically important banks.¹³

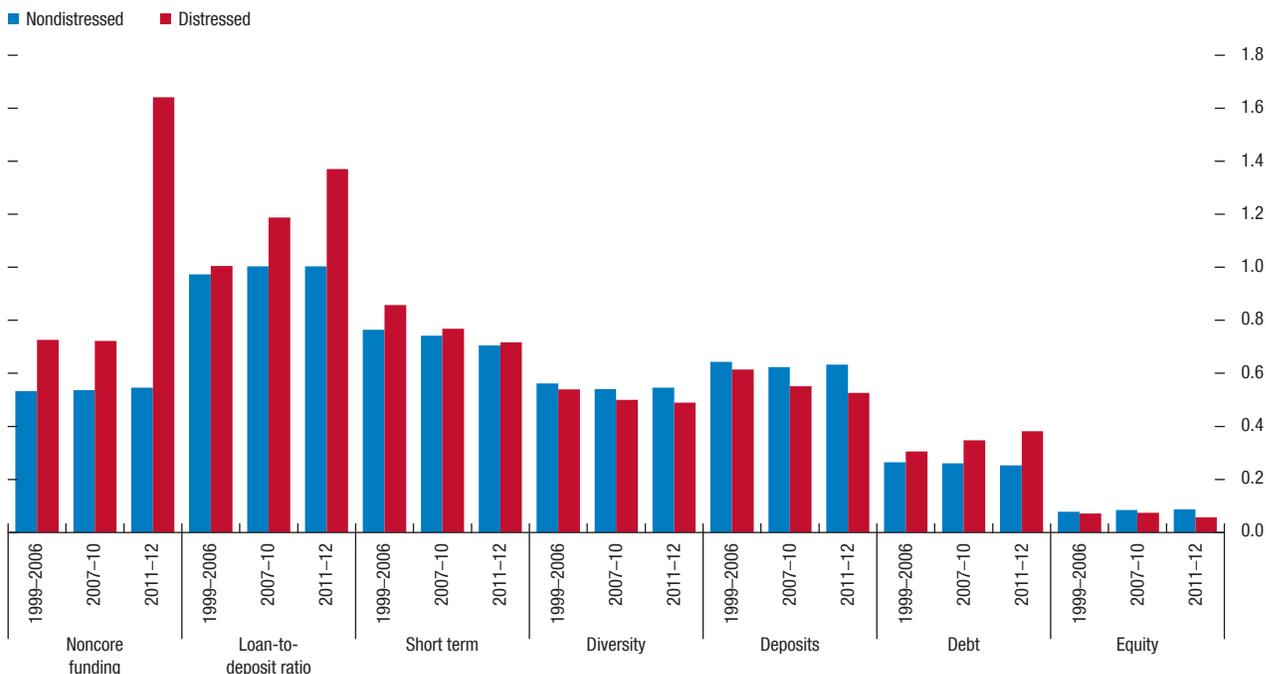
- Higher reliance on wholesale funding (a higher loan-to-deposit ratio), is linked to higher bank distress in both advanced economies (under all distress measures) and emerging market economies (using the balance sheet distress measure) during the sample period.¹⁴ However, especially in the absence of cred-

¹²In related research, Bertay, Demirgüç-Kunt, and Huizinga (forthcoming) find that systemically important banks are less profitable and do not have lower risk. Ueda and Weder di Mauro (2012) find that credit ratings of systemically important banks imply a structural subsidy.

¹³For the full period and for advanced economy banks, the results for the analysts' ratings-based measure associate lower distress probabilities with higher debt-to-asset ratios, which likely reflects the (eventually unsustainable) buildup of leverage before the global financial crisis. However, analysts assign lower distress probabilities to systemically important banks with lower debt ratios.

¹⁴A similar result was found in a country-based panel framework for emerging market economies. No threshold effects, in which other interest-bearing liabilities above a certain level were associated with banking crises, were found in this study. See Chapter 4 of the October 2012 GFSR. Gudmundsson and Valckx (forthcoming) also

Figure 3.11. Evolution of Bank Funding Characteristics (Ratios)



Sources: Bloomberg, L.P.; and IMF staff estimates.

Note: Distressed banks are those with z-scores that fall in the lowest 10 percent of the distribution (z-scores below 3). Noncore funding is the ratio of debt to customer deposits and equity. Short term is short-term debt plus repurchase agreements (repos) as a percent of total bank debt and repos. Diversity is a Herfindahl index of funding concentration (lower ratio indicating more funding diversity, defined as the squared shares of deposits, debt, and equity). Deposits, debt, and equity are expressed relative to total bank assets. Deposits are total customer deposits. Debt is defined as nondeposit bank liabilities. Equity is total common equity (at book value).

ible deposit insurance programs, panic deposit runs could be destabilizing.

- Higher concentration in funding sources is associated with a higher level of bank distress in some cases, which suggests that banks need to seek a balanced funding mix.

Since the crisis began, most banks have altered their funding structures to make themselves less vulnerable to financial instability, but distressed banks (those with low z-scores) are still subject to unfavorable funding market developments (Figure 3.11).¹⁵

- Nondistressed banks have improved their funding structures by slightly increasing their capitalization ratios (equity-to-asset ratios) and lowering their debt ratios. Also, their funding sources have become slightly more diversified, and reliance on short-term debt and repos (relative to total borrowings) has

fallen, while the loan-to-deposit ratio has remained broadly stable.

- Distressed banks have made some improvements to their funding structures, but most components have changed for the worse. On the positive side, their use of short-term debt and repos has fallen close to the levels for nondistressed banks (perhaps because of an inability to roll over short-term debt), and their funding mix has become more diversified than for nondistressed banks. However, their loan-to-deposit ratios have increased as a result of reduced access to deposits, and debt financing (including recourse to central bank funding through repos) has increased, pushing up their leverage and reducing equity-to-asset ratios considerably.

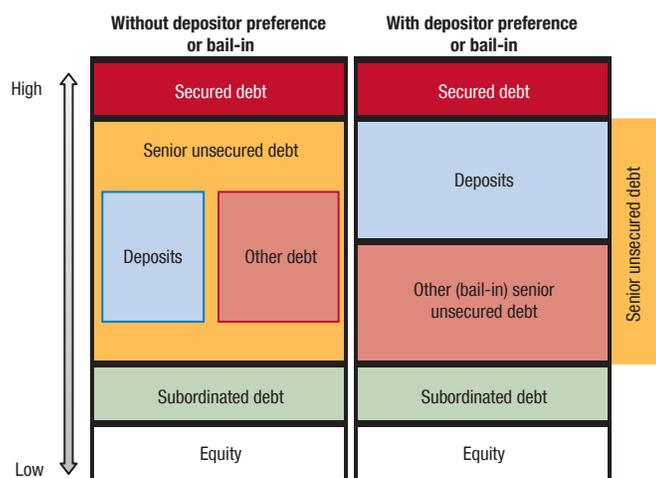
Crisis and the Impact of Regulatory Reforms on the Pricing of Bank Liabilities

The crisis has prompted various regulatory reform proposals, some of which are aimed at directly changing bank funding structures and loss-sharing rules across

analyze the importance of core and noncore funding ratios as in Hahm, Shin, and Shin (2012).

¹⁵Distressed banks are defined as those with z-scores below 3 (those in the lowest 10 percent of the distribution).

Figure 3.12. Priority of Claims of Bank Liabilities



Source: IMF staff.

various funding instruments. Basel III capital regulations should raise banks’ loss-absorbing equity buffers, and the accompanying liquidity regulations should strengthen funding structures against liquidity shocks. OTC derivatives reforms, by requiring collateral to be set aside in bilateral trades and at centralized counterparties, will enhance the safety of these markets but will encumber more assets. Proposals to strengthen resolution frameworks (such as introducing depositor preference and providing bail-in powers) may increase losses for some bank creditors in an effort to protect small depositors and limit the burden on taxpayers in the event of resolution (Figure 3.12 and Annex 3.2).¹⁶

Policymakers need to be aware of the complex interactions of these reforms—while acknowledging the legacy effects of the crisis—on bank funding structures and costs. In particular, some changes to funding structures (including more equity) combined with reallocation of losses upon bank failure among different debt holders can produce disproportionate changes of funding costs that are not easily anticipated. On the one hand, having more equity (a larger loss-absorbing buffer) makes all debt safer and cheaper. On the other hand, bail-in powers and the introduction of depositor preference—which are being actively discussed in Europe—combined with high levels of asset encum-

¹⁶Bail-in powers are generally designed to ensure that shareholders and debtors internalize the cost of bank failure rather than being bailed out by taxpayers. See Le Leslé (2012) for the broad impact of these regulatory initiatives on European banks.

brance (elevated, in part, as a result of the ongoing crisis) magnify the expected losses that senior unsecured debt holders will suffer in the event of default, which can increase their costs. The overall effect on funding costs is not easily surmised, as not only will the rates associated with each liability type change, but the amounts used of each type will also change. Most likely, systemically important banks that had been able to fund themselves at a lower overall cost than other banks as a result of their implicit too-big-to-fail status will see their cost of funding rise. For other banks, the effects will depend on a combination of factors, as highlighted in the following examples (Box 3.4).

A numerical analysis based on the option-like features of bank funding structures can help shed light on the possible repricing effects of some key aspects of these reforms. This approach, which builds on Merton (1974), allows a holistic analysis by linking the price of debt to the overall composition of funding (including the equity buffer) and to the risks on the bank’s balance sheet. At the same time, not all regulatory reforms can be placed into this framework. For example, Basel III liquidity regulation can make a bank safer by changing its asset structure, rather than its liability structure, and by reducing its asset-liability maturity mismatch, which is the main source of liquidity risk. Before discussing the numerical exercise, this section first reviews selected aspects of regulatory reforms and asset encumbrance, providing a sense of their likely effects on funding structures (for more details, see Annex 3.2).

Basel III Capital Regulations: More and Higher-Quality Capital

The Basel III capital regulations promote higher levels of minimum equity capital and improve its quality, making any debt safer and cheaper.¹⁷ Although the minimum total capital requirement is set at the same level as in Basel II—8 percent of risk-weighted assets—the quality of capital in Basel III is higher, requiring 4.5 percent of risk-weighted assets to be of higher-quality capital (common equity Tier 1 [CET1]). In addition, Basel III sets considerably more stringent criteria for what qualifies as CET1, additional Tier 1 capital, and Tier 2 capital. The Basel III framework

¹⁷The Basel Committee on Banking Supervision (BCBS) issued the details of its global regulatory capital standards in 2010 (BCBS, 2010a). They are expected to be phased in by 2019.

Box 3.4. Bank Funding in Emerging Market Economies and the Impact of Regulatory Reforms

This box summarizes funding structures of emerging market economy banks and provides some indications of how regulatory reforms will affect these banks.

In general, emerging market economy banks have safer funding structures than advanced economy banks. Emerging market economy banks are better capitalized, rely more on deposits and less on debt, and have lower funding gaps (loan-to-deposit ratios), all of which are desirable features for a more resilient bank (Figures 3.4 and 3.10). Even larger banks do not appear to rely excessively on wholesale versus deposit funding (Figure 3.5). Asset encumbrance appears to be limited as well: most of their medium-term debt is either senior unsecured or capital-qualifying debt (Figures 3.2 and 3.6). In some economies, funding from a foreign parent bank—a type of wholesale funding—could be a relevant source of bank funding, although in some cases subsidiaries provide funds to parents.

Current bank funding structures in emerging market economies appear to be less affected by regulatory reforms, although some cross-border effects pose concerns. Emerging market banks seem to be better positioned to satisfy Basel III requirements, on average, than their advanced economy peers. Potential tensions arising in advanced economies (among liquidity regulations, asset encumbrance, depositor preference, and bail-in power) appear less stark as well. However, interactions among home (advanced economies) and host (emerging market economies) jurisdictions will require enhanced cooperation and communication so as to reduce potential cross-border tensions from reforms that aim to strengthen resolution framework and lower financial stability risks.

- Basel III capital and liquidity requirements are expected to be implemented on the same schedule for all Basel Committee on Banking Supervision member jurisdictions, including those in emerging market economies such as Argentina, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, and Turkey, and those in the European Union. Some other emerging market economies in Latin America and Asia have also indicated that they will implement the new regulations. However, in other countries, it could take much longer before they adopt Basel III.

The authors of this box are Marc Dobler, Hiroko Oura, and Mamoru Yanase.

- In general, the already-higher capitalization and greater reliance on deposits should support emerging market economy banks' transition to Basel III. However, there are variations across jurisdictions. For instance, banks in Mexico tend to rely much more on repurchase agreements and other wholesale funding sources than do their Asian peers (CGFS, 2013), which could mean lower liquidity ratios. While some jurisdictions have voiced concern about their limited supply of government securities, which is a major component of high-quality liquid assets in satisfaction of the liquidity coverage ratio, many emerging market economy banks have an even higher share of government securities on their balance sheet than do their advanced economy bank peers, including banks from Saudi Arabia or financial centers such as Hong Kong SAR and Singapore (see Chapter 3 of the April 2012 *Global Financial Stability Report*, although liquidity of these securities could be less than those in advanced economies.
- One area of uncertainty faced by emerging market economy banks is how any funding they receive from their parent banks in advanced economies will be treated. In principle, liquidity regulations are applied at group levels, covering both parent and subsidiary, and it is up to host supervisors to decide whether to additionally apply the regulation on a solo basis to foreign bank subsidiaries in their jurisdiction, which should help to ensure that liquidity buffers are sufficient for the local bank. However, there could be a direct impact on their funding if these banks are borrowing substantially from their parent and their parents need to adjust their own operations to cope with new regulatory requirements, including by deleveraging and by increasing local high-quality liquid assets and deposits.
- The Financial Stability Board (FSB) is encouraging the G20, including the major emerging market economies, to adopt the legal reforms necessary to fully meet the *Key Attributes of Effective Resolution Regimes for Financial Institutions* (FSB, 2011) by the end of 2015. Emerging market economy banks' high share of deposit funding, combined with bail-in powers and deposit preference (if adopted) could potentially push up their cost of issuing unsecured debt. However, low asset encumbrance and relatively high equity capital buffers should help to mitigate any adverse impact on overall funding costs.

Box 3.4. (continued)

- Key concerns of policymakers in emerging market economies are (1) how the reforms for global systemically important banks would affect their scale of operations and intermediation costs in host jurisdictions (particularly when the host banking systems are largely foreign-owned); and (2) whether benefits and costs of the reforms would be spread unevenly across home and host jurisdictions, depending on where additional loss-absorbing

capacity is held and which jurisdiction is permitted to trigger a bail-in. The FSB is encouraging enhanced cooperation and communication between home and host authorities, including with host authorities who have not been invited to participate in the crisis management groups that have been set up for each global systemically important bank to address these risks.

also adopts a non-risk-sensitive simple leverage ratio that serves as a backstop to the risk-based measures by constraining the buildup of leverage in the banking system. Furthermore, Basel III adds various buffers,¹⁸ which will eventually raise the effective total capital ratio to between 10.5 and 15.5 percent, depending on the applicability of the extra buffers, mostly in CET1.¹⁹ Global systemically important banks are subject to surcharges, given their critical relevance for financial stability. With no change in assets, higher capital buffers should reduce the probability of default, reducing the costs of debt regardless of the remaining funding structure.²⁰

Basel III also raises the loss-absorbing capacity of debt that qualifies as additional Tier 1 and Tier 2 capital, better protecting senior debt. In particular, the relevant authority should have discretion to write off or convert these other instruments to common equity if the bank is judged to be nonviable.²¹ The objective is to give better incentives for investors to limit banks' risk taking and to increase the private sector contribution in resolving failed banks while reducing fiscal costs.

¹⁸These include (1) a conservation buffer (additional 2.5 percent of risk-weighted assets with CET1) that triggers supervisory limits on a bank's payouts (for example, dividends) when banks fall into the buffer range; (2) a countercyclical buffer (an additional zero to 2.5 percent of risk-weighted assets with CET1) that is added when supervisors judge that credit growth is leading to an unacceptable buildup in systemic risk; and (3) additional charges on G-SIBs (currently 1 to 2.5 percent of risk-weighted assets with CET1) to ensure they have higher loss-absorbing capacity to reflect risks that they pose to the financial system.

¹⁹Some view this minimum capital requirement to be insufficiently large (Admati and Hellwig, 2013).

²⁰See also the section in this chapter on "Are Bank Funding Structures Relevant to Financial Stability?"

²¹For instance, this would occur if minimum capital requirements are breached and recapitalizing through private markets is not feasible.

Basel III Liquidity Regulations: Longer and More Stable Funding

The systemic liquidity shocks during the global financial crisis promoted globally agreed-upon quantitative liquidity regulations for the first time. The regulations are formulated as the liquidity coverage ratio to improve resilience to short-term liquidity shocks by encouraging banks to hold high-quality liquid assets for such events, and the net stable funding ratio (NSFR) requiring long-term assets to be financed by stable funding (BCBS, 2010b). These regulations aim to reduce liquidity risks arising from maturity mismatches and short-term funding sources and to provide a stronger incentive for banks to shift their funding mixes to include more insured deposits (from individuals and small and medium enterprises) and more longer-term funding (secured or unsecured), which have been shown to be relatively more resilient during the recent crisis.

Most banks are on track to satisfy the liquidity requirements, implying little additional need to modify liability structures. The latest Quantitative Impact Study (QIS) for liquidity coverage ratios (BCBS, 2012) showed that banks in the BCBS member jurisdictions already had a greater than 90 percent liquidity coverage ratio, on average, at the end of 2011, compared with the 100 percent requirement to be achieved by 2019, although European banks lag somewhat.²² With the 2013 revision to the rule (BCBS, 2013a), the average liquidity coverage ratio for those banks is likely to exceed 100 percent. The latest QIS (as of June 2012) suggests that the average net stable funding ratio had already reached the required 100 percent level (BCBS,

²²Central bank funding is less likely to affect the liquidity coverage ratio because it reduces both the unencumbered high-quality liquid assets (that is, the numerator of the ratio) and, because of the stability of central bank funding, the amount of funds that can be lost within 30 days (that is, the denominator).

2013b), although the rule is currently under review by the BCBS and has yet to be finalized.

The Impact of the Crisis and Various Reforms on Asset Encumbrance

The more assets are used as collateral (termed “encumbered”) to mitigate counterparty risks, the less likely it is that unsecured creditors will receive what they are due in the event of a resolution, thus raising their costs. Encumbered assets are used to back up repayments owed to secured debt holders or the settlement of losses on derivatives contracts (see Table 3.4 in Annex 3.2 for an illustration). Collateral is useful for mitigating counterparty risks, and secured funding (including central bank funding) could be the only available source of market funding during a systemic liquidity crisis. However, higher asset encumbrance reduces the amount that debt holders without collateral will receive if the bank becomes insolvent, and therefore those debt holders will require higher yields to hold this debt. At the same time, other liability holders will be better protected (including those holding secured debt), and their required returns will likely be lower. The overall effect on funding costs will depend on the amounts of various types of funding instruments, the relative funding costs, and the underlying riskiness of the banks’ assets (both encumbered and unencumbered), leading to an ambiguous overall effect on funding costs.

Asset encumbrance can be driven by both transient and permanent factors.

- *Transient factors (including crises)*: Periods of financial distress can be accompanied by systemic liquidity shortages resulting from the declines in private short-term wholesale funding that occur when participants withdraw due to elevated counterparty credit risk. During such times, central banks provide liquidity to banks against collateral, leading to higher asset encumbrance (see Figure 3.8).²³ Moreover, weaker banks may only be able to tap private markets if they offer secured debt. These increases should dissipate once financial conditions normalize.

²³Gorton and Metrick (2012) indicate jumps in the reductions (“haircuts”) assigned in the U.S. private repo market. Covered bonds are typically issued with collateral whose value exceeds that of bonds, and this excess is measured by overcollateralization. Rating agencies often set the level of overcollateralization that is necessary to maintain a certain rating. These levels vary significantly across bonds, from less than 10 percent to more than 100 percent.

- *Regulatory factors*: In contrast, regulatory changes could lead to more permanent changes in asset encumbrance.²⁴
 - Some aspects of the Basel III liquidity regulations could encourage covered bond issuance and increase asset encumbrance. For instance, covered bonds qualify as a part of high-quality liquid assets, which would improve the liquidity coverage ratio if a bank holds covered bonds as assets.²⁵ The ratio for an issuing bank would improve if long-term covered bonds replace shorter-term wholesale funding. Issuing covered bonds can also improve the net stable funding ratio by raising the available amount of long-term stable funding.
 - OTC derivatives reforms will lower counterparty credit risks at the expense of higher encumbrance. The reforms will encourage participants to place collateral either with derivatives counterparties (including dealer banks) or with a formal central counterparty, both of which will receive preferential treatment in the event of resolution. Because activity in this market is dominated by banks, it is expected that the collateral requirements could be quite large, encumbering more assets.

The Impact of Bank Resolution Reforms

Two elements of the current bank resolution reform proposals could especially affect bank funding patterns and costs. These are: (1) depositor preference in liquidation, when bank operations are discontinued; and (2) the bail-in of creditors in resolution, when bank operations are maintained but, possibly, restructured.

Depositor preference gives depositors legal seniority over other senior unsecured creditors when a bank is closed, providing better protection for (small) depositors at the expense of bondholders (see Figure 3.12 and Table 3.4 in Annex 3.2). This preference contrasts with corporate liquidation systems in which all unsecured creditors are ranked equally (that is, *pari passu*), unless contracts state otherwise. Depositor preference can contribute to financial stability by enhancing depositor confidence and reducing contingent liabilities of the

²⁴For a discussion of covered bonds and the degree to which they alter bank incentives, see Jones and others (forthcoming).

²⁵Banks are becoming major investors of covered bonds issued by other banks, in part motivated by their preferential treatment in the liquidity coverage ratio framework. However, at the end of 2011, covered bonds amounted to less than 3 percent of high-quality liquid assets.

deposit guarantee scheme. Many countries, including the United States, already have some form of explicit depositor preference, and many provide implicit preferences during a systemic crisis. The international proposal—the Financial Stability Board’s *Key Attributes of Effective Resolution Regimes for Financial Institutions* (FSB, 2011)—does not require countries to adopt depositor preference. However, its use may facilitate the use of other resolution tools, such as bail-in.²⁶ A number of countries, including the European Union as a whole, are actively considering depositor preference. Depositor preference can be “tiered” so that insured deposits are covered first, with the deposit guarantee scheme stepping in to assume the rights of the depositor in liquidation proceedings (called subrogation), and then other deposits that are eligible for the deposit guarantee scheme coverage (but that exceed the insurance limit) are covered before payouts are made to senior unsecured creditors. This tiered structure offers the greatest financial protection for the state (or the deposit guarantee scheme), but also would concentrate potential losses on a smaller group of creditors.

Statutory bail-in aims to hold bank bondholders accountable for the risks they assume by removing the implicit too-big-to-fail subsidy for systemically important institutions and by imposing larger losses on them than on smaller retail creditors. Statutory bail-in grants authorities the power to write down debt or convert debt to equity when a bank is near failure so that these bailed-in debts absorb losses should capital be exhausted (see Zhou and others, 2012).²⁷ These powers become available when a bank is no longer viable but before it becomes insolvent, ensuring that

bank bondholders fully bear the risks they assume.²⁸ This action should remove bank bondholders’ expectations that their investments in systemically important banks will be bailed out by taxpayers. Bank bondholders are typically institutional investors who are assumed to have the capacity to make more informed choices and absorb losses more easily than retail depositors. Therefore, the Financial Stability Board’s proposal (FSB, 2011) excludes insured depositors (and secured debt holders) from bail-in, although some countries may exclude additional liabilities, such as short-term debt and interbank funding. These exclusions would increase losses for bail-in debt holders beyond what would have applied when they were ranked equally with all other senior creditors.²⁹ Hence, to attract bondholders for bail-in debt, their yields would need to rise to reflect the increased prospect of losses (Figure 3.12 and Table 3.4).

For bail-in powers to effectively provide more loss-absorbing capacity, banks would need to maintain a certain amount of bail-in debt, leading to proposals for some quantitative targets. The 2012 European Commission’s proposal (EC, 2012) suggests 10 percent of total liabilities (including regulatory capital) as the target. In the United Kingdom, the Vickers report (ICB, 2011) proposes loss-absorbing capacity between 7 and 10 percent of risk-weighted assets (in addition to equity amounting to 10 percent of risk-weighted assets). This level was set to ensure that banks would have enough loss-absorbing capacity to cover losses comparable to those that have materialized in the most recent bank failures.^{30,31}

²⁸The point at which a resolution authority decides a bank is not viable should be somewhere between breaching the regulatory minimum capital requirement and becoming insolvent, and it should be the same as for other bank resolution tools. The Basel III capital regulations already incorporate such bail-in characteristics with capital-qualifying debt instruments.

²⁹However, in the past, resolution authorities have protected some depositors without legal rights. For instance, a failing bank’s deposits and some corresponding assets may be transferred to other banks. Therefore, the current yield for senior unsecured debt should already reflect such differential treatment to some degree.

³⁰During 2007–10, the Anglo Irish Bank suffered a loss of 39 percent of risk-weighted assets, though all other banks saw losses of less than 16 percent.

³¹This emphasis on “large enough” loss-absorbing capacity contrasts with some of the traditional views that emphasize the role that even a small amount of debt (for example, subordinated debt) can play in motivating such creditors to monitor and discipline banks’ activities (Calomiris, 1999; Calomiris and Kahn, 1991). In contrast, Admati and Hellwig (2013) challenge the disciplining role of bank debt and propose that banks should have a higher amount of equity capital (15 percent of unweighted total assets) to absorb losses.

²⁶For example, if a resolution authority decides to restructure and revive a bank, forcing general debt holders to forgo some value (that is, bail-in) while protecting insured depositors, the general debt holders can potentially sue the resolution authority, claiming they would have been better off if the bank had been liquidated. Introducing depositor preference for insured depositors would align the recovery amount for general debt holders more closely to the bail-in amount, preventing such a lawsuit.

²⁷Statutory bail-in power and bail-in debt should not be confused with contingent convertible capital instruments (CoCos), despite their similarities. CoCos are new bank capital instruments that have contractual clauses indicating they are written off or converted to equity when contractually set criteria are met, such as a decline in the CET ratio to, say, 7 percent (a level that could be set above regulatory minimums). In contrast, statutory bail-in powers give legal rights to a country authority to give a haircut to general debt (such as senior unsecured debt or uninsured deposits, unless explicitly exempt) or convert it to equity when a bank is deemed not viable.

Potential Challenges Posed by the Regulatory Reforms

Strengthening resolution regimes will increase the cost of senior unsecured bonds but will also require a sufficient amount of bail-in debt to provide potential loss absorption.

- Introducing depositor preference would increase unsecured creditor losses in the event of a bank failure by reducing their seniority rank. This provides better protection for retail depositors and small and medium enterprises. Bail-in powers could also impose higher losses on unsecured creditors, increasing the cost of this bail-in debt. The largest effect on funding costs will likely be on systemically important banks because it will lessen the implicit subsidy they have received from their too-big-to-fail status. Some researchers (for example, Ueda and Weder di Mauro, 2012) estimate that the implicit subsidy is worth between 80 and 100 basis points. The exact cost impact of several configurations is explored quantitatively in the following section. The higher cost could drive banks to increase insured deposits and secured funding. It also raises the question of whether traditional investors in bank debt will purchase bail-in debt in the future (see Box 3.5).
- The growing use of deposits in some jurisdictions and the likelihood that uninsured deposits will either be formally preferred or given de facto preferential treatment in a resolution (for instance, via public guarantees to contain a deposit run) may reduce the effectiveness of bail-in powers, without commensurate efforts to ensure that sufficient bail-in debt is issued.

Some reforms encourage asset encumbrance, even though this may be detrimental to resolution processes. Excessive asset encumbrance reduces bail-in debt and makes resolution less effective. When too many assets are encumbered, unsecured creditors (including the deposit guarantee scheme) will incur higher losses in order to honor secured debt contracts and collateral payments. The full extent of asset encumbrance, including central bank funding during a crisis, short-term repos, and covered bonds with overcollateralization, is hard to gauge with current reporting systems. Therefore, some countries are improving the reporting of asset encumbrance or setting limits on encumbrance, for example, by limiting the combined value of assets that can be used to secure covered bonds.³² However, avoiding

³²For example, Australia, Canada, and Singapore set limits on asset encumbrance (with Australia's introduction in October 2011

higher asset encumbrance is difficult when banks face systemic funding difficulties. Attempts to introduce bail-in rules or limits to asset encumbrance in the middle of a systemic crisis could exacerbate instability. Moreover, limits on asset encumbrance may also make it more difficult to achieve the goal of making OTC derivatives safer. On the other hand, without such limits, a bank may have too few assets to be shared among unsecured creditors (including uninsured depositors and the deposit guarantee scheme) when they face resolution.

Basel III liquidity regulations and the alterations in resolution regimes may push bank funding structures in different directions and will likely drive some intermediation into the shadow banking arena (see Chapter 1). The liquidity regulations encourage (insured) deposit funding that is likely to be protected by depositor preference and from being bailed in, and hence may reduce the proportion of bail-in debt.³³ Banks also may rely on long-term secured debt to reduce maturity mismatches, encumbering more assets. Although the latest Quantitative Impact Study indicates banks are broadly on track to meet the liquidity ratios, European banks—the main issuers of covered bonds—have tended to lag. And in general, banks' ability to acquire funding may become more difficult, leaving room for other nonbank institutions (shadow banks) to collect savings and intermediate credit.

Implications of Regulatory Reforms on Bank Funding Costs: A Numerical Exercise

There have been many attempts to assess the cost implications of bail-in powers, depositor preference, and asset encumbrance, but few of these fully incorporate the changes in the overall funding structure of a bank. So far, the difference between the yield spreads of secured and senior unsecured bank debt has been relatively small compared with the spread against subordinated debt (Figure 3.13). Various market

corresponding to its allowance of covered bond issuance). The Netherlands, Norway, and the United Kingdom took a case-by-case approach that set threshold values for covered bond issues for individual institutions (Houben and Slingenberg, 2013). The European Banking Authority issued a consultation paper (2013) on strengthening reporting and transparency of asset encumbrance.

³³As an extreme example, suppose a bank funds itself with 90 percent insured deposits and 10 percent equity. This liability structure would be desirable from the perspective of the Basel III liquidity requirements but inconsistent with the desire to have bail-in debt. Of course, enough equity capital would supplant the need for bail-in debt.

Box 3.5. Investor Base for Bail-in Debt and Bank Bond Ratings

Three types of bail-in bonds are potentially available—senior, subordinated, and contingent convertible debt (or CoCos)—with different investor bases. The degree to which traditional buyers of senior bank debt are willing to purchase bail-in debt will largely depend on whether the issuing banks are able to maintain stand-alone investment grade status. CoCos would likely attract investors with higher risk tolerance because of their higher trigger points, compared with senior and subordinated debt. New regulations and accounting standards may also play a role.

Traditionally, the main buyers of senior bank debt have been insurers and pension funds, as well as some mutual funds devoted to investment-grade fixed-income instruments and sovereign wealth funds that have a moderate appetite for credit risk. Event-driven credit arbitrage hedge funds have also participated in this market, but they are more prominent in the subordinated bank debt market.

Investor demand for senior debt critically depends on whether the issuing banks maintain investment-grade ratings. According to a recent investor survey by JPMorgan (Henriques, Bowe, and Finsterbusch, 2013), 34 percent of European bank debt investors say they would reduce their investment in senior unsecured debt if it became a bail-in instrument, while 63 percent of them would maintain it as is. At the same time, survey participants indicated that the most important factor determining their decision would be whether the debt would still carry investor grade ratings. Recent guidelines provided by rating agencies suggest that only issuers with high stand-alone ratings would have investment grade senior bail-in debt. If that is the case, the investor base for senior debt may shrink. Currently, more than 90 percent of the senior unsecured debt issued by banks is investment grade.

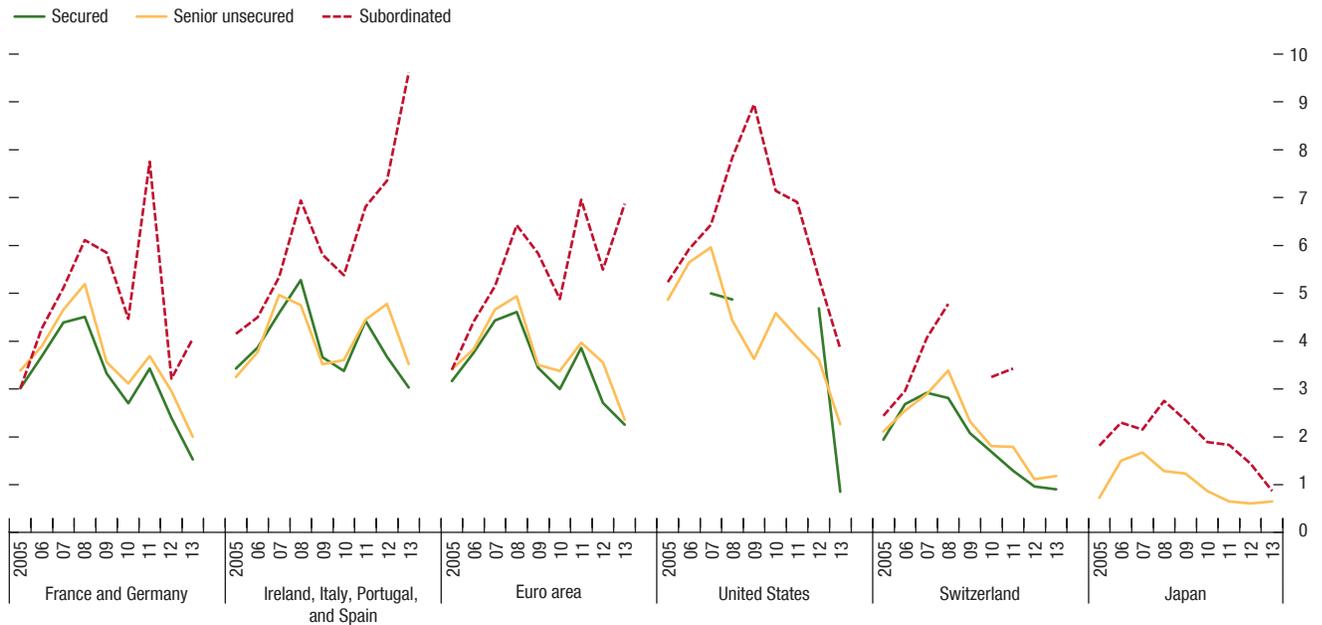
CoCos would likely attract investors with higher risk tolerance because of their higher trigger points, compared with senior and subordinated debt. The payoff structures of senior and subordinated debt are similar in the sense that the value of debt is written

off or converted to equity (the trigger point) when the resolution process is introduced (for example, when the corresponding capital ratio is between zero and the minimum requirement). By contrast, the trigger for CoCos is usually set at higher levels (closer to the minimum capital requirement), which would, all else equal, result in a higher probability of default, making these securities more attractive to investors with a higher tolerance for credit risk, such as hedge funds or high-yield investment funds. Given the more limited investor base, development of CoCos may be constrained. Total assets under management for event-driven credit arbitrage hedge funds are only \$16 billion, although the hedge fund industry has been growing rapidly, with year-over-year growth of 10 percent as of the end of 2012. Barclays (2013) estimates that the European CoCo market currently stands at only about €19 billion, but if interest from investors expands, then this could rise to as much as €400 billion, which is equivalent to the size of the existing European bank subordinated debt market.

Some investors may be constrained by regulations even though the current low interest rate environment would otherwise make them likely candidate buyers for bail-in debt. Insurance companies are a good example—two opposite factors influence their appetite (CGFS, 2011). The negative factor includes prospective changes to international regulatory and accounting standards, which can reduce demand for riskier bonds. New mark-to-market rules in international accounting standards are expected to increase the volatility of insurance companies' financial statements, making riskier assets with higher price variation less attractive. The Solvency II Directive in Europe, currently scheduled to be phased in beginning in 2014, will also require assets to be marked to market and more capital to be held against equity-like instruments, structured products, and long-term or low-rated corporate and bank bonds. However, the current low interest rate environment lowers insurers' profits (because many of them continue to offer high guaranteed returns or generous defined-benefit-type products), encouraging them to search for higher-yielding assets, creating potential demand for the riskier bail-in debt.

The authors of this box are Serkan Arslanalp and Takahiro Tsuda.

Figure 3.13. Bank Bond Yield to Maturity at Issuance: Selected Advanced Economies
(Percent)



Sources: Dealogic; and IMF staff estimates.

Note: Weighted average yield using deal volume, through May 2013. Excludes deals without volume or yield-to-maturity data, perpetual bonds, and those in foreign currencies. Sample includes both private and public banks but excludes agency bonds.

estimates indicate the yield of senior unsecured debt could increase by 100 to 300 basis points under bail-in powers. The current spread between existing CoCos and senior debt (about 500 basis points) is viewed by some as a good approximation, although CoCos are part of subordinated debt, which would continue to be ranked below senior bail-in debt (Le Leslé, 2012). Moreover, the estimates typically fail to account for the positive influence of the larger equity buffers that will be required under Basel III.

Depositor Preference and Asset Encumbrance

Depositor preference and asset encumbrance can be analyzed using a similar pricing model, despite their conceptual and legal differences. Both secured debt and preferred deposits have priority over other unsecured bondholders (see Annex 3.3).³⁴ Based on a stylized

³⁴To be exact, there are clear differences between having priority claims based on depositor preference and on asset encumbrance. Depositor preference provides legal seniority to deposits over other unsecured creditors. Secured debt holders have priority claim only up to the value of the collateral assets. If collateral value falls short of the face value of secured debt, then the creditors rank equally to other general debt holders for the shortfall amount. See Chan-Lau and Oura (forthcoming) for a fuller analysis of asset encumbrance.

liability structure, as in Figure 3.12, bondholders face losses on their debt when the total losses of the bank exceed the sum of all the claims with lower priority (that is, subordinated debt defaults when the losses are larger than the amount of equity). Therefore, changes in the ranking of priority or in the size of each type of debt affect the cost to other bondholders. For convenience, all types of instruments (including secured debt) that are ranked above other creditors are labeled “preferred creditors” in this exercise.

Because the resolution framework reforms are currently being actively debated in Europe, the yield spreads on each type of debt are calculated for a hypothetical bank that has characteristics broadly similar to those of large European banks.³⁵ In particular, the proportions of equity and subordinated debt to total assets are about 5 percent (see Figure 3.1) and 2 percent, respectively (using only balance sheet assets, not risk-weighted assets). To see the sensitivity of bank funding costs vis-à-vis bank capital levels, we also examine the

³⁵Based on the average capital structure for Royal Bank of Scotland, Commerzbank, DnB NOR, Société Générale, Lloyds, Barclays, HSBC, Banco Bilbao Vizcaya Argentaria, Intesa Sanpaolo, Nordea Bank AB, Danske Bank, Crédit Agricole S.A., and BNP Paribas.

yields when a bank hypothetically maintains two higher equity-to-total asset ratios: 10 percent, at the highest end of possible capital requirements across countries, and 15 percent, an even higher level.³⁶ The other liabilities are assumed to be funded either by deposits or senior unsecured debt. For large European banks, secured debt and deposits average about 17 percent and 48 percent, respectively (Street, Ineke, and McGrath, 2012).³⁷ With 24 to 70 percent of the deposits insured in Europe (see Annex 3.2), the exercise assumes that preferred creditors account for 30 to 50 percent of total liabilities.³⁸ The analysis measures bank riskiness using total asset volatility and considers two levels: 5 percent, close to the current average for global systemically important banks; and 10 percent, the worst case during the global financial crisis.³⁹ All debts are assumed to have zero coupons with a maturity of five years. The five-year risk-free rate is set at 3 percent.

The spreads across different funding instruments depend mostly on the underlying health and riskiness of bank assets and the share of preferred creditors. Figure 3.14 shows the calculated spreads for all types of debt over the risk-free rate for several underlying situations: (1) alternative proportions of preferred creditors (horizontal axis); (2) equity buffers; and (3) different levels of asset volatility. The figure also shows the yield of senior unsecured debt when it is ranked equally with preferred creditors (labeled as *pari passu* yields) for comparison. Introducing depositor preference changes the seniority structure and raises senior unsecured debt yields from the *pari passu* levels to the “senior unsecured” line in Figure 3.14. If preferred creditors represent secured bondholders, then the cost

³⁶A level of 10 percent equity to total assets roughly corresponds to the CET1 requirement with maximum possible buffers and a 0.7 percent ratio between risk-weighted assets and total assets (comparable to the levels in the United States and emerging market economies). It is worth noting that U.S. banks had an equity-to-total-asset ratio of more than 10 percent for the decades before World War II (Miles, Yang, and Marcheggiano, 2012). Although it is not universally endorsed by economists, Admati and Hellwig (2013) propose a 15 percent ratio.

³⁷Assuming repos and short sales are net with reverse repos.

³⁸These are very rough estimates, applying a range of national aggregate estimates for the share of insured deposits to the average share of deposits in total liabilities among the 13 large European banks. Much larger variations across individual banks could be present.

³⁹The 10 percent corresponds to the highest observation across time and across banks using total asset volatility as calculated by Moody's KMV for global systemically important banks (as defined by the Financial Stability Board) from January 2005 through June 2013. The median (across time and banks) is about 4 percent, and the average for May 2013 is 4.2 percent.

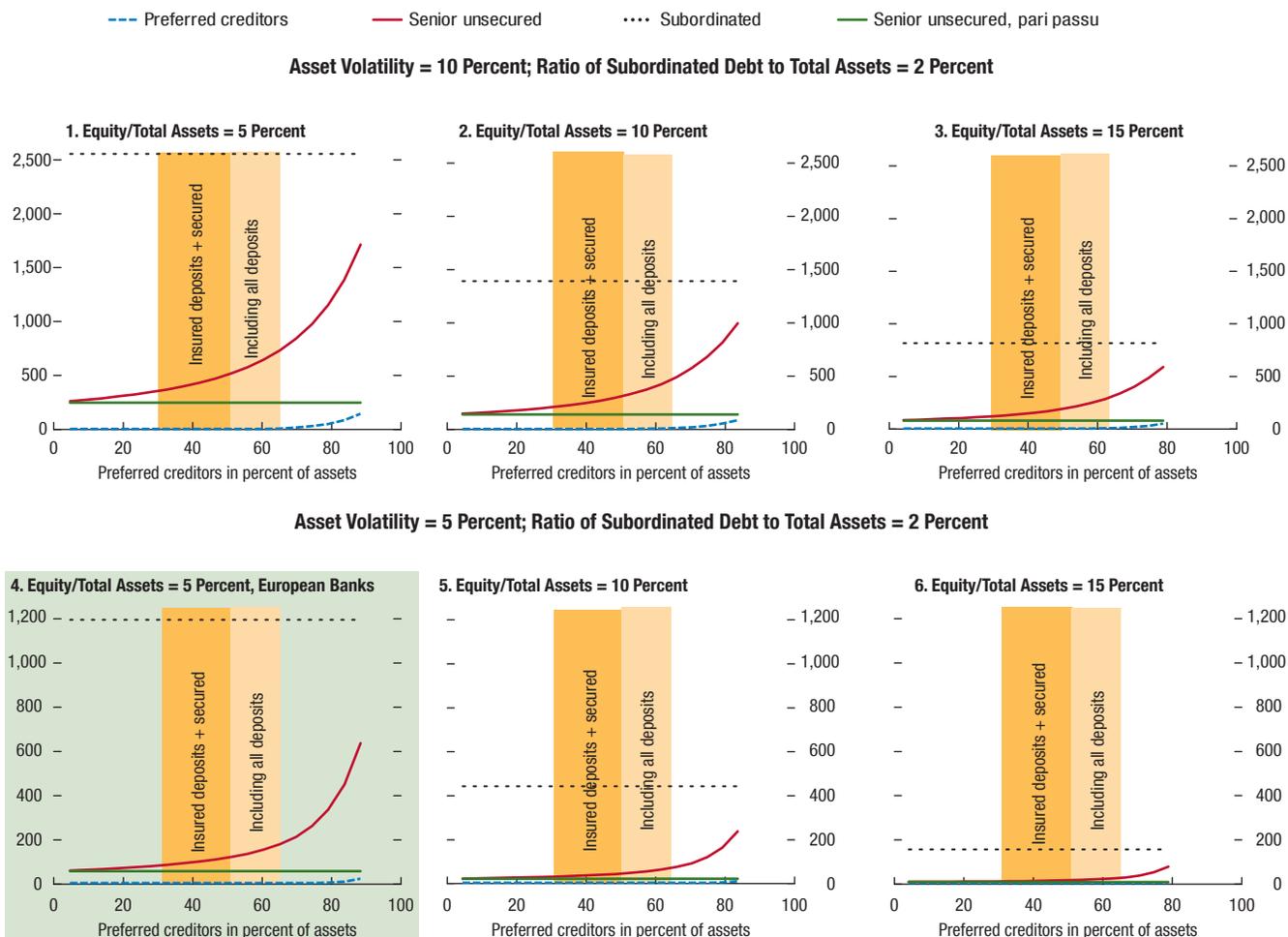
of senior unsecured debt changes (along the line) for different shares of preferred creditors:

- As bank capitalization (the equity-to-asset ratio) declines and asset volatility increases, spreads rise disproportionately, indicating much higher funding costs for riskier and less-capitalized banks. If a bank maintains recent levels of safety (5 percent asset volatility) and is exceptionally well capitalized (15 percent equity-to-asset ratio), even subordinated debt can be issued at a fairly low cost (below 200 basis points over the risk-free rate), and the senior unsecured debt yield rises fewer than 50 basis points regardless of the proportion of preferred creditors (Figure 3.14, panel 6).
- The exercise shows that the share of preferred creditors has a major influence on the spreads of senior unsecured debt (see Figure 3.14).

- (1) Asset encumbrance alone appears less likely to increase the cost of senior unsecured bonds to unbearable levels for European banks (Figure 3.14, panel 4). The share of secured debt, at an aggregate level, is about 25 percent even for Greece (see Figure 3.8). At these levels, the increase in the senior unsecured debt spread (along the “senior unsecured” line in Figure 3.14) is less than 30 basis points. The spread of senior unsecured debt over secure debt (preferred creditors' yield) is about 55 to 75 basis points, comparable to the actual differences for most European banks (see Figure 3.13).
- (2) However, the senior unsecured debt yield spread rises more appreciably with depositor preference. The spread would rise relative to the “senior unsecured *pari passu*” line and would depend on the share of preferred deposits, which can be much larger than secured debt. For European banks (Figure 3.14, panel 4), the increase is about 30 to 50 basis points when preferential treatment is limited to insured deposits (dark orange section in Figure 3.14) on top of secured debt. But it could range from 50 to 120 basis points when deposits that receive preferential treatment rise from 50 to, say, 65 percent of assets (light orange section).⁴⁰ The actual increases critically depend on the size of

⁴⁰Depositor preference should also reduce the cost of deposits from the senior unsecured *pari passu* debt levels to preferred creditors levels. However, banks might already enjoy low deposit funding costs thanks to a deposit guarantee scheme. In that case, higher seniority benefits the deposit guarantee scheme but not the banks.

Figure 3.14. Debt Pricing under Depositor Preference and Asset Encumbrance
(Spread over risk-free rate; basis points)



Source: IMF staff estimates.

Notes: "Preferred creditors" may include secured debt, preferred deposits, or both. The lines for "senior unsecured" show yield for holders of senior unsecured debt when they have lower priority than "preferred creditors." The lines for "senior unsecured, pari passu" show yields for senior unsecured debt (and for preferred creditors) when it is ranked the same as for preferred creditors.

Assumptions: Equity-to-total-asset ratio for European banks is about 5 percent (Figure 3.1), and the subordinated debt ratio is about 2 to 3 percent. A 10 percent equity-to-asset ratio roughly corresponds to the Basel III CET1 requirement, with maximum possible buffers and 70 percent risk-weighted-assets-to-total-asset ratio (e.g., U.S. and emerging market bank levels). The 15 percent corresponds to the proposal by Admati and Hellwig (2013). The asset volatility assumption is based on the estimate by Moody's KMV for global systemically important banks (January 2005–June 2013), with 10 (4) percent as the highest (median) across time and banks. The average for May 2013 is 4.2 percent. For large European banks, secured debt (assessing repos on a net basis) and deposits average 17 percent and 48 percent of the assets, respectively, and 24 to 70 percent of the deposits are insured (Table 3.5).

preferred deposits and the other parameters in the model.

- Depositor preference or asset encumbrance increases the cost of senior unsecured debt but not to the levels of subordinated debt. The spreads for senior unsecured debt are well below those for subordinated debt even when the share of preferred creditors is as high as 70 percent—the current share of total deposits for banks in Japan and

emerging Asia (see Figure 3.1). Senior unsecured debt is likely to remain a distinct asset class from subordinated debt.

Bail-in Powers

The pricing effects of introducing bail-in powers depend on the conditions for initiating a bail-in and the liabilities excluded from being bailed in. This section assumes that the bail-in debt is converted to

equity when the equity-to-asset ratio falls to 5 percent and original equity holders are diluted.^{41,42} It is further assumed that banks have three types of liabilities: (1) a liability that is exempted from being bailed in, labeled as “preferred creditors;”⁴³ (2) bail-in senior unsecured debt; and (3) capital (equity and capital-qualifying subordinated debt combined). Capital buffers of 7 percent, 12 percent, and 17 percent are considered.⁴⁴ Other assumptions are the same as in the depositor preference and asset encumbrance cases.

The simple existence of bail-in powers would have a relatively small impact on bail-in bond yield spreads (Figure 3.15):

- The effect of converting bail-in liabilities to equity is small. The “benchmark” yield spread shows the yield spread of senior unsecured debt that is junior to preferred creditors. The difference between the benchmark and bail-in debt yield spreads represents the effects of conversion to equity. For European banks, the difference is small when the exemption is limited to insured deposits and secured debt (dark orange section). When all deposits are exempted (the share of preferred creditors is about 65 percent), bail-in debt costs about 50 basis points more than the benchmark yields (difference between red dashed and red solid lines).
- However, the share of exempt liabilities (namely, preferred creditors) plays a large role similar to that of the depositor preference and asset encumbrance cases. The benchmark yield spreads themselves are already 120 basis points higher than the yield spreads when senior unsecured debt is ranked equally to preferred creditors (pari passu yields), because seniority is given to preferred creditors.

Bank-Specific Estimates

The simulation is applied to four global systemically important banks with distinctive capital structures and risks to gauge whether the model produces realistic

⁴¹This is a fairly high trigger point: the equity-to-asset ratio for European banks is a little higher than 5 percent (see Figure 3.1).

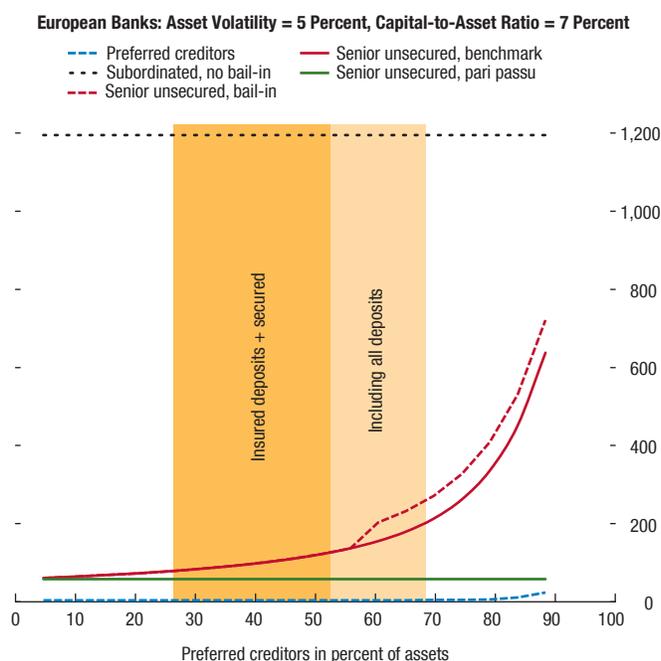
⁴²In practice, there will be uncertainty as to exactly when authorities will exercise their bail-in power. This uncertainty is excluded from this illustrative exercise.

⁴³As discussed in Annex 3.2, in reality, some deposits may be considered to be bail-in instruments, while some types of senior unsecured debt (for example, short-term debt) may be exempted.

⁴⁴For simplicity, the subordinated debt and equity funding in the previous exercises are combined into capital. Therefore, the capital levels of 7 percent, 12 percent, and 17 percent are considered, respectively combining 5 percent, 10 percent, and 15 percent of equity with 2 percent of subordinated debt.

Figure 3.15. Debt Pricing under Bail-in Power
(Spread over risk-free rate; basis points)

The liability side has three instruments: deposits—exempt from bail-in; senior unsecured bail-in debt—converted to equity when the capital-to-asset ratio declines to 5 percent; and capital.



Source: IMF staff estimates.

Note: The “senior unsecured, benchmark” line is the same as the “senior unsecured” line in Figure 3.14 and represents the yield when senior unsecured debt is junior to “preferred creditors,” but not subject to bail-in. When “senior unsecured, benchmark” bonds are de facto junior to “preferred creditors” their yield is already higher than that of “preferred creditors” and the yield when the two are ranked equally (“senior unsecured, pari passu”). In addition, applying bail-in power and converting them to equity when the bank becomes unviable will raise their yield from the “senior unsecured, benchmark” line to the “senior unsecured, bail-in” line yield. The equity buffer in this figure corresponds to the sum of equity and subordinated debt in Figure 3.14.

Assumptions: The capital-to-total-asset ratio for European banks is about 7 percent (equity plus subordinated debt). The asset volatility assumption is based on the estimate by Moody’s KMV for global systemically important banks (January 2005–June 2013), with 10 (4) percent as the highest (median) across time and banks. The average for May 2013 is 4.2 percent. For large European banks, secured debt (assessing repos on a net basis) and deposits average 17 percent and 48 percent of the assets, respectively, and 24 to 70 percent of the deposits are insured (Table 3.5).

outcomes. These represent an investment bank, a global retail bank, a stressed European bank, and a U.S. retail bank (Table 3.1 and Figure 3.16).

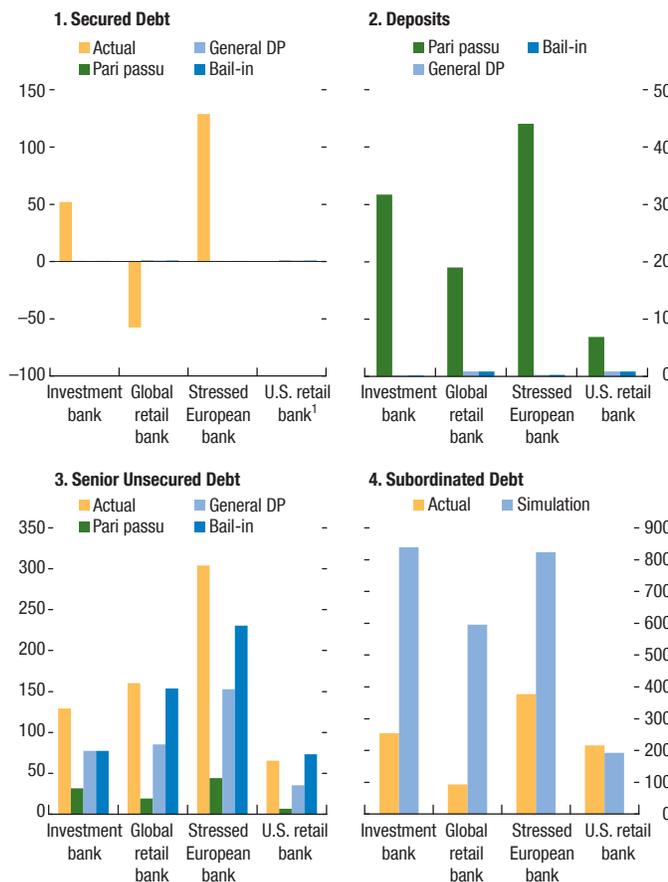
- *Senior unsecured debt:* The difference between the simulated yields and the actual yields is consistent across the four banks. For example, the yields are much higher for the stressed European bank than for the U.S. retail bank. Across banks, the actual yields are close to those of bail-in debt, indicating that changes in resolution frameworks may already be priced into current yields (although the current yields could also reflect heightened sovereign risk of the countries in which they are headquartered).

Table 3.1. Characteristics of Four G-SIBs in Simulation Exercise

	Investment Bank	Global Retail Bank	Stressed European Bank	U.S. Retail Bank
Percent of Total				
Capital Structure				
Secured Debt	16.0	6.5	22.2	2.5
Deposits	44.7	67.0	49.2	70.5
Senior Unsecured Debt	30.5	18.1	19.1	14.8
Subordinated Debt	3.7	2.5	3.0	1.2
Equity	5.1	5.9	6.4	11.1
Percent				
Asset Volatility	4.5	3.8	5.1	3.9

Sources: Company annual reports; Moody's KMV; Street and others (2012); and IMF staff estimates.
 Note: G-SIBs = global systemically important banks.

Figure 3.16. Simulation Results for Specific Banks
 (Yield to maturity for five-year debt; spreads over risk-free rate; basis points)



Sources: Bloomberg, L.P.; and IMF staff estimates.
 Note: DP = depositor preference. The pari passu case assumes that all deposits and senior unsecured debt are ranked equally. The general DP case assumes that all depositors (irrespective of sector or insurance coverage) will rank above senior unsecured debt. The bail-in case also assumes that all deposits are exempt from bail-in. Simulated deposit rates exclude effects from deposit insurance. Risk-free rates are proxied by five-year government bond yields for Germany (for euro-denominated debt) and the United States (for dollar-denominated debt). Actual yield to maturity corresponds to August 2013 and is computed as the weighted average of bonds issued in the currency most used by the bank and including all maturities.
¹No actual data are available.

- *Subordinated debt:* The large equity buffer and low risk of the U.S. retail bank keep its simulated subordinated debt yield at low levels, which is in line with the actual and at much lower levels than for other banks (Figure 3.16, panel 4). However, for other banks, market yields are much lower than simulated yields, which could reflect in part a too-big-to-fail subsidy.
- *Secured debt and deposits:* Depositor preference and bail-in powers can provide strong protections to depositors, reducing the deposit rate to the near-risk-free rate, even without deposit insurance. Simulated secured debt yields are also near risk-free rates, although they are not close to the actual yields, perhaps owing to specific characteristics of the debt that are not well captured in the model.⁴⁵

Funding Structure and Incentives to Make a Bank Safer

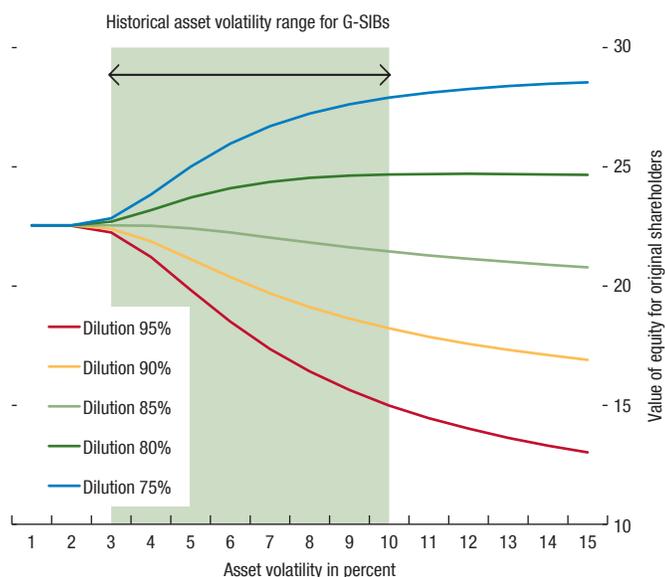
Although difficult to determine for banks as a whole, banks' total funding costs may decline if the reforms are calibrated to provide shareholders with incentives to prefer safer asset portfolios. For instance, bail-in powers that ensure that shareholders are heavily diluted when a bank becomes unviable could be particularly effective for reducing the risk-increasing behavior that shareholders normally exhibit in a limited liability setting. With bail-in powers, the gains from pursuing higher asset volatility for the original shareholders may be offset by the costs that would come from equity dilution. When the cost is sufficiently large, the original shareholders would prefer a safer portfolio with low asset volatility (Figure 3.17).

Summary and Policy Recommendations

The analysis confirms the relevance of bank funding structures for financial stability. Banks have diverse

⁴⁵These characteristics would include the maturity, collateral, and extent of overcollateralization.

Figure 3.17. Equity Value for Original Shareholders under Bail-in Regime Converting Debt to Equity



Source: IMF staff estimates.

Note: G-SIBs = global systematically important banks. Ten percent dilution means bail-in debt holders receive 10 percent of (new) equity after they are converted to shareholders, whereas 90 percent of the new equity is given to original shareholders. Original shareholders' claim is diluted by 10 percent in this case. For simplicity, this exercise assumes two types of liabilities: (bail-in) debt and equity. It is assumed that \$100 is initial asset value, \$90 is face value of total debt, and 3 percent is the risk-free rate. Debt is converted to equity when asset value declines to \$92.

funding patterns that change only slowly. The empirical results suggest that countries in which banks were overly reliant on short-term wholesale funding (primarily larger banks in many advanced economies) were more likely to experience financial instability. They also suggest that banks with more stable, diversified funding structures and those that carry less leverage are less likely to experience distress. Since the start of the global financial crisis, some improvements have been made, with most banks lowering their overexposure to short-term wholesale funding, but the funding structures of some banks, particularly those in distress, have not improved similarly, and they remain vulnerable.

Overall, the reform agenda aims to make financial systems safer by improving the shock resistance of bank funding structures and by forcing bank creditors to assume their contractual obligations. However, the reforms to bank capital and liquidity, to OTC derivatives, and to bank resolution will likely have different and perhaps unintended consequences for some institutions. Specifically, there is a trade-off between, on the one hand, pressuring banks to increase their use of more secured funding (raising levels of asset

encumbrance) and insured deposits and, on the other hand, ensuring that some debt holders bear more losses in a resolution through reforms to resolution regimes (bail-in debt and the prospects for additional depositor preference). Altogether, these elements of reform raise the cost of unsecured bail-in debt, in particular. For systemically important banks, the reforms will likely increase the overall cost of funding, particularly by reducing the too-big-to-fail subsidy enjoyed by these financial institutions. Weaker institutions may also experience a larger impact, particularly if they have inadequate amounts of capital. For other banks, the overall impact is ambiguous and will depend on the relative costs and amounts of different funding sources, the level of equity capital, and the underlying riskiness of their assets.

A numerical examination of these potential trade-offs shows that the simulated price impact on unsecured senior debt spreads is relatively small under present conditions, including in euro area countries. But the share of preferred deposits and the level of asset encumbrance are important drivers of the cost of bail-in debt, which rises disproportionately more than when the share of these other liabilities increase in the funding structure. For weaker banks, the increased risk to unsecured bondholders may leave traditional investors unwilling to hold this debt and may make it difficult to issue enough of it to maintain its market-discipline role. In this event, these institutions would need to raise more equity capital and perhaps restructure their operations and alter their funding structures.

However, these potential trade-offs can be managed so as to ensure that the financial stability benefits of the reforms can be realized and hence the current set of reforms should move forward in a deliberate manner, paying close attention to their potential interactions. The following policy recommendations for capital and liquidity rules, asset encumbrance, bail-in powers, and depositor preference will help.

New Basel Capital and Liquidity Regulations

- First and foremost, equity capital plays a quantitatively significant role in reducing the probability of bank failures and in lowering the cost of any type of debt. Capital requirement reforms that raise the amount of common equity should be implemented without delay because more equity supports economic growth and mitigates the effects of other

reforms that may increase the cost of bail-in debt.⁴⁶ The positive effects on the cost of debt are disproportionately large if a bank builds its capital buffer beyond Basel III requirements.

- As noted in previous issues of the GFSR, supervisors should continue to implement Basel III liquidity standards as agreed. The new global liquidity standards for the liquidity capital ratio and net stable funding ratio are designed to discourage short-term wholesale funding, and they are unlikely to result in rapid, large-scale changes in banks' funding structures, in part because many banks already satisfy the requirements and their implementation is gradual. Indeed, the standards for the net stable funding ratio have yet to be completed, and early agreement would help lessen uncertainties surrounding its final contours.

Concentration in Funding and Asset Encumbrance

- Although the reforms should continue to be implemented on the current timelines, regulators and policymakers need to monitor the effects of all the policies that increase demand for collateral (including the introduction of the liquidity capital ratio and net stable funding ratio as well as reforms to OTC derivatives) and weigh the resulting asset encumbrance against the resilience to liquidity risk and lower counterparty risks. Limits on encumbrance, for example, on covered bonds, may be one way of ensuring a diversified funding structure and the benefits from other reforms. However, consideration would need to be given to different business models and country circumstances. In particular, the introduction of limits on encumbrance during a period of funding stress may be counterproductive, limiting the ability of banks to obtain necessary funding through the use of, for instance, covered bonds.
- Market discipline and appropriate risk-pricing mechanisms for bank debt can be enhanced by requiring banks to provide regular, standardized public disclosure of their liability structures and asset encumbrance. Appropriately priced liabilities are important for ensuring that good risk- and burden-sharing arrangements exist across all stakeholders.

⁴⁶See Chapter 4 of the October 2012 GFSR for an estimate of the positive implications of higher capital buffers on output growth.

Bail-in Powers and Depositor Preference

- When the proportion of preferred creditors is too large, a bank may find it difficult to preserve a sufficiently large proportion of unsecured debt to absorb losses if capital is exhausted. In such cases, minimum bail-in debt requirements can be used. By the same token, depositor preference regimes can usefully signal to depositors the likelihood that they will receive their deposits in case of bank distress and thereby prevent runs and support financial stability. To the extent that a deposit guarantee scheme is already in place, a tiered depositor preference structure is desirable—one that prefers insured deposits (and the deposit guarantee scheme that substitutes for such depositors when liquidation takes place, that is, through subrogation) over uninsured deposits and that prefers both over other senior unsecured creditors, as this will help to lower contingent claims on the government.
- To the extent that bail-in powers and depositor preference reduce demand for debt issued by banks regarded as systemically important, market discipline is enhanced because these banks no longer receive a funding advantage. Traditional long-term buyers of senior bank debt—insurers and pension funds—appear to be willing to purchase bail-in debt if the issuing banks are able to maintain stand-alone investment-grade ratings and carry sufficient equity capital buffers. If the debt turns out to be too risky for traditional holders even at higher yields, a different investor base may develop. Regardless, it will be important to ensure that all investors are fully aware of the risks they assume by means of appropriate disclosures of the terms under which they could be bailed in. This calls for greater clarity around the statutory criteria used by resolution authorities for putting a bank into resolution and for applying the bail-in tool, among others. Hence, appropriately balanced with other reforms, bail-in powers and depositor preference can be effective ways to limit government bailouts and enhance financial stability.
- The timing of any introduction of depositor preference or bail-in powers should be carefully considered, taking into account the specific funding structures of banks in each country and their vulnerability to systemic funding shocks. If systemic financial stress is low, depositor preference or bail-in powers could usefully be introduced sooner rather than later, so as to be in place in advance of bank

failures. However, in countries in which balance sheet repair and the restructuring of distressed institutions are still under way, the introduction of these measures could inadvertently increase the likelihood of failures. For example, the recent shift in nonresident holdings of bank debt securities in the euro area suggests that the risks may be getting more localized and concentrated in some countries. At the same time, distressed banks rely increasingly on secured funding. Hence, the ongoing risk of a recurrent systemic liquidity crisis highlights the urgency of first dealing with distressed banks, before introducing depositor preference or bail-in powers. Discussions within the EU appear to be focusing on dates far enough in the future to reduce the risk that the introduction will be destabilizing, but only if balance sheet repair and restructuring are accomplished first.

Overall, some bank funding structures are more closely associated with financial stability than others. Many banks in emerging market economies already have safer structures than do their advanced economy counterparts, and some of the reforms discussed above may not be necessary in those economies. Regardless of the funding structure, however, any type of bank debt is safer and less costly when there is adequate equity capital in place. Therefore, policymakers in both advanced and emerging market economies must continue to pay close attention to this component, so that these other reforms can achieve their intended objectives.

Annex 3.1. Data Description and Additional Empirical Results

This annex describes the data sources, contains technical background, and provides key results from the empirical analysis in this chapter.

Data Sources and Coverage

The analysis is based on detailed bank-level balance sheet and market statistics from listed and unlisted banks in advanced and emerging market economies. Table 3.2 reports country and bank coverage statistics. Primary data sources are SNL Financial and Dealogic for the stylized developments in funding patterns. Bloomberg, L.P., is used for the empirical analysis. SNL Financial's annual data coverage starts in 2005 or 2007 for banks outside the United States (somewhat

earlier for U.S. banks), while the Bloomberg coverage starts as early as 1990 globally. The analysis ends with data for 2012. The empirical analysis also uses IMF and World Bank macrofinancial time series and governance indicators. The definitions of the variables and data sources are in Table 3.3.

Determinants of Bank Funding Patterns

To answer the question of what drives bank funding structures, the following panel regression model is estimated:

$$Z_{ijt} = \alpha BANK_{ijt-1} + \beta MACFIN_{jt-1} + \gamma REG_{jt} + \delta Z_{ijt-1} + Fixed\ effects + \varepsilon_{ijt}, \quad (3.1)$$

in which Z denotes a source of funding (bank equity, debt, or deposits expressed as a fraction of total assets) or the loan-to-deposit ratio. $BANK$ is a vector of bank-specific factors, $MACFIN$ is a vector of macro-financial factors, REG is a vector of institutional and governance indicators, and ε is the model's residual for bank i in country j in year t .⁴⁷ The coefficients (or coefficient vectors) to be estimated are α , β , γ , and δ . Separate ordinary-least-squares panel regressions are estimated for each source of funding, with and without cross-section and time-fixed effects, using robust standard errors. Models are estimated in levels because funding variables do not contain unit roots by construction (funding structure shares are bound between zero and 1), but include a lagged dependent variable to account for slow adjustment toward a preferred funding structure.^{48,49} The general-to-specific approach is applied to arrive at the final specification for each funding source.

The empirical evidence here indicates that bank funding structures are affected mainly by bank-specific factors, but also by macrofinancial and market variables as well as by the regulatory environment. The

⁴⁷See Table 3.3 and Gudmundsson and Valckx (forthcoming) for a more detailed description of the explanatory variables and expected signs.

⁴⁸To attenuate potential endogeneity, explanatory variables are lagged one period.

⁴⁹Gropp and Heider (2010); Octavia and Brown (2010); Brewer, Kaufman, and Wall (2008); Demirgüç-Kunt and Huizinga (2010); Rauh and Sufi (2010); Lemmon, Roberts, and Zender (2008); and Antoniou, Guney, and Paudyal (2008) also analyzed bank and nonfinancial companies' funding structures, using similar firm-specific variables but different country samples or time periods. See Gudmundsson and Valckx (forthcoming) for a detailed review.

Table 3.2. Country and Bank Coverage Statistics

Bloomberg, L.P. Sample								SNL Financial Sample							
Advanced Economies				Emerging Market Economies				Advanced Economies				Emerging Market Economies			
All	Euro Area		Other	All	Asia	CEE		AE	Euro Area		Other	EM	Asia	CEE	
Australia	6	Austria	Australia	Argentina	6	China	Croatia	Australia	16	Austria	Australia	Bulgaria	8	China	Bulgaria
Austria	7	Belgium	Canada	China	16	India	Poland	Austria	16	Belgium	Canada	China	77	India	Croatia
Belgium	3	Cyprus	Denmark	Croatia	5	Indonesia	Russia	Belgium	11	Cyprus	Czech Republic	Croatia	14	Indonesia	Hungary
Canada	7	Finland	Hong Kong SAR	India	30	Malaysia	Turkey	Canada	11	Finland	Denmark	Hungary	8	Malaysia	Lithuania
Cyprus	3	France	Japan	Indonesia	29	Philippines		Cyprus	4	France	Hong Kong SAR	India	38	Pakistan	Poland
Denmark	10	Germany	Norway	Malaysia	9	Thailand		Czech Republic	6	Germany	Iceland	Indonesia	25	Philippines	Romania
Finland	2	Greece	Singapore	Philippines	14			Denmark	40	Greece	Japan	Lithuania	5	Thailand	Russia
France	7	Ireland	Sweden	Poland	13	<u>Latin America</u>		Finland	5	Ireland	Korea	Malaysia	20	Vietnam	Turkey
Germany	6	Italy	Switzerland	Russia	36	Argentina		France	34	Italy	New Zealand	Pakistan	4		Ukraine
Greece	13	Malta	United Kingdom	Thailand	11			Germany	75	Luxembourg	Norway	Philippines	8		
Hong Kong SAR	7	Netherlands	United States	Turkey	14			Greece	12	Malta	Sweden	Poland	16		
Ireland	3	Portugal			183			Hong Kong SAR	20	Netherlands	Switzerland	Romania	9		
Italy	16	Slovenia						Iceland	3	Portugal	Taiwan Province	Russia	33		
Japan	52	Spain						Ireland	13	Slovak Republic	of China	Thailand	14		
Malta	3							Italy	56	Slovenia	United Kingdom	Turkey	17		
Netherlands	3							Japan	42	Spain	United States	Ukraine	11		
Norway	3							Korea	14			Vietnam	5		
Portugal	6							Luxembourg	14				312		
Singapore	3							Malta	4						
Slovenia	5							Netherlands	14						
Spain	10							New Zealand	7						
Sweden	4							Norway	27						
Switzerland	9							Portugal	7						
United Kingdom	9							Singapore	4						
United States	46							Slovak Republic	6						
	243							Slovenia	3						
								Spain	55						
								Sweden	6						
								Switzerland	37						
								Taiwan Province							
								of China	21						
								United Kingdom	30						
								United States	75						
									688						

Source: IMF staff.

Note: AE = advanced economies; CEE = central and eastern Europe; EM = emerging market economies. Number of banks effectively used in the computations and estimations is indicated after the country's name. Banks are stand-alone legal entities (subsidiaries) within the country in question. SNL Financial data cover both listed and nonlisted banks (top 100 by assets for the United States) which are either operating or acquired/defunct companies from North America, Europe, and the Asia-Pacific region. The Bloomberg sample contains listed and nonlisted banks from western and eastern Europe, developed and developing Asia, and North and Latin America, retrieved using Bloomberg's EQS and PSCR functions.

main results are as follows, focusing on statistically and economically⁵⁰ significant variables:

- *Partial adjustment to preferred funding levels:* A 1 standard deviation shock to banks' funding sources can shift funding sources by between 1 and 3 percentage points (5 to 10 percentage points for the loan-to-deposit ratio). The impact is larger since 2007 compared with the precrisis period and for emerging market economy banks relative to advanced economy banks. Also, comparable shocks to equity funding result in smaller adjustments than do debt and deposit shocks.
- *Size:* Larger banks have less equity and more debt (and higher loan-to-deposit ratios). The reduction in equity ratios is proportionately larger for emerging market economy banks (−1.6 percentage points)

⁵⁰Economic significance is gauged by 1 standard deviation shocks to the explanatory variables, which makes their effects comparable.

than for advanced economy banks (−0.3 percentage point) and systemically important banks (−0.5 percentage point).

- *Profitability and securities and tangible assets:* Banks that pay dividends and those with higher profitability have lower equity ratios (−0.3 percentage point for a 1 standard deviation shock to the return on assets). Safer banks, with more securities and tangible assets to total assets, tend to have lower debt ratios (−1 percentage point for every 1 standard deviation increase in “tangibility”) and lower loan-to-deposit ratios (about a 3 percentage point impact from a 1 standard deviation shock).
- *Growth and currency volatility:* Banks in countries with (1 standard deviation) higher GDP growth experience about 2 percentage points less debt and higher deposit and equity-to-asset ratios (and 4 percentage point lower loan-to-deposit ratios). Higher currency volatility reduces debt reliance (and

Table 3.3. List of Variables Used in the Panel Data Analysis

Variable	Definition	Data Source
Dependent Variables		
Equity/Assets	Total equity divided by total assets	Bloomberg, L.P.
Deposits/Assets	Customer deposits divided by total assets	Bloomberg, L.P.
Debt/Assets	Nondeposit liabilities divided by total assets	Bloomberg, L.P.
Explanatory Variables		
Bank-Specific Variables		
Size	Log of total assets	Bloomberg, L.P.
Profitability	Pretax income divided by total assets	Bloomberg, L.P.
Growth Assets	Annual growth in total assets	Bloomberg, L.P.
Dividend Payer	Dummy that equals 1 if bank pays dividend	Bloomberg, L.P.
Collateral	Securities + interbank assets + fixed assets divided by total assets	Bloomberg, L.P.
Business Model I	Share of net interest income to interest and noninterest income	Bloomberg, L.P.
Business Model II	Loans to total assets	Bloomberg, L.P.
Asset Quality	Loan loss provisions to loans	Bloomberg, L.P.
Macroeconomic and Financial Market Variables		
GDP Growth	Annual growth rate of real GDP	WEO
Inflation	Annual change in the consumer price index	WEO
Interest Spread	Long-term bond yield minus short-term interest rate	WEO, WB
Stock Return	Annual change in the country's main stock market index	Bloomberg, L.P., WB
Bond Market Capitalization	Outstanding volume of nonfinancial corporate bonds to GDP	BIS, WB
Stock Market Capitalization	Outstanding volume of stock market capitalization to GDP	WB
Household Saving Ratio	Household savings to disposable income	WEO, WB
Government Debt	General government gross debt to GDP	WEO
Openness I	Current account surplus or deficit, percent of GDP	WEO
Openness II	Exports plus imports to GDP	WEO
Openness III	External positions of reporting banks vis-à-vis individual countries' banks (difference between all sectors and nonbanks) relative to GDP	BIS Locational Banking Statistics
Foreign Exchange Volatility	Standard deviation of monthly currency rate return against SDR	IFS
Stock Market Volatility	260-day standard deviation of daily stock returns	Bloomberg, L.P.
Banking Crisis Dummy	Dummy variable that equals 1 if the country experiences a systemic banking crisis for the duration of the crisis	Laeven and Valencia (2012)
Regulatory and Institutional Variables		
Government Effectiveness ¹	Perception of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	WB
Regulatory Quality ¹	The ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	WB
Rule of Law ¹	The extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence	WB
Accountability and Voice ¹	Perception of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media	WB
Legal Origin	A dummy variable that identifies the legal origin of the company law or commercial code of each country. The five origins are English, French, German, Nordic, and socialist.	La Porta and others (2000)
Bank Funding Structure Variables		
Senior Debt	Principal amounts outstanding on loans, notes payable, bonds, securities sold under repurchase agreements (repos), mortgage-backed bonds, short-term borrowing, mortgage notes and other notes payable, capitalized lease obligations, and other debt instruments not classified as subordinated debt	SNL Financial
Subordinated Debt	Debt in which the creditor's claims to the bank's assets are subordinated to those of other creditors	SNL Financial
Total Equity	Includes par value, paid-in capital, retained earnings, and other adjustments to equity. Minority interest may be included per relevant accounting standards.	SNL Financial
Wholesale Funding Ratio	Interbank borrowing, repo debt, and senior and subordinated debt relative to total debt and customer deposits	SNL Financial
Secured Funding Ratio	Secured senior debt relative to both secured and unsecured senior debt outstanding, aggregated by country	DCM Analytics
Core Tier 1 Capital	Core common capital as defined by regulatory guidelines	SNL Financial
Additional Tier 1 Capital	Tier 1-eligible hybrid capital securities, reserves, and allowances; minority interests; and other Tier 2 capital adjustments as defined by the bank's domestic central bank/regulator	SNL Financial
Tier 2 Capital	Tier 2-eligible hybrid capital securities, reserves, and allowances; minority interests; and other Tier 2 capital adjustments	SNL Financial
Tier 3 Capital	Eligible subordinated debt and other capital adjustments	SNL Financial

Source: IMF staff.

Note: BIS = Bank for International Settlements; IFS = IMF, International Financial Statistics Database; SDR = special drawing right; WB = World Bank; WEO = IMF, World Economic Outlook Database.

¹Governance indicators are in units of a standard normal distribution, with mean zero, standard deviation of 1, and ranging from approximately -2.5 to 2.5, with higher values corresponding to better governance. Data are taken from the World Bank Doing Business Database.

lowers loan-to-deposit ratios) by about 1 percent (2 percent) in the full sample and for systemically important banks.

- *Savings and deposits*: Banks in countries with (1 standard deviation) higher household savings rates enjoy (between 0.5 and 0.8 percentage point) higher deposit financing and have lower loan-to-deposit ratios.
- *Regulatory factors*: Systematically important banks in countries with high-quality regulatory environments (“Regulation”) have more than 1 percent higher deposits. Banks in countries with stronger disclosure have marginally higher equity and deposit ratios and lower loan-to-deposit ratios.

Bank Funding Patterns and Financial Stability

In line with recent studies, we examine whether bank funding structures have an impact on financial stability when combined with other bank characteristics and macrofinancial factors.⁵¹ Using the Bloomberg panel data set described previously, we estimate a (panel/pooled time series) probit model:

$$P\{\text{Distress}_{ijt} \mid X_{ijt-1}, Z_{jt-1}\} = F(\beta_{ij}X_{ijt-1} + \beta_j Z_{jt-1}), \quad (3.2)$$

in which $P\{\}$ is the probability that bank i from country j will be in distress at time t , conditional on bank-specific and country-level characteristics X_{ijt} and Z_{jt} . $F(\cdot)$ is the standard normal distribution function that transforms a linear combination of the explanatory variables into the $[0,1]$ interval. The estimations use lagged explanatory variables to reduce endogeneity concerns and report robust standard errors. The general-to-specific approach is applied to arrive at the final probit specifications.

Given that the data do not directly provide bank status characteristics (default versus going concern),

⁵¹Vazquez and Federico (2012) find that European and U.S. banks with higher net stable funding ratios (NSFRs) and equity-to-asset ratios before the 2008–09 crisis had lower crisis failure probabilities. Demirgüç-Kunt and Huizinga (2010) showed that wholesale funding and banks with higher noninterest income experience higher average fragility, for banks from 101 countries. Demirgüç-Kunt, Detragiache, and Merrouche (2010), for 313 banks from 12 countries, and Beltratti and Stulz (2009), for 98 large banks from 20 countries, find that better capitalized banks (and large, more deposit-financed banks) saw smaller stock price declines during the crisis, whereas wholesale funding increased bank fragility. Bologna (2011) and Berger and Bouwman (2013) find that U.S. banks with less stable deposit funding were more likely to fail, controlling for nonperforming loans and capital ratios. Huang and Ratnovski (2009) find that deposit funding contributed to the stability of banks in Canada and 72 other large Organization for Economic Cooperation and Development country banks during the crisis.

various 0–1 dummy variables are constructed to characterize banking distress:

- *Balance sheet distress*: Bank z-scores below 3, which corresponds to the lowest decile of the panel series’ distributions, are used as an indicator of potential capital shortfall.
- *Bank equity price distress*: Price-to-book ratios below 0.5, which comprises the lowest 7.5 percent of the banks, are used. Stock returns falling by 60 to 90 percent during a given year are also considered and yield broadly similar results.
- *Analysts’ ratings*: Bank equity analysts’ ratings (on a scale of 1 to 5, with 1 a strong sell and 5 a strong buy) below 2.5, which corresponds to the 10 percent left tail, are used.

The exercise uses five different characteristics of bank funding:

- *Loan-to-deposit ratio*: roughly corresponds to the wholesale funding ratio because it measures the deposit funding gap to be filled by debt (or equity);
- *Funding concentration*: a Herfindahl index of bank funding structure (sum of squared percentages of debt, deposits, and equity), with higher values indicating less diverse funding;
- *Short-term debt funding*: the share of debt expiring within the year, as a share of total bank debt;
- *Banks’ debt-to-asset ratios*: the ratio of debt liabilities to total assets; and
- *Banks’ equity-to-asset ratios*: the ratio of total equity to total assets.

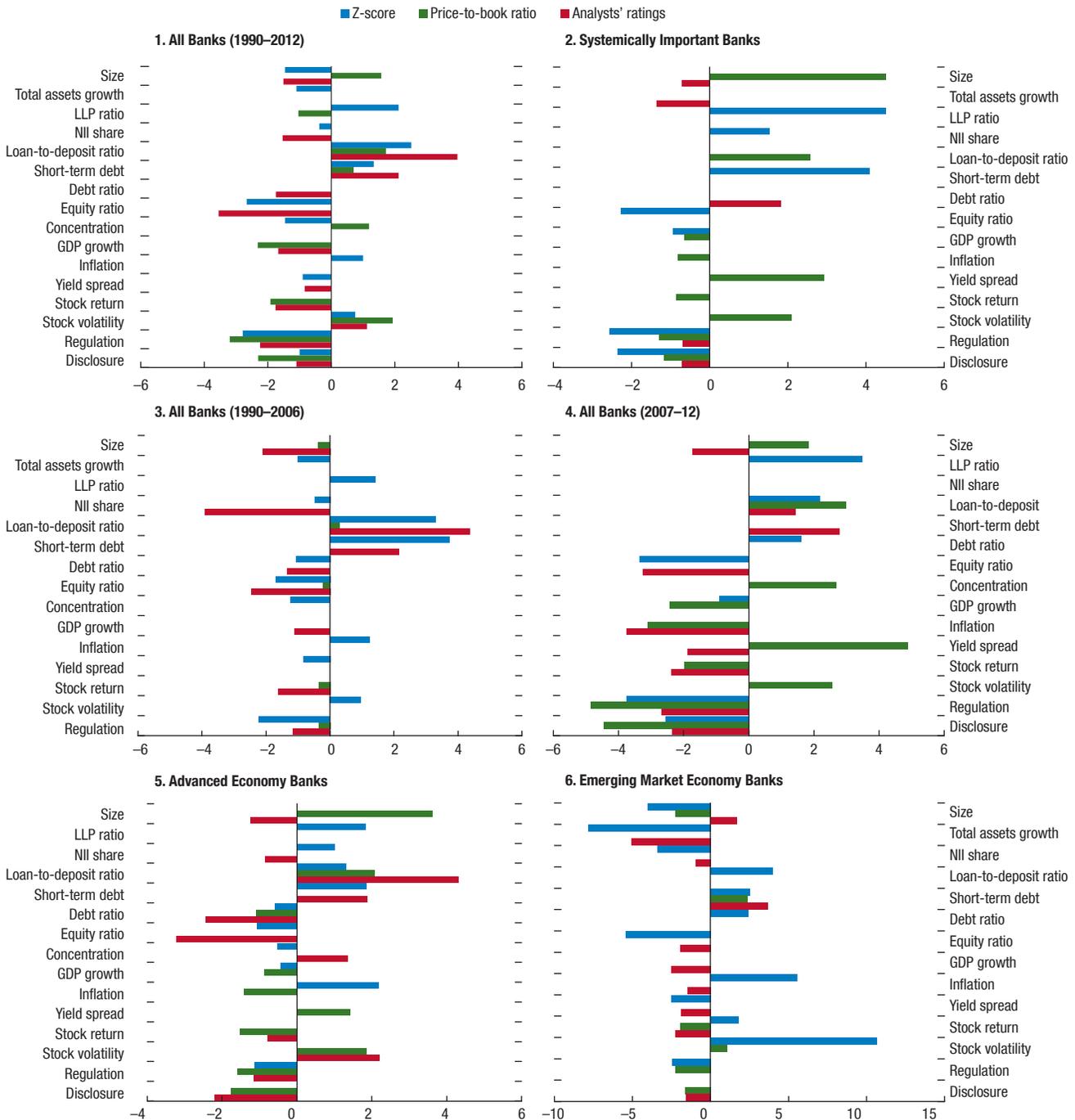
The assumption is that higher loan-to-deposit ratios, less diverse funding sources, higher reliance on short-term debt funding, and higher leverage will increase banks’ probabilities of distress.

Other bank-specific factors and general macroeconomic conditions are controlled for. These include size, asset growth, the loan loss provision ratio, real GDP growth, inflation, the interest rate term spread, as well as the broad stock market return and volatility.

The results suggest that, in addition to bank funding, some other bank characteristics, as well as the macrofinancial and broad regulatory environment, significantly affect banks’ distress probabilities (Figure 3.18). Focusing on 1 standard deviation shocks away from the mean, the impact on distress probabilities are as follows:

- *Size*: Bigger advanced economy banks and larger systemically important banks seem 3.6 to 4.5 percent more likely to be under stress (under the price-to-book

Figure 3.18. Contribution of Specific Variables to Bank Distress in Probit Models
(Relative size; percentage points)



Sources: Bloomberg, L.P.; and IMF staff estimates.

Note: LLP = loan loss provisions; NII share = net interest income in percent of operating income. Regulation and disclosure are the first and second principal component scores, derived from the four World Bank indicators of regulatory and institutional quality. See Table 3.3 for details on factors and their definitions. Figure shows the economic significance of bank and country characteristics, evaluated at the variable's mean plus 1 standard deviation on the probability of distress specified under alternative distress models and samples. Bank distress is a dummy variable, defined either as a z-score below 3, price-to-book ratio below 0.5, or average analyst ratings of 2.5 or lower. Different probit estimations are performed for the full 1990–2012 sample (all banks), the 2007–12 period, advanced economy banks, and emerging market economy banks. The emerging market economy sample contains banks from developing Asia and central and eastern Europe.

- measure), whereas large emerging market economy banks seem 2 to 4 percent less likely to be under stress.
- *Asset growth:* More rapidly growing emerging market economy banks seem less likely to be under stress, by up to 8 percent.
 - *Asset quality:* Banks with higher loan loss ratios have up to 4.5 percent higher distress probabilities with the z-score measure (but not using the price-to-book or analysts' ratings distress measures).
 - *Retail versus wholesale focus:* Banks with more traditional business (higher net interest income to total income) experience slightly lower distress overall, especially using the analysts' ratings-based distress measure. However, chances of distress for more traditional advanced economy banks and systemically important banks increase by 1 to 1.5 percent using the z-score measure. In the same vein, banks with a more wholesale orientation experience substantially higher distress probabilities, of 4 percent or more, with some measures.
 - *Funding structure, debt, and equity:* Increases in short-term debt, or in overall debt ratios for emerging market economy banks and systemically important banks, raise banks' distress probabilities by 1 to 4 percent. Higher equity buffers, however, uniformly lower distress probabilities across all measures, by up to 5.5 percent.
 - *GDP growth, yield spreads, and inflation:* Higher growth results mostly in 0.5 to 2.5 percent lower banking sector distress. Similarly, higher yield spreads reduce the likelihood of distress using the z-score and analysts' ratings measures by 1.0 to 2.5 percent (but using the price-to-book measure, higher yield spreads raise distress). Banks in higher-inflation countries are more likely to be in distress according to the z-score measures (+5 percent distress for emerging market economy banks), whereas the price-to-book and analyst ratings measures indicate the reverse, probably reflecting the possibility of hedging against inflation with stocks (up to 4 percent lower distress).
 - *Stock return and volatility:* Higher market returns and lower volatility are beneficial to banking stability and are significant across the various specifications, with effects on distress probabilities broadly between 1.0 and 2.5 percent.
 - *Regulatory quality and disclosure:* Stronger and better-quality regulatory environments, as well as countries with higher disclosure requirements, reduce banking distress probabilities by between 1 and 5 percent.

Annex 3.2. Regulatory Developments Affecting Bank Funding

This annex summarizes the details of Basel III capital and liquidity regulation and proposals for strengthening resolution framework for financial institutions.

Basel III Capital Regulation

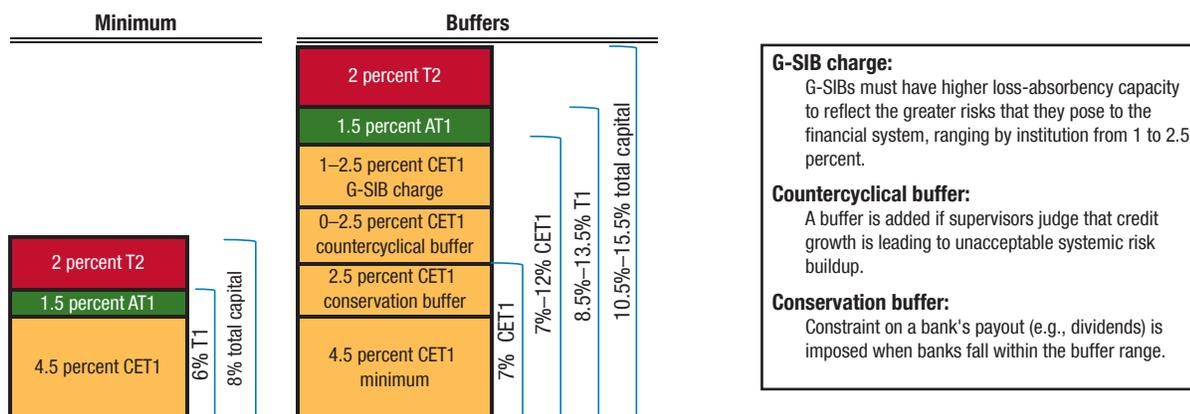
Basel III capital regulations require more and better capital than do Basel II regulations. The majority of the minimum capital requirement should be of the highest quality (common equity). Various buffers are added for macroprudential purposes or to account for the systemic relevance of some institutions (Figure 3.19). Basel III also requires more capital to better cover risks from securitization, the trading book (including proprietary trading), and banks' exposures to derivative counterparties, other financial institutions, and central counterparties (namely, counterparty risks). A non-risk-based leverage ratio will be added to minimum requirements in 2018 and could stem a buildup in leverage caused by off-balance-sheet exposures and repo transactions.

Basel III Liquidity Regulations

The Basel III liquidity regulation includes two quantitative ratios: the liquidity capital ratio (LCR) and the net stable funding ratio (NSFR). The LCR assesses shorter-term (30-day) vulnerability to liquidity shocks, and the NSFR aims to reduce maturity mismatches over one year. Specifically:

- The LCR is defined as the stock of high-quality liquid assets as a proportion of the bank's net cash outflows over a 30-day time period. Banks will be required to maintain a 100 percent LCR when the phase-in period ends in 2019. The size of the net outflow is based on assumed withdrawal rates for short-term liabilities, according to their stability (for example, withdrawal rates are lower for insured retail deposits than for deposits from corporations and nonresidents) and the potential drawdown of contingency facilities. Having more long-term debt (maturities greater than 30 days) is positive for the LCR, because its associated outflow within 30 days is zero.
- The NSFR is defined as a bank's available stable funding (ASF) divided by its required stable funding (RSF) and must be greater than 100 percent. Each

Figure 3.19. Basel III Minimum Capital Requirements and Buffers
(Percent of risk-weighted assets)



Source: IMF staff based on BCBS (2010a).

Note: AT1 = additional Tier 1; CET1 = common equity Tier 1; G-SIB = global systemically important bank; T2 = Tier 2. The G-SIB surcharge, in principle, could be as high as 3.5 percent, but currently no SIBs are charged more than 2.5 percent.

asset category is assigned an RSF “factor,” which is lower for liquid assets and higher for illiquid assets. Similarly, ASF factors are assigned to each liability category, and the factors are higher for more stable liabilities (for example, capital, long-term debt with a maturity of more than one year, and insured deposits) and lower for less stable funding (for example, short-term wholesale funding).

Reform Agenda for Resolution Frameworks

Despite an agreement on the broad initiatives for strengthening resolution frameworks, there is not yet full agreement on some specific aspects, including the scope of bail-in, depositor preference, and minimum holdings of bail-in debt. At the global level, the Financial Stability Board’s *Key Attributes of Effective Resolution Regimes for Financial Institutions* were agreed to by the G20 in 2011 and cover both bail-in powers for authorities and protection of insured depositors. Many countries are making progress in implementing them, and a date of the end of 2015 has been set.⁵² Even before the global initiatives,

⁵²At the same time, separate proposals in individual countries or regions have emerged, including the Dodd-Frank Act (Dodd-Frank [2012]) in the United States, which has provisions for bank resolution, and the EU’s Recovery and Resolution Directive. The agreement of the European Commission on the directive would, if enacted, introduce depositor preference and phase in bail-in powers in the European Union. In addition to the legislative proposals, recommendations by high-level committees and expert groups such as the U.K.’s Vickers’ report (ICB, 2011) and the EU’s Liikanen report (High-Level Expert Group on Reforming the Structure of the

however, some countries already had bail-in powers or depositor preference (for example, the United States).

Depositor preference provides seniority to some depositors over other senior unsecured debt holders at liquidation (Table 3.4). Liquidation is a form of resolution in which the bank’s assets are sold and the values recovered are used to pay creditors in the order of priority. Without depositor preference, insured depositors hold the same seniority as other senior unsecured debt holders; therefore, their recovery ratios (without considering payouts from the deposit guarantee scheme) at the time of a bank failure are the same (examples [A] and [E] in Table 3.4). In a liquidation with depositor preference, and when asset recoveries are insufficient to repay all senior creditors, depositors are paid before senior unsecured debt holders, and their recovery ratios are higher (examples [B] and [F] in Table 3.4). The formal introduction of depositor preference with bail-in powers would help to limit legal challenges and claims for compensation in cases of resolution, even if the bank is not liquidated, making bail-in powers more effective.

There are two main forms of depositor preference. The specifics of existing and proposed forms vary across countries, suggesting that the share of preferred deposits in total liabilities varies substantially (Table 3.5).⁵³

EU Banking Sector, 2012) also discuss providing bail-in powers to authorities and raising the loss-absorbing capacity of banks.

⁵³Several countries have some forms of depositor preference legislation in place, including Argentina, Australia, Austria, Belgium, China, Germany, Greece, Hong Kong SAR, Italy, Latvia, Norway, Portugal, Romania, Russia, Singapore, Spain, Switzerland, the United Kingdom, and the United States.

Table 3.4. Illustration of Creditor Hierarchy and Loss Sharing under Alternative Resolution Tools

	Without Asset Encumbrance										
	Balance sheet		[A]: Liquidation (+DGS, no DP) ¹		[B]: Liquidation (+DGS and insured DP) ²		[C]: Bail-out ³		[D]: Bail-in, with exclusion of insured deposits ⁴		
	Assets	Liabilities	Recovery	Liabilities	Recovery	Assets	Liabilities	Recovery	Assets	Liabilities	Recovery
Remaining value of asset \$70	\$40 insured deposits	\$40 insured deposits (including \$9 DGS payment)	100% (78% without DGS)	\$40 insured deposits	100%	Remaining value of asset \$70	\$40 insured deposits	100%	Remaining value of asset \$70	\$40 insured deposits	100%
\$30 losses on assets	\$50 senior unsecured debt	\$39 senior unsecured debt	78%	\$30 senior unsecured debt	60%	Bail-out subsidy \$30	\$50 senior unsecured debt	100%	\$23 senior unsecured debt	\$23 senior unsecured debt	46% + \$7 equity
	\$2 sub. debt	\$0 sub. debt	0%	\$0 sub. debt	0%		\$2 sub. debt	100%	\$0 sub. debt	\$0 sub. debt	0%
	\$8 equity	\$0 equity	0%	\$0 equity	0%		\$8 equity	100%	\$0 equity	\$0 equity	0%
Bank operations		Discontinued		Discontinued		Continue			Continue		
DGS cost, net		\$9	78%	\$0	...			...		\$0	...
Taxpayer cost, excluding DGS		\$0	...	\$0	...		\$30	...		\$0	...
Recovery value calculations											
DGS/insured deposits without DGS		70x(40)/(40+50)		...			...			...
Senior unsecured debt		70x(50)/(40+50)		70-40			...			70-40-7	
DGS net payment to depositors		40-70x(40)/(40+50)		...			...			...

Table 3.4. Illustration of Creditor Hierarchy and Loss Sharing under Alternative Resolution Tools (concluded)

Balance sheet		[E]: Liquidation (+DGS, no DP) ¹		[F]: Liquidation (+DGS and insured DP) ²		[G]: Bail-out ³		[H]: Bail-in, with exclusion of insured deposits and secured debt ⁴	
Assets	Liabilities	Liabilities	Recovery	Liabilities	Recovery	Assets	Liabilities	Assets	Liabilities
Remaining value of asset \$70	\$10 secured	\$10 secured	100%	\$10 secured	100%	Remaining value of asset \$70	\$10 secured	Remaining value of asset \$70	\$10 secured
	\$40 insured deposits	\$40 insured deposits (including \$10 DGS payment)	100% (75% without DGS)	\$40 insured deposits	100%		\$40 insured deposits		\$40 insured deposit
\$30 losses on assets	\$40 senior unsecured debt	\$30 senior unsecured debt	75%	\$20 senior unsecured debt	50%	Bail out subsidy \$30	\$40 senior unsecured debt		\$13 senior unsecured
	\$2 sub. debt	\$0 sub. debt	0%	\$0 sub. debt	0%		\$2 sub. debt		\$7 equity	$7 equity
	\$8 equity	\$8 equity	0%	\$0 equity	0%		\$8 equity		\$0 equity
		Discontinued		Discontinued		Continue		Continue	
Bank operations									
DGS cost, net		\$10		\$0		...		\$0	
Taxpayer cost, excluding DGS		\$0		\$0		...		\$0	
Recovery value calculations									
DGS/insured deposits without DGS		(70-10)x(40)/(40+40)		70-10-40		...		...
Senior unsecured debt		(70-10)x(50)/(40+40)		...		...		70-10-40-7	
DGS net payment to depositors		40-(70-10)x(40)/(40+40)		...		...		...

Source: IMF staff.

Note: DGS = depositor guarantee scheme; DP = depositor preference. Loss and recovery amounts include rounding errors. Senior unsecured debt includes uninsured deposits.

¹Liquidation with DGS: Insured-depositor claims are paid in full by the DGS and the DGS "steps into" the rights of the insured depositors in liquidation proceedings. DGS (taking the place of depositors) ranks equally (pari passu) with other senior unsecured creditors.

²Liquidation with DGS and DP: Insured-depositor claims are paid in full by the DGS and the DGS "steps into" the rights of the insured depositors in liquidation proceedings. DGS (taking the place of depositors), under DP, ranks above senior unsecured creditors in the proceedings.

³Bail-out: In the example, the government is assumed to make good on the losses caused by too-big-to-fail concerns through an asset-protection scheme without charge. The government could instead inject capital (perhaps after writing off subordinated debt and equity) to absorb the losses and add fresh equity buffers, while protecting the payments to senior debt holders, depositors, and secured debt holders.

⁴Bail-in: The bank is rehabilitated with debt restructuring, under the bail-in power given to the country authority. Insured deposits are assumed to be exempt from bail-in, as per the FSB's Key Attributes. (This does not necessarily imply giving DP in liquidation—a country with a bail-in resolution regime may have a liquidation framework with DP, as in cases [A] and [E]). Losses are first absorbed by equity and subordinate debt holders and then by senior unsecured debt holders, whose claims are partly written down and partly converted into new equity. The conversion values are set to achieve a 10 percent capital-to-asset ratio in this example.

⁵Secured debt holders have senior claim on the collateral assets to (insured) deposits and senior unsecured debt and are exempt from bail-in. For simplicity, secured debt is assumed to be fully collateralized. If the remaining value of assets is below \$50 in cases [F] and [H], losses are first absorbed by depositors (through the DGS). Secured debt holders experience losses only when the asset value falls below \$10.

Table 3.5. Cross-Country Comparison of Covered Deposits, end-2010

	Total Domestic Deposit Base (billions of U.S. dollars)	Covered Deposits (percent of total)	Eligible Deposits (percent of total)
Cyprus ¹	128	24	...
Greece ¹	169	63	...
France	1,742	67	92
Germany	3,395	...	40
Italy	2,050	31	45
Netherlands	1,202	48	59
Spain	1,963	47	65
Switzerland	1,481	24	73
United States	7,888	79	100

Source: Financial Stability Board (2012a).

¹IMF staff estimates.

- *Insured depositor preference* provides preferential treatment for insured deposits and ranks all other senior unsecured creditors, including uninsured deposits, equally.
- *General depositor preference* gives preference to all deposits of a deposit-taking institution, including to balances higher than the deposit insurance limit over senior unsecured creditors.
- *Tiered depositor preference* prefers insured deposits (and the deposit guarantee scheme through subrogation) over uninsured deposits and prefers both over senior unsecured creditors.

In contrast to depositor preference, bail-in power is applied when a bank failure is resolved while keeping the bank operational (see Table 3.4). Junior stakeholders (subordinated debt and shareholders) are the first to lose their stakes, and if these amounts are not sufficient to restore viability, senior debt holders are then bailed in at the discretion of the resolution authority (Table 3.4, examples [D] and [H]). Secured debt holders and some depositors may be exempt from bail-in; therefore, their recovery amounts are assumed to be higher than those of the senior unsecured debt holders.

Several aspects of bail-in power for bank rehabilitation need to be established in advance. The first is the scope of bail-in debt as discussed in the main text. The second is establishing when this power would be exercised. The power should be applied when a bank becomes unviable, which could be any time after a bank breaches a regulatory capital ratio but before it becomes insolvent, and therefore requires further specificity in legislation. The third is creditor seniority order. Bail-in powers could impose losses on creditors in a different order and of a different magnitude than losses in liquidation. For instance, bailing in senior unsecured debt holders while exempting insured depositors (cases [D] and [H] in Table 3.4) could

make senior unsecured debt holders worse off than in liquidation, in which they would be treated equally (cases [A] and [E] in Table 3.4). This outcome could lead to a lawsuit. Formal introduction of depositor preference simultaneously with bail-in power would align the recovery for debt holders in liquidation and restructuring, limiting legal challenges and claims for compensation.

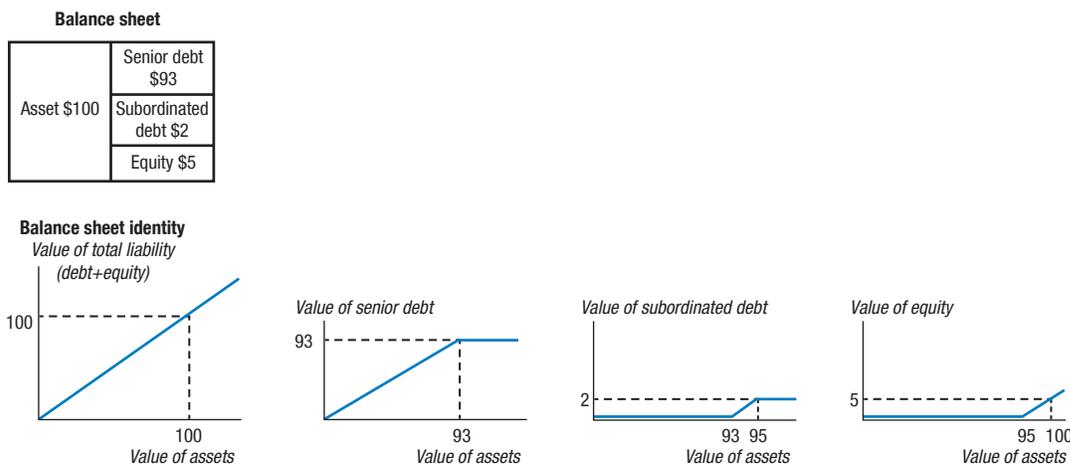
Annex 3.3. Bank Bond Pricing Model

Merton-Style Bond Pricing Framework for Senior and Subordinated Debt and Equity

The price of a bond that may default depends on the value of a bank's assets relative to the face value of the bond and its seniority rank. Consider a bank that issues only three types of liabilities, senior and subordinated debt as well as equity (Figure 3.20). The total liabilities of the bank, excluding equity, are \$95. If the asset value is greater than \$95, both senior and subordinated debt holders (creditors) recover the full face value of debt and the rest goes to shareholders (for example, if the asset value is \$110, shareholders receive \$15). But if the value of assets declines below \$95, the bank defaults. The recovery after bank failure for debt holders depends on their seniority and the capital structure. For instance, if the asset value becomes \$50, senior debt holders receive \$50, while subordinated debt creditors and shareholders recover \$0. If the asset value is between \$93 and \$95, senior creditors receive \$93, shareholders recover \$0, and the rest goes to subordinated creditors.

The contingent nature of the liabilities suggests that a standard option pricing formula can be used to value these liabilities. The value of equity is the same as the value of buying a call option—that is, the right to buy the asset at a strike price of \$95—on the bank's

Figure 3.20. Pricing of Senior and Subordinated Debt and Equity



Source: IMF staff.

Note: The balance sheet identity implies that the total value of assets should be equal to the total value of liabilities, which is the vertical sum of the values of senior debt, subordinated debt, and equity.

total assets (see Figure 3.20). The value of senior debt over the risk-free asset is represented by the value of selling a put option—the right to sell the asset at the strike price of \$93—on the bank’s assets.

Once the value of equity and senior debt is calculated, the balance sheet identity determines the value of subordinated debt that sits between senior debt and equity. It is calculated as the difference between total assets and the sum of the equity and senior debt values, because balance sheet identity implies that the value of all types of debt and equity will sum to the value of total assets. In other words, a liability with a seniority ranking between senior debt and equity can be modeled as a combination of purchasing a call option with a strike price of \$93 and selling a call option with a strike price of \$95 as shown in Figure 3.20. (Options strategists call this a “vertical spread.”) This figure represents the potential payoffs to subordinated debt holders at maturity of the option.

The chapter’s analysis adopts all the assumptions stated by Merton (1974), including that the asset value follows a geometric Brownian motion. The asset value changes at any given future date are distributed normally.⁵⁴ Default is assumed to occur only at maturity—that is, the options are “European.”

⁵⁴More complex and realistic processes, including jump-diffusions or distributions with fatter tails, can be accommodated within this framework. The numerical results should be taken as illustra-

Bond Pricing with Depositor Preference or Asset Encumbrance

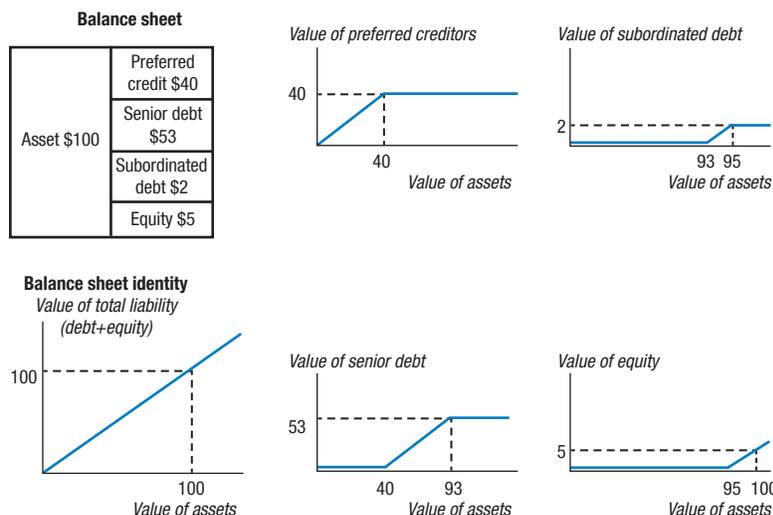
Both depositor preference and asset encumbrance (that is, the use of secured debt) in effect create an additional type of liability that is ranked above other senior debt for pricing purposes. The senior debt in Figure 3.20 is now split into a “preferred creditor” status that is senior to all other debt and to both senior debt and subordinated debt in Figure 3.21. “Preferred creditor” debt in this exercise includes every type of debt that will have preferential ranking over other senior debt as a result of depositor preference or asset encumbrance.⁵⁵

The changes in seniority ranking affect the value of liabilities relative to the case without asset encumbrance or depositor preference (see Figure 3.12 for an illustration of the creditor hierarchy). The values of equity and subordinate debt remain the same, because their seniority ranking is unaffected. Figure 3.21 shows

tive examples rather than precise estimates; the qualitative analysis, however, is robust.

⁵⁵To be precise, secured debt holders have seniority only up to the value of their collateral assets. However, central bank repurchase agreements (mostly short term, with haircuts on the collateral assets) and covered bonds (overcollateralization, which implies the collateral is greater than that needed to ensure payments) are structured such that they are very likely to recover full value of the debt. See Chan-Lau and Oura (forthcoming) for a fuller analysis of asset encumbrance in the situation in which secured creditors have less than full seniority over other creditors. The quantitative impact is small.

Figure 3.21. Pricing of Liabilities with Depositor Preference and Asset Encumbrance



Source: IMF staff.

Note: The balance sheet identity implies that the total value of assets should be equal to the total value of liabilities, which is the vertical sum of the values of preferred credit, senior debt, subordinated debt, and equity.

how different combinations of puts and call options on the asset value of the bank can be used to price the liabilities.

Preferred creditors face losses only when the asset value declines to less than \$40. In contrast, senior debt faces losses when the asset value declines to less than \$93, which is when the equity and subordinated debt buffers are used up. Moreover, the recovery value of senior debt is also lower than it would be if it were ranked equally with deposits, given that \$40 of the assets' value is reserved to first pay off preferred creditors. The probability of default of senior debt remains the same because the bank defaults whenever the asset value is \$93 but its recovery value declines, which is reflected in higher yields relative to the case in which senior debt ranks equally with deposits.

Bail-in Debt

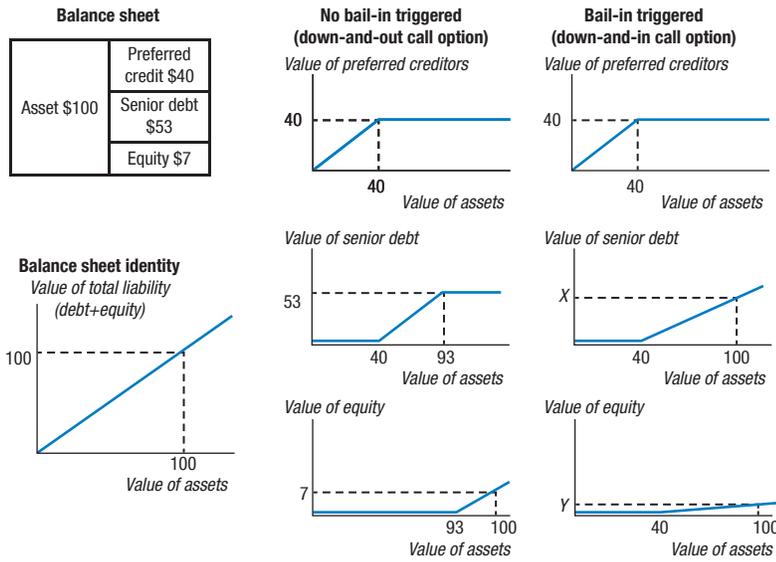
When bail-in powers are exercised, all bail-in debt is assumed to be converted to equity when the equity-

to-asset ratio calculated using market values falls below a prespecified level, set at 5 percent in this exercise.

The recoveries for bail-in debt and equity depend on whether the event is triggered (Figure 3.22). Their values can be expressed as a combination of two barrier options that have closed-form solutions: a down-and-out call option that assigns recovery values provided the bail-in is not triggered and a down-and-in call option for when bail-in is applied.⁵⁶ When bail-in is triggered, senior debt holders and existing shareholders are assumed to receive new equity in proportion to the market value of their respective claims at the time of bail-in.

⁵⁶Barrier options are options whose payoffs depend on the strike price and an additional event. A down-and-out (down-and-in) option ceases to exist (becomes activated) if the value of the underlying asset falls below a prespecified value, or barrier value, at some point during the life of an option.

Figure 3.22. Pricing of Liabilities under Bail-in Power



Source: IMF staff.

Note: X and Y depend on the extent of dilution for existing shareholders when bail-in power is applied. In this exercise, senior debt holders and existing shareholders are assumed to receive new equity in proportion to the market value of their respective claims. Suppose $SenD^*$ and E^* represent the market value of senior debt and equity, respectively, when bail-in kicks in. Senior debt holders receive $SenD^*(SenD^*+E^*)$ percent of new equity and the rest goes to existing shareholders. The balance sheet identity implies that the total value of assets should be equal to the total value of liabilities, which is the sum of the values of preferred credit, senior debt, subordinated debt, and equity.

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