

Monitoring Financial Stability in Developing and Emerging Economies

Practical Guidance for Conducting Macroprudential Analysis

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Abstract

In the aftermath of the global financial crisis, interest in systemic risk has surged among academics and policy makers. The mitigation of systemic risk is now widely accepted as the fundamental underlying concept for the design of the post-crisis regulatory agenda. Effective mitigation requires the presence of a well-developed analytical methodology for monitoring systemic risk, so that policy makers can make informed policy choices. This remains a challenging

area, particularly in developing and emerging economies characterized by rapid structural changes and gaps in data availability. This working paper aims to provide policy makers in developing and emerging economies with practical tools for the analysis of systemic risk, focusing on the identification of domestic, systemically important banks; analyzing interconnectedness within the financial system; and analyzing the cyclical component of systemic risk.

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1. Introduction

Among the many lessons from the global financial crisis is the realization that precrisis supervisory and regulatory frameworks lacked a “macro” dimension. There is by now consensus that before the crisis regulators paid insufficient attention to the accumulation of risk at the level of the financial system as a whole, as opposed to individual financial institutions. Macroprudential oversight, focusing on systemic risk, is meant to fill this gap. It complements existing microprudential oversight arrangements by adding a macro overlay. Macroprudential oversight aims to detect and mitigate systemic risk. It adopts a holistic perspective by focusing on the interactions between the components of the financial system (that is, between financial institutions, markets, infrastructure), and the wider economy. Macroprudential oversight encompasses an analytical component (aimed at detecting systemic risk) and a policy component (aimed at mitigating systemic risk). The central bank usually is the lead authority responsible for macroprudential analysis, and it often reports on the outcomes in the form of periodic Financial Stability Reports.

Effective and timely mitigation of systemic risk starts with a rigorous analysis of systemic risk, informing policymakers when and how to act. Despite burgeoning academic interest in the topic, this is still a serious challenge in practice. Financial stability policy differs from monetary policy in that the target is not directly observable, and—by extension—risks to financial stability are neither easily measurable nor quantifiable. In emerging and developing countries, these challenges are often compounded by limitations in technical capacity and gaps in data. Despite its intuitive appeal, the intellectual and practical challenges in establishing a robust framework for macroprudential analysis can thus be considerable.

The stakes are high in emerging and developing countries. The financial sector matters for economic development and poverty reduction, when it works well and when it malfunctions. On the upside, there is increasing appreciation for the financial sector’s potential in accelerating economic growth and poverty reduction. However, the global financial crisis has also acted as a forceful reminder of the dark sides of finance, including its inherent procyclicality, and its propensity to unsound practices. If unaddressed, these tendencies can set the stage for financial crises, potentially undoing years of progress in terms of economic growth and poverty reduction. By informing policymakers when and where the most pressing risks to financial stability are building, macroprudential analysis can support the public interest in capturing developmental opportunities while keeping risks to stability in check.

This working paper aims to provide policymakers in developing and emerging economies with practical guidance in developing a framework for macroprudential analysis. The paper is divided into four sections. Following this introduction, the second section summarizes ongoing efforts to assess systemic risk and elaborates on some of the challenges surrounding this task. The third section describes the characteristics of a basic framework for macroprudential analysis, consisting of the following three building blocks: criteria for identifying domestically important banks; analyzing interconnectedness at the level of the financial system; and analyzing the time series dimension of systemic risk. The fourth section addresses practical questions related to implementation.

2. Analyzing Systemic Risk: Theoretical Background and Practical Challenges

The case for financial sector regulation has been traditionally built around a set of market failures, including anticompetitive behavior, market misconduct, information asymmetries, and systemic instability (Carmichael and Pomerleano 2002). Information asymmetries have traditionally served as the main justification for prudential regulation. Concerns about asymmetric information arise when the nature of assets and liabilities are sufficiently complex that disclosure by itself does not allow investors to make informed choices. Information asymmetries abound between buyers and sellers of financial products. Professional bankers possess expert knowledge, and obtaining such knowledge is time-consuming and costly. This asymmetry can serve as an incentive for financial intermediaries to take on excessive risk. In a similar vein, the regulator may seek to protect the small, unsophisticated depositor, who is ill-equipped to evaluate the safety and soundness of banks, by guaranteeing banks' deposits.

The global financial crisis has put increasing emphasis on systemic stability. These developments need to be seen against the background of the social costs imposed by the crisis and its aftermath, but also of the limitations of market discipline in mitigating systemic risk. Market discipline proved ineffective in taming risk taking by unregulated investment banks, even though their main counterparties were the most sophisticated and professional investors.

The mitigation of systemic risk is now widely accepted as the fundamental underlying concept for the design of the postcrisis regulatory agenda. Systemic risk is typically defined as "a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and that has the potential to have serious negative consequences for the real economy" (IMF, BIS, FSB 2009, p. 5). Policymakers worldwide have various initiatives to build a more resilient financial system. An important part of the answer is to raise regulatory requirements for banks, particularly liquidity and capital requirements. The G20 leaders have also committed to extending the scope of regulation and supervision in response to widespread regulatory arbitrage in the run-up to the crisis.¹

The financial crisis has also highlighted the need to add a macro dimension to existing micro-based approaches to financial regulation and supervision. It is now commonly accepted that robust microprudential frameworks are critical to building a resilient financial system, but not a sufficient condition for achieving financial stability. The latter requires policymakers to put in place a coherent framework for the timely detection and mitigation of systemic risk. Macroprudential oversight is meant to fill this gap. Macroprudential *analysis* deals with authorities' capacity to detect systemic risk in a forward-looking fashion, while macroprudential

¹ Regulatory arbitrage refers to the practice wherein financial institutions push risk-taking activities towards segments of the financial system with lighter or absent prudential requirements.

policy refers to measures to redress threats to financial stability.² Macroprudential oversight takes a holistic perspective by focusing on the financial system, rather than on the safety and soundness of individual financial entities. It aims to preserve financial stability by preventing the buildup of systemic risk and containing shocks to the financial sector and the real economy as a whole. Table 2.1, adapted from Borio (2003), compares the micro and macro perspectives on financial sector oversight.

Table 2.1. Macroprudential and Microprudential Perspectives on Financial Regulation

	Macroprudential perspective	Microprudential perspective
Proximate objective	Limit financial system-wide distress	Limit distress of individual institutions
Ultimate objective	Avoid output (GDP) costs	Consumer (investor/depositor) protection
Model of risk	Endogenous	Exogenous
Correlations and common exposures across institutions	Important	Irrelevant
Calibration of prudential controls	In terms of systemwide distress; top-down	In terms of risks of individual institutions; bottom-up

Source: Borio 2003.

Many countries have taken an active interest in macroprudential oversight. Since the global financial crisis, there has been a surge in analytical work aimed at assessing systemic risk, often undertaken by dedicated financial stability departments of central banks. In addition, many countries are introducing new policies and regulations aimed at containing systemic risk, including through capital surcharges for systemically important banks, and countercyclical capital buffers aimed at mitigating the financial cycle. In addition, several countries have established institutional frameworks for the purpose of macroprudential policymaking. As an illustration, the United States has established the Financial Stability Oversight Council (FSOC), which is the key body responsible for macroprudential surveillance. With the establishment of the European Systemic Risk Board (ESRB) within the European System of Financial Supervision, a policy framework was put in place for macroprudential policy at the European Union level, to be exercised through warnings and recommendations.

To effectively mitigate systemic risk, it is necessary to somehow monitor it, which remains challenging. Risks to financial stability are not easily measurable, and several authors have referred to the “fuzziness” of measuring systemic risk (Borio and Drehmann 2009). Academic research has typically focused on measuring particular aspects of systemic risk, and less so on developing an overarching analytical framework for macroprudential analysis (see Box 2.1). As a

² Based on a survey conducted in 2011, the IMF identified 10 macroprudential instruments that are most frequently used. The instruments can be loosely classified into the following three categories: (i) *credit-related measures* (caps and ceilings on (a) the loan-to-value (LTV) ratio, (b) the debt-to-income (DTI) ratio, and (c) foreign currency lending, and (d) aggregate credit to particular sectors or categories of debtors); (ii) *liquidity-related*, (limits on net open currency positions and/or currency mismatch (NOP), and limits on maturity mismatch and reserve requirements); and (iii) *capital-related* (countercyclical capital requirements and dynamic provisioning).

consequence, periodic macroprudential analysis, typically conducted in the context of a Financial Stability Reports (FSRs), often suffers from a lack of specificity and conclusiveness. In this spirit, Čihák and others (2012) observe that FSRs still tend to leave much to be desired in terms of their clarity, coverage of key risks, and consistency over time, while their lack of “forward-lookingness” (that is, insufficient analysis of risks and vulnerabilities) limits their effectiveness in assessing systemic risk. This raises important questions about the suitability of the current generation of FSRs in guiding macroprudential policymaking.

Box 2.1 Quantitative Approaches to Assess Systemic Risk

The global financial crisis has caused a surge in academic research on financial instability. The experiences of the global financial crisis, together with the increasing emphasis on macroprudential policy to preempt threats to financial stability, have led to a proliferation of academic studies and methodologies covering various aspects of systemic risk (for a comprehensive review of techniques, see Bisias and others 2012).

Various quantitative approaches have been proposed to assess the time series dimension of systemic risk, including early warning indicators, Value-at-Risk (VaR) models, and top-down stress tests, each of which has particular strengths and weaknesses (Galati and Moessler 2010). While previous generation Early Warning Models had only mixed success in predicting banking crises, more recent work that is based on credit growth and financial asset prices seems more promising. VaR and statistical models are widely used in forecasting, but the assumption of normality can be difficult to reconcile with the dynamics of financial crises, which are characterized by fat tails. In addition, VaR models are typically based on recent historical data, which tend to underrepresent risk in the upswing, when volatility is low and asset prices rise. Top-down stress tests are helpful tools in gauging the impact of large but plausible exogenous shocks. New-generation stress test models also aim to capture the amplifying effects of contagion within the financial system and negative feedback loops from the real economy to the financial system (Schmieder, Pühr, and Hasan 2011).

Analytical work on assessing the cross-sectional dimension of systemic risk has focused on quantifying the contribution of individual financial institutions to systemic risk. Adrian and Brunnermeier (2009) propose an extension of existing Value-at-Risk (VaR) methodology to capture individual banks’ contribution to systemic risk. The CoVaR is defined as the VaR of the entire financial sector, conditional on a particular financial institution being in distress. By taking the difference between the CoVaR conditional on the distress of an institution and the CoVaR conditional on the “normal” state of a financial institution, the marginal contribution of a financial institution to overall systemic risk can be calculated. Acharya and others (2010) measure the contribution of each financial institution to systemic risk as its systemic expected shortfall (SES): that is, its propensity to be undercapitalized when the system as a whole is undercapitalized. SES is a theoretical construct and is proxied on the basis of the outcomes of the stress test performed on the U.S. financial system in February 2009, equity returns, and credit default swap spreads.

Several authors have analyzed specific aspects of the cross-sectional dimension of systemic risk, particularly linkages between banks through the interbank market. Since the early 2000s, the study of systemic risk using network approaches has attracted the attention of economists and scientists in general. These approaches typically involve the study of interbank financial data, using tools initially developed in the natural sciences to shed additional light on possible contagion effects through interbank linkages. The study of interbank data includes the attribution of topologic properties to a financial system, where an intricate web of relations exists through various kinds of exposures. In addition, the stability of the network itself is analyzed, including its capacity to absorb shocks (Montagna and Lux 2013).

In the case of developing economies, these challenges are often compounded by deficiencies in the quality and availability of data and constraints on technical capacity. Data coverage and quality is often problematic, with data on the real economy being particularly troublesome. GDP estimates are often available only with a significant delay and subject to frequent ex post revisions, while granular data on the financial position of households and enterprises are often lacking altogether. Longitudinal analysis of key variables is impossible in many cases due to frequent structural breaks in data series. As a consequence, it can be very difficult to draw a line between beneficial financial deepening and unsustainable credit booms and leverage cycles. Weaknesses in technical skills can add significantly to the challenges.

The presence of a robust, well-calibrated analytical framework is a critical precondition for effective macroprudential policymaking. Macroprudential policy is not costless. Measures aimed at mitigating systemic risk can carry opportunity costs in terms of financial deepening and diversification, with an adverse impact on economic growth—and, ultimately, on poverty reduction. This highlights the importance of a robust framework to identify systematic risks that helps policymakers detect and assess vulnerabilities. Such a framework can help policymakers select and calibrate macroprudential instruments in a manner that reflects the underlying sources of risk. After the framework is implemented, the effectiveness and efficiency of the instruments needs to be assessed, taking into consideration opportunity costs as well as possible leakages and arbitrage effects (ESRB 2014). In the absence of a robust analytical framework for monitoring systemic risk, there is an elevated risk that macroprudential policy will be ineffective (that is, it will respond too little or too late in the face of increasing risks to financial stability, or will be poorly tailored to address the true challenges). The opposite case, in which authorities adopt an excessively restrictive (macroprudential) policy stance, is associated with detrimental consequences on development.³

Macroprudential oversight should explicitly address both the cross-sectional and the cyclical dimension of systemic risk. A conceptual distinction can be made between the cross-sectional

³ There is an extensive debate on whether countercyclical measures should be principally rule-based or discretionary. The optimal balance can be decided only in a particular national context, and may depend on the objectives of specific measures. However, irrespective of whether the authorities favor a rule-based or discretionary approach, effective macroprudential policy requires the authorities to monitor systemic risk and gauge the timing and appropriateness of policy actions (Ren 2011).

dimension of systemic risk, which entails the allocation of risk and the possibility of contagion within the financial system at a given point in time, and the cyclical dimension, which encompasses the evolution of aggregate risk in the financial system over time (Borio 2010).

The cross-sectional dimension of systemic risk refers to interconnectedness within the financial system. Modern-era financial systems are characterized by a complex web of interconnections, exposures, and linkages among financial institutions, markets, and infrastructure. In normal times, these linkages sustain the functioning of the financial system and the real economy and promote diversification, but in times of crisis they can function as contagion channels, through which shocks can be propagated and amplified. Contagion can be the result of directly observable exposures and interconnections (such as through the payment system), but it may also spread through the confidence channel. This occurs when economic agents (such as depositors and investors) change their behavior in response to a particular trigger event, typically by becoming more risk averse. As an illustration, following the announcement of serious difficulties at a particular bank, investors and retail depositors may start speculating which other banks are susceptible to the originating shock, due to similarities, real or perceived, in business models (such as weak internal controls), or financial exposures (such as toxic assets).⁴

Proposals have been made to contain interconnectedness, with particular focus on complex interconnected financial institutions. Among other measures, capital surcharges have been proposed for the Global Systemically Important Banks (G-SIBs), while an increasing number of countries are in the process of introducing stricter prudential requirements for banks that are considered systemically important in a domestic setting: that is, Domestic Systemically Important Banks (D-SIBs). In addition, several countries have taken measures to limit the exposure of depository institutions to financial markets by separating traditional, transactional banking from investment banking.⁵ In addition, several countries are using existing regulatory tools, such as concentration limits, absolute ceilings on exposures for certain financial instruments, or ad hoc increases in risk weights for particular asset categories (both on- and off-balance sheet) in a more rigorous fashion.

A proper appreciation of interconnectedness requires the adoption of a truly systemwide perspective on the financial sector. This has important implications for the scope of macroprudential analysis. Although financial intermediation in the majority of developing and emerging countries is heavily bank-based, it is important that macroprudential analysis go beyond analyzing the safety and soundness of the banking system. Non-deposit taking financial entities should also be included, as well as financial markets, financial infrastructure (the payment and settlement systems), and—crucially—the various linkages that exist among these elements. In addition, the analysis should cover the economic and financial environment in

⁴ Speculation about exposure to subprime assets played a key role in the initial stages of the global financial crisis, when interbank funding nearly ceased.

⁵ Prominent examples include the Volcker rule in the United States, which prohibits insured deposit taking banks from engaging in proprietary trading and acquiring equity or sponsoring hedge funds or private equity funds, as well as the Vickers Report in the United Kingdom and the Liikanen Report in the European Union.

which the financial system is operating (the macro-financial and real economic outlook), and the health of the balance sheets of households and nonfinancial corporations.

A thorough understanding of the main linkages within the financial system is a precondition for an informed use of measures to contain interconnectedness. The concept of interconnectedness is often interpreted in a rather restrictive manner, with interbank exposures being the main area of focus. While this is indeed an important aspect, there are many additional linkages within the financial system that can be highly relevant, including interconnectedness through the payment systems, ownership linkages between financial institutions,⁶ and banks as providers of contingent credit lines for other financial institutions.

The time series dimension refers to the cyclical dimension of systemic risk. The financial system is characterized by strong procyclical tendencies. Consequently, the financial system can act as an amplifier rather than as an absorber of economic and financial shocks. The procyclical tendencies of the financial system were already well-documented in the academic literature before the global financial crisis, including in Minsky (1982) and Kindleberger (2000), but interest in these tendencies has increased recently (see Brunnermeier and others 2009; Adrian and Shin 2009). Borio (2012) has observed that the financial cycle is on average about twice as long as the traditional business cycle and has significantly larger amplitude. Contractions of the financial cycle that coincide with recessions are particularly disruptive. In the upturn of the financial cycle, credit growth tends to outpace economic growth, while financial firms, nonfinancial corporations and households become increasingly indebted against the backdrop of a high appetite for risk. Once the virtuous circle ends, credit availability becomes more constrained as the creditworthiness of borrowers worsens (because of declining household income and wealth and deteriorating profitability in the corporate sector), collateral values deteriorate, and risk aversion increases. The damage to the real economy can be exacerbated by procyclical tendencies induced by financial regulation, as banks that have been faced with a significant deterioration of asset quality may seek to restore their capital adequacy ratio by moderating credit growth, restraining access to credit for those categories of loans that represent a high risk weight, such as uncollateralized loans to small and medium enterprises (SMEs) (Repullo and Suarez 2008).

A significant number of emerging market economies have had experience before the crisis with lean-against-the-wind measures aimed at moderating the financial cycle. These measures need to be seen against the background of potentially destabilizing capital flows, concerns about excessive credit growth, and the volatility of financial asset prices, often in an environment characterized by limited investment opportunities. Several East Asian economies have used macroprudential instruments to avoid excessive procyclicality in sectors that are considered prone to speculative bubbles, particularly real estate, either through a more rigorous use of ceilings on credit and large exposure limits or through leverage limits, such as the lowering of loan-to-value (LTV) and debt-to-income (DTI) limits during real estate booms (see CGFS 2010;

⁶ This includes the Special Purpose Vehicles (SPVs), which in the early stages of the global financial crisis exposed their parent banks to serious contagion effects. Although the SPVs were separate entities from a legal point of view, the sponsoring banks came to their rescue for reputational reasons.

Moreno 2011). In addition, some emerging market economies have used reserve requirements to prevent the buildup of domestic imbalances arising from volatile cross-border capital flows. While the verdict is still out on the effectiveness of macroprudential policies, there are indications that macroprudential policies addressing the leverage of borrowers—caps on LTV and DTI ratios and limits on foreign exchange–denominated lending—have been particularly effective in containing the buildup of systemic risk during the upturn of the financial cycle (Claessens, Ghosh, and Miller 2013).

A thorough understanding of the stage of the financial cycle is a prerequisite for effective use of countercyclical financial regulation. Countercyclical financial regulation aims to slow down the upturn of the financial cycle while moderating the subsequent downswing—or (more modestly) to use the upturn more effectively to build buffers so that the downturn is less disruptive. Consequently, such regulation can contribute to building a financial system that functions as an absorber, rather than an amplifier, of economic shocks. An effective use of countercyclical financial regulation requires that policymakers have a well-developed understanding of the stage of the financial cycle, so that they can make informed decisions as to when to build/release buffers and to lower/raise time-varying caps.

Conventional indicators for advanced countries do not always perform well in emerging and developing countries. This point can be illustrated with regard to credit-to-GDP gaps, which play a key role in Basel III in distinguishing between “due and undue” momentum in financial cycles, thereby informing policymakers when to activate and release countercyclical measures. Cross-country heterogeneity can greatly obscure the wider picture: While credit-to-GDP gaps and thresholds of 2 percent and 10 percent seem to do a reasonable job in anticipating excessive credit growth in the Basel Committee member states, it is found that these thresholds are less accurate predictors in emerging countries. As a consequence, these trigger points may be unduly restrictive for countries that are engaged in a financial deepening process and start from a low base.

In addition, it is increasingly recognized that mitigating systemic risk through various lean-against-the-wind measures also requires policymakers to conduct policy simulations, although this is still a challenging area. Once a thorough diagnosis about the main sources of systemic risk has been produced, policymakers need to devise a risk mitigation strategy. At a minimum, this requires a broad understanding of the effectiveness of the policy instruments under consideration in relation to the emerging systemic threat. Ideally, the effectiveness of these instruments can be assessed before they are implemented on the basis of a policy simulation, which may take the form of quantitative model-based approaches—or, more modestly, through the use of so-called transmission maps. Such transmission maps provide stylized representations of how individual lean-against-the-wind measures are expected to help mitigate the cyclical dimension of systemic risk (CGFS 2012). Such a mapping of the result chain should also incorporate potential side-effects (such as arbitraging effects), as well as potential costs in terms of credit growth and overall financial development. The use of such tools also permits cost-benefit comparisons between various policy options.

3. A Simple Framework for Assessing Systemic Risk

The question thus arises what requirements an effective macroprudential analytical framework needs to meet to satisfy policymakers' demand. A key requirement of any framework is that it delivers conclusive guidance. As illustrated above, an informed use of macroprudential tools requires policymakers to have a thorough understanding of where potential threats to financial stability are building, when they reach a critical level, and when action needs to be taken. In absence of a sound and intuitively appealing evidence base, this is likely to be a tall order. Consequently, it will be challenging to overcome industry pressures or political hurdles to taking discretionary action, and the so-called inaction bias will likely prevail.⁷

The remainder of this section contains detailed proposals, focusing on the monitoring of systemic risk, particularly on the following three components: identification of domestic systemically important banks (the so-called D-SIBs); mapping of interconnectedness at the level of the financial system; and a simple framework for periodic analysis of financial stability. Developing effective analytical frameworks for the monitoring of systemic risk is a complex undertaking. Given the considerable challenges that many countries experience in this area, this discussion focuses on monitoring systemic risk, and will not elaborate on (comparative) policy simulation.

Identification of D-SIBs

Experiences in the global financial crisis have raised policymakers' awareness about the problems posed by systemic banks that are too big or too interconnected to fail. Once critically impacted, these entities can leave the policymakers with a stark choice between a disorderly failure (with prohibitive knock-on effects on the financial system and the real economy) and a bail-out often funded with public resources. In practice, the failure option may simply not be credible. From a public policy perspective, this poses serious difficulties. Not only do most publically funded bail-outs substantially increase public indebtedness, but the expectation of being bailed out may boost the risk appetite (moral hazard) of financial institutions that are too big to fail and may translate into an undue funding cost advantage, making the playing field unlevel.

Several measures have been rolled out to better protect the public interest against the risks associated with systemically important banks. They aim to reduce the likelihood that systemically important banks will fail, particularly through the introduction of capital surcharges, and to lessen the impact of their failure on the financial system and the real economy, through the preparation of so-called recovery and resolution plans, bail-ins,⁸ and

⁷ For an overview of the requirements of effective macroprudential frameworks, see CGFS (2011).

⁸ Bail-ins refer to the statutory power of the resolution authority to restructure the liabilities of a distressed financial institution by writing down its unsecured debt and/or converting it to equity.

proposals for establishing minimum standards for Total Loss-Absorbing Capacity (TLAC) of G-SIBs.⁹

The Basel Committee on Banking Supervision (BCBS) has focused initially on banks that are systemically important on a global scale (that is, the G-SIBs). The updated BCBS framework (2013) proposes an indicator-based measurement approach, with five groups of criteria: cross-jurisdictional activity, size, interconnectedness, substitutability, and complexity. For each of these sets of criteria, supporting indicators have been defined (see table 3.1). The score for a particular indicator is expressed in terms of banks' market share for the banks that have been included in the sample. Equal weights are applied to all five categories.

Table 3.1. G-SIB Indicator-based Measurement Approach

Category and weighting	Individual indicator	Indicator weighting (percent)
Cross-jurisdictional activity (20%)	Cross-jurisdictional claims	10.00
	Cross-jurisdictional liabilities	10.00
Size (20%)	Total exposures as defined for use in the Basel III leverage ratio	20.00
Interconnectedness (20%)	Intrafinancial system assets	6.67
	Intrafinancial system liabilities	6.67
	Securities outstanding	6.67
Substitutability/financial institution infrastructure (20%)	Assets under custody	6.67
	Payments activity	6.67
	Underwritten transactions in debt and equity markets	6.67
Complexity (20%)	Notional amount of over-the-counter derivatives	6.67
	Level 3 assets ^a	6.67
	Trading and available-for-sale securities	6.67

Source: BCBS 2013.

a. Level 3 assets are assets whose fair value cannot be assessed using observable measures.

Banks that have a score that exceeds a cutoff level set by the Committee will be classified as G-SIBs. Supervisory judgment may also be used to add banks with scores below the cutoff. As per the latest November 2013 update, a total of 29 G-SIBs have been identified. It is envisaged that the assessment will be conducted annually. These banks have been divided into five groups with additional capital requirements ranging from 1 percent to 3.5 percent of risk-weighted assets. The higher loss absorbency requirement will be phased in between January 1, 2016 and year-end 2018, along with the capital conservation and countercyclical buffers, becoming fully effective on January 1, 2019.

⁹ The Financial Stability Board (FSB) has issued in November 2014 policy proposals for public consultation consisting of a set of principles and a detailed term sheet on the adequacy of the loss-absorbing and recapitalization capacity of G-SIBs, aimed at providing home and host authorities with confidence that G-SIBs have sufficient capacity to absorb losses, both before and during resolution, and enabling resolution authorities to implement a resolution strategy that minimizes any impact on financial stability and ensures the continuity of critical economic functions.

The framework for identifying banks that are of systemic importance in a domestic setting (the so-called D-SIBs) is more principle-based. The G-SIB framework is intended to limit negative cross-border externalities on the global financial system and economy associated with the most globally systemic banking institutions. However, this only partially remedies the too-big-to-fail problem. There are many banks that are not necessarily systemically important on the global level, but that would still expose the financial system and economy of jurisdictions to similar spillovers when critically affected. For this set of institutions, the international standard setting bodies have designed the D-SIB framework. It is best understood as taking a complementary perspective to the G-SIB regime by focusing on the impact that the distress or failure of banks (including international banks) will have on the domestic economy.

The BCBS recommends taking into consideration size, interconnectedness, substitutability, and complexity,¹⁰ but it is up to national authorities to add detail and tailor the D-SIB framework to the specificities of the local context. The D-SIB framework is based on the assessment conducted by the local authorities, who are best placed to evaluate the impact of failure on the local financial system and the local economy. This calls for an appropriate degree of national discretion, contrasting with the more prescriptive approach in the G-SIB framework. Many authorities are currently in the process of preparing D-SIB frameworks. Several countries, including Australia and Canada, have disclosed their assessment methodologies for identifying D-SIBs, and the shortlist of banks that are earmarked as D-SIBs. Canada has also issued regulations and has specified the applicable capital surcharges for these banks.

The need to tailor the criteria for identifying D-SIBs to the specificities of the national context is especially pressing for emerging economies. Some of the indicators that are part of the G-SIB framework may have little relevance in countries with relatively simple banking systems and little exposure to sophisticated financial instruments. It may also be helpful to include additional criteria in the assessment because some of the areas that are of particular interest for developing countries are not explicitly covered, such as the dominance of particular banks in economic sectors that are particularly credit-constrained, like SMEs. These considerations underscore the point that the identification of systemically important banks should go beyond a simple copying and pasting of international standards.

While international efforts are most advanced for the banking sector, systemic nonbank financial institutions (NBFIs)¹¹ and financial infrastructure have also increasingly received attention, while monitoring of the so-called shadow banking sector is being stepped up. The international standard-setting bodies have made significant headway in developing methodologies for identifying systemically important insurance companies and financial infrastructure (see box 3.1). In addition, the FSB has stepped up efforts to monitor “shadow banks”: that is, all entities outside the regulated banking system that are engaged in credit intermediation (the conversion of savings into loans).¹² Examples include broker-dealers that fund their assets using repurchase agreements; money market mutual funds that pool

¹⁰ See BCBS (2012a). D-SIBs may be subsidiaries (or even branches) owned by banks that are considered G-SIBs.

¹¹ NBFIs include insurance companies, mutual funds, pension funds, cooperative banks, and credit unions.

¹² Credit intermediation involves maturity transformation, liquidity transformation, leverage, and credit risk transfer.

investors' funds to purchase commercial paper or mortgage-backed securities; financial entities that sell commercial paper and use the proceeds to extend credit to households (such as finance companies); credit insurers and financial guarantee providers; and securitization vehicles. So far, the FSB's monitoring exercise has aimed to systematically take account of the size, composition, and trends of nonbank financial intermediation in 25 jurisdictions. The increasing attention directed to shadow banking also needs to be seen against the background of the tightening of prudential requirements applicable to the banking sector, which could trigger a process of regulatory arbitrage—wherein credit intermediation is shifted away from the mainstream banking sector to domains where oversight arrangements are less intrusive.

Box 3.1. Systemically Important Insurance and Financial Infrastructure

In the NBFIs sector, international efforts are underway to identify systemically important insurance companies. In July 2013, the Financial Stability Board (FSB), in consultation with the International Association of Insurance Supervisors (IAIS) and national authorities, identified an initial list of nine global systemically important insurers (G-SIIs), using an assessment methodology developed by the IAIS. The methodology follows an indicator-based approach similar to the one adopted for G-SIBs, and includes similar broad categories covering size, global activity, interconnectedness, nontraditional and noninsurance activities, and substitutability.^a For 2014, nine G-SIIs have been identified. In the course of 2015, the G-SII assessment methodology will be revised to ensure that it addresses all types of insurance and reinsurance, and other financial activities of global insurers. The revised G-SII assessment methodology will be applied from 2016. A methodology for linking G-SII status to enhanced loss absorbency requirements is under preparation and is expected to be applied from January 2019.

Countries follow a variety of approaches to identify systemically important financial infrastructure. Updated standards have been issued by the Committee on Payment and Settlement Systems (CPSS) and the International Organization of Securities Commissions (IOSCO), applying not only to systemically important payment systems, but also to central securities depositories, securities settlement systems, central counterparties, and trade repositories. In conceptual terms, a payment system can be considered systemically important if it has the potential to trigger or transmit systemic disruptions. Countries apply a variety of approaches to determining systematic importance, but in practice, this includes systems that are either the sole payment system or the principal system in terms of the aggregate value of payments; systems that mainly handle time-critical, high-value payments; and systems that settle payments used to effect settlement in other systemically important infrastructures.

a. The specific indicators are total assets and total revenues (for *size*); revenue derived abroad and number of countries (*global activity*); intrafinancial assets and liabilities, reinsurance, derivatives, large exposures, turnover, and level 3 assets (*interconnectedness*); non-policy holder liabilities and noninsurance revenues, derivatives trading, short-term funding, financial guarantees, variable annuities, and intragroup commitments (*nontraditional insurance and noninsurance activities*); and premiums for specific business lines (*substitutability*).

The discussion that follows provides suggestions as to how the broad BCBS guidance for identifying D-SIBs can be put to actual use in emerging and developing countries. Additional detail is provided for each of the broad criteria. For each of these aspects, suggestions are

made to measure the systemic importance of individual banks. As is the case in the G-SIB framework, an indicator-based approach is proposed, wherein individual bank's scores are expressed in terms of market share. The score for each of the four components (size, interconnectedness, substitutability, and complexity) can be calculated by averaging the score for the supporting indicator. The overall score per bank can be defined as the simple or weighted mean of the four components.

Size

Size is the most easily measurable of the four components that are part of the D-SIB framework. Several authors have emphasized the importance of size as a proxy for systemic importance (see, for example, Goldstein and Verón 2011). In the G-SIB framework, size corresponds to the measure of total exposures used in the Basel III leverage ratio. It includes total on-balance sheet assets, derivatives exposures, securities financing transactions, and other off-balance sheet exposures (including contingent credit lines, liquidity facilities, acceptances, letters of credit, failed transactions, and unsettled securities). A similar approach can be followed in the D-SIB framework, although countries with limited exposure to derivatives and securities financing transactions, and with limited off-balance sheet exposures might simply opt for total on-balance sheet assets.

An alternative approach is to define size as the mean of the market share for various categories of loans and deposits. Banks' market share can be assessed for business, mortgage, and consumer loans. On the deposit side, banks' market share can be assessed for several types of deposits (term, demand deposits). In addition, it can be helpful to assess deposits in relation to the size of the deposit insurance fund, with particular focus on those banks whose insured deposits exceed the funds available in the fund. The amount of *uninsured* deposits can also be taken into consideration, as this gives an indication of the magnitude of the loss of private wealth associated with banking failures, and the concomitant damage to the real economy. The inclusion of these indicators can contribute to a more granular picture, although in some cases the more refined indicators are highly correlated with size defined as total exposures. If this is the case, the inclusion of more granular data somewhat complicates the analysis without contributing to a richer analysis.

Many countries have two-tier banking systems. The top tier is typically dominated by three or four banks that often have a market share in the range of 70–80 percent. The remaining banks typically follow at considerable distance, providing for a natural separation from the top tier banks that can be considered systemically important because of size. Naturally, the exercise, including the determination of cut-off points, is more difficult in countries with more moderate levels of concentration in the banking system.

Interconnectedness

The G-SIB framework defines interconnectedness in terms of lending and borrowing from other financial institutions, and the amount of outstanding securities. A bank's market share in total intrafinancial system assets and liabilities is indicative of its lending and borrowings from other financial institutions, while the amount of securities covers the amount of debt securities,

commercial paper, and certificates of deposits a bank has outstanding, as well as the book value of its equity and its equity market capitalization.

The question arises whether this component should be given equal weight as size. The banking systems in many developing and emerging economies are only moderately interconnected, because banks fund their operations primarily through deposits from households and nonfinancial corporates. Loans to other financial institutions account for only a small proportion of total assets, and overall levels of financial market activity are lower. It may therefore be worthwhile to apply a lower weight for interconnectedness.

It may be useful to develop more refined indicators than the ones proposed under the G-SIB framework. The interconnectedness component is meant to assess the risk of cascading domino effects through among banks and within the financial system. This is not necessarily captured in the G-SIB framework, as it merely assesses banks' market share for various classes of interbank and financial market operations. It can therefore be useful to conduct a more in-depth analysis. This can be done by constructing a simple matrix that captures all mutual exposures between banks at a given point in time, or as an average over a period (see table 3.2).¹³ Exposures should be defined in a comprehensive manner, capturing interbank claims, deposits, and bond holdings, among other considerations. Banks enter the matrix as debtors in the rows, while they are represented as creditors in the columns. As an illustration, the second cell in the first row thus refers to Bank B's total claim on Bank A, or conversely the sum of Bank A's total liabilities vis-à-vis Bank B.¹⁴

Subsequently, the claims represented in the matrix can be expressed in terms of the capital and liquidity buffers of the creditor bank (that is, the amount of capital and liquidity that the creditor bank holds in excess of regulatory requirements). This gives a more precise idea about the magnitude of the likely direct knock-on effects that could arise as a result of the default of a debtor bank.¹⁵ For each debtor bank, this methodology allows for the identification of creditor banks that are critically exposed, that is, banks that would be in risk of becoming undercapitalized or noncompliant with liquidity requirements as a direct result of the debtor's inability to honor its obligations. A creditor bank is thus considered to be critically exposed to a particular debtor bank if the creditor bank's exposure to the debtor bank exceeds the creditor's liquidity or solvency buffers.

For each debtor bank, the market share of the "critically exposed" creditor banks can be identified, which can then be used as a more refined measure for interconnectedness. Alternatively, banks could be considered systemically important with respect to interconnectedness if their default would cause a certain proportion of the banking sector to

¹³ Alternatively, the matrix could capture peak exposures observed over a certain time horizon.

¹⁴ It may be illustrative to expand the matrix with NBFIs, cooperative banks and deposit-taking microfinance institutions, particularly in countries where such financial institutions account for a significant share of the financial system. NBFIs often keep significant amounts of deposits in the banking system. Similarly, cooperative banks and microfinance institutions often keep sizable deposits in the regular banking system.

¹⁵ More sophisticated methodologies can be used to incorporate second-round effects and behavioral responses (for instance, banks that are perceived to be weak are increasingly excluded from the interbank market). Such methodologies typically involve network analysis.

become undercapitalized, either directly or in subsequent rounds. For the total exposure matrix presented in table 3.2, an interface with the offsite monitoring system could be developed so that the authorities at any point in time would have a fully up-to-date overview. Complementing the total exposure matrix, it may also be helpful to obtain a more granular picture by differentiating the matrix according to financial instrument, maturity, currency, and collateralization.

Table 3.2. Total Exposure Matrix among Financial Institutions

		<i>TO</i>		
		Bank A (creditor)	Bank B (creditor)	Bank C (creditor)
<i>FROM</i>	Bank A (debtor)	-----	Total gross claim of Bank B on Bank A	Total gross claim of Bank C on Bank A
	Bank B (debtor)	Total gross claim of Bank A on Bank B	-----	Total gross claim of Bank C on Bank B
	Bank C (debtor)	Total gross claim of Bank A on Bank C	Total gross claim of Bank B on Bank C	-----

Substitutability

The G-SIB framework defines substitutability in terms of payment system activity, as a provider of client services to market participants and as an underwriter of securities. Three indicators are used to measure substitutability/financial institution infrastructure: the total amount of assets that a bank holds as a custodian; payments activity, defined as the value of a bank’s payments sent through all of the main payment systems; and underwritten transactions in debt and equity markets, calculated as the total annual value of debt and equity instruments underwritten.

Depending on the particular characteristics of the country, it may be helpful to somewhat alter the definition of the indicators for identifying D-SIBs. Instead of assessing payment activity exclusively on the basis of value, it may be worthwhile to take into consideration the number of transactions. The score per bank for this indicator could be calculated by taking the average market share on the basis of both value and number of transactions. In addition, in many developing countries, banks’ engagement in securities underwriting is limited, as securities markets lack scale and depth.¹⁶ Alternatively, it may be relevant to assess banks’ market share in the market for government paper, as this market serves as the backbone for other financial markets. Banks’ market share could be assessed on the basis of ownership of government paper.

¹⁶ In some countries, banks have significant merchant banking activities.

It is also relevant to assess whether a particular bank fulfills highly specialized functions that cannot be taken over easily by other suppliers of financial services. In this context, geographical and sectoral concentrations are relevant considerations. A bank with a dominant presence in a remote region or that operates in a highly specialized business segment may be difficult to replace quickly. Its demise can thus result in serious disruption in the provision of financial services to a significant number of households and enterprises, with potentially serious adverse consequences for the real economy. Geographical concentrations are most likely to be an issue in sparsely populated, remote rural areas. Similarly, it is worthwhile to review loans to various categories of enterprises (such as agriculture, construction, or tourism), as these often require specific expertise that cannot be acquired overnight by competing financial institutions. In this context, dominant market shares of banks for enterprises that tend to be most credit-constrained—usually SMEs and microenterprises—need to be reviewed.

Complexity

In the G-SIB framework, complexity is assessed primarily on the basis of investment activities. Relevant indicators include banks' holdings of over-the-counter (OTC) derivatives; ii) level 3 assets; and available-for-sale and trading securities portfolio. In the majority of developing countries, particularly those with less developed financial systems, banks' investment activities are usually modest in size, and banks' exposure to complex financial products is mostly fairly limited. As a consequence, complexity as defined in the G-SIB framework is likely to be of limited relevance in most developing countries.

It may therefore be appropriate to assess banks' complexity on the basis of a set of alternative indicators, focusing particularly on organizational complexity. It may be especially important to highlight those banks that are part of a wider group. It is relevant to understand the make-up of the overall group (whether the bank is part of a financial group with significant nonbanking undertakings, or a mixed conglomerate with significant undertakings outside the financial sector). It may therefore be useful to include an indicator that considers the materiality of nonbanking undertakings of the wider group to which the bank belongs—for instance, by expressing the group's nonbanking assets as a ratio of the total assets of the group.¹⁷ A similar approach can be followed for cross-border banking activities, by considering the total assets of foreign branches and subsidiaries as a percentage of total assets of the group, thus taking a home country perspective.

Additional considerations

Indicator weights: As explained, the G-SIB framework gives equal weight to each of the five components of the assessment methodology (20 percent each for cross-jurisdictional activity, size, interconnectedness, substitutability, and complexity). The question is whether a similar approach should be pursued in the D-SIB framework, or whether differential weights should be used. There may indeed be a case for using different weights, considering that several

¹⁷ Alternatively, and to ensure consistency with the other indicators that are expressed in terms of individual banks' market share, the nonbanking assets of the group to which the particular bank belongs may be expressed as a share of total bank assets owned by financial conglomerates.

components (such as interconnectedness and complexity) may be of less relevance in more basic banking systems. In practice, some countries have experimented with differential weights, putting greater emphasis on size, but the impact on the overall scores and ranking is fairly limited, as banks' scores on interconnectedness, substitutability, and complexity often tend to be highly correlated with their size. In such cases, it may be preferable for simplicity to use the simple unweighted average.¹⁸

Establishing cut-off points: A key decision in process of identifying D-SIBs is where to draw the line between systemic and nonsystemic banks. While this may be relatively straightforward in countries with a de facto two-tier banking system, it is likely to emerge as a challenging issue in constituencies with a relatively low level of concentration in the banking system. The appropriateness of any threshold level depends to a large degree on the intended use of the D-SIB framework. If the intention is to submit banks identified as D-SIBs to stricter and regulatory standards (capital surcharges, more intensive supervision, recovery and resolution plans), it may be prudent to set the thresholds relatively low so as to minimize the likelihood of a potentially systemically important bank entering into difficulties. However, in some countries, the bank resolution framework explicitly distinguishes between systemic and nonsystemic banks, often implying privileged access to public support mechanisms for the former. If this is the case, it is preferable to set the thresholds higher and aim for a concise list of D-SIBs, to counter bail-out expectations and the associated moral hazard. In any case, it is important not to use the D-SIB framework as a mechanical tool for guiding resolution decisions for troubled banks, as an individual banks' systemic importance depends not only on its structural features but also on the prevailing circumstances, such as financial market sentiment, stage of the financial cycle, stage of the business cycle, solvency and liquidity buffers of other financial institutions, and strength of the balance sheets of households and companies.

Role of supervisory judgment: Although the indicators proposed above are a key ingredient in assessing the systemic importance of banks, it may be useful to supplement the indicator-based approach with expert judgment in the process of identifying D-SIBs. The G-SIB framework explicitly allows for such judgment, but—to ensure consistency in its application—notes that it is meant as an override only in exceptional cases. The bar for making such adjustments to the scores should therefore be high.

Mapping Interconnectedness at the Level of the Financial System

Besides identifying systemically important banks, it can be helpful to identify the main interconnections within the financial system. The interbank linkages analyzed in the preceding section are an important aspect of interconnectedness, but—taking a systemwide perspective—there are usually many more linkages at the level of the financial system. The key advantage of analyzing interconnectedness at the level of the financial system is that it provides a frame of reference for assessing the likely direction and intensity of contagion effects that

¹⁸ If differential weights are used, ideally there should be a quantitative methodology on the basis of which the weights for the individual components can be determined. This may be technically challenging. A possible alternative approach is to use principal component analysis.

follow after a concrete or a plausible triggering event (a severe shock or disruption originating either in the financial system or in the real economy).

The impact of a triggering event can be amplified through contagion effects within the financial system. A distinction can be made between idiosyncratic and systematic triggering events. An *idiosyncratic shock* occurs when the initial shock affects the health of only a single element of the financial system, such as the failure of an individual bank due to internal fraud. *Systematic shocks* are common shocks that simultaneously affect a greater number of players at the same time, such as through the collapse of an exchange rate peg. Operational linkages, financial exposures, and other kinds of interconnections between financial institutions, financial markets, and financial infrastructure can contribute to the propagation of the triggering shock from one segment of the financial system to another, amplifying the triggering event.

The full set of linkages and exposures between financial institutions, markets and infrastructure can be summarized in a so-called contagion matrix, which is meant to provide a snapshot of the main interconnections within the financial system. The key advantage of doing so is that it provides a frame of reference with which the systemic impact of impending threats to financial stability (for ongoing financial stability monitoring) or particular triggering events (in the event of crises) can be assessed in a disciplined and time-efficient manner. The contagion matrix presented in table 3.3 is a generic version, elaborated in Dijkman (2010).

Table 3.3. A generic version of the Contagion Matrix

		Contagion to		
		Institutions	Markets	Infrastructure
Contagion from	Institutions	<ul style="list-style-type: none"> - <i>Credit risk exposures</i> refer to the risk of loss due to a debtor's nonpayment of a loan or other line of credit. - Difficulties in branches or subsidiaries may spread to the group level (or vice versa) through <i>shareholder links</i>. - <i>Contingent credit lines</i> can ward against liquidity distress but they may work as a contagion channel when the guarantor is a financial institution that partakes in the resolution of liquidity difficulties of the beneficiary. - In countries without a prefunded <i>deposit insurance fund</i>, the remaining banks pay for the costs of invoking the insurance. - Larger banks often provide smaller financial institutions with <i>access to key financial infrastructure</i>, which may be disrupted in case of severe difficulties at the level of the access provider. 	<ul style="list-style-type: none"> - Financial institutions, including nonbank institutions such as hedge funds, can play an important role as <i>market makers for derivatives</i>, which serve as key hedging instruments for managing interest rate and exchange rate risk. - The bankruptcy of a large <i>underwriter of credit default swaps (CDSs)</i> may not only dislocate the CDS market, but may also cause CDS contracts to become void. - Troubled financial institutions may seek to generate liquidity by liquidating assets at <i>fire sale</i> prices. Through mark-to-market valuation of the trading portfolio, this can cause other financial institutions to incur serious investment losses. 	<ul style="list-style-type: none"> - In absence of safeguards such as real-time gross settlement, delivery versus payment, and payment versus payment, failure of an important financial institution can cause <i>operational disturbances</i> in financial infrastructure, with possibly broader systemic repercussions.
	Markets	<ul style="list-style-type: none"> - Adverse price developments in financial markets may cause <i>investment losses</i>, mainly in the trading and available-for-sale portfolio. - Deteriorating financial conditions may be associated with losses through the <i>revenue channel</i> (for example, through reduced profitability of proprietary trading or lower fee income). - Due to increasing reliance on wholesale funding, disturbances in interbank markets may have a serious impact on banks' <i>funding and liquidity management</i>. 	<ul style="list-style-type: none"> - A sudden loss of confidence in one market may limit the willingness of intermediaries to trade through the <i>information channel</i>, thus reducing overall market liquidity and affecting the price-formation process. It may also lead to an overall reappraisal of risk-return assessments (as in the form of a flight to quality). 	<ul style="list-style-type: none"> - Adverse financial market developments can cause a fall in collateral values, which can trigger <i>margin calls</i>. The trader will have to pledge additional collateral, or close out the position by selling the securities (long) or buying them back (short). The broker may also sell the securities or other assets. If this happens on a large scale, financial asset prices may come under pressure.
	Infrastructure	<ul style="list-style-type: none"> - Disturbances in financial infrastructure may cause <i>delays in incoming and outgoing payments</i>, complicating liquidity management. 	<ul style="list-style-type: none"> - Operational disturbances in market supporting infrastructure (such as <i>trading platforms and clearing and settlement systems</i>) can affect market turnover and distort price formation. 	<ul style="list-style-type: none"> - Through <i>supporting services, technical links, and connected ICT systems</i>, disruptions in critically important systems can spread.

Generally, as financial systems develop and become more sophisticated, the degree of interconnectedness significantly increases. Nonetheless, even simple, bread-and-butter financial systems are usually characterized by linkages among financial institutions, markets, and infrastructure. The following is a selective list of contagion channels that are often found in lesser-developed financial systems:

- *Ownership linkages among financial institutions:* In many developing countries, the financial sector is dominated by financial conglomerates, with either a banking institution or a holding company at the top. In times of crises, the holding company may feel obliged for reputational reasons to come to the rescue of the distressed subsidiaries by mobilizing excess liquidity and capital buffers available within the other entities of the group. Difficulties in conducting group-wide consolidated supervision often undermine the effectiveness and comprehensiveness of oversight regimes.
- *Deposits in the banking system:* NBFIs often keep significant deposits in the banking system, or may own significant amounts of bank bonds. This may expose them to significant risks when the bank gets into difficulties. Conversely, a sudden withdrawal of deposits by NBFIs may complicate the liquidity management of the bank.
- *Risk of fire sale(s):* Troubled financial institutions may seek to generate liquidity by liquidating assets at fire sale prices. This can cause dislocation of the market for the particular instrument, putting significant downward pressure on prices. Accounting rules also play an important role. Mark-to-market valuation makes the impact of investment losses felt immediately, in the form of unrealized losses through earnings (for trading securities).¹⁹ In the majority of developing countries, investment portfolios in the banking system are small in size but are dominated by government paper.
- *Exposures to government securities:* Financial entities, particularly pension funds and insurance companies, are often heavily exposed to the market for government securities and government securities often represent the lion's share of their total financial assets. It is also common for brokerage firms to have significant open positions in repos, with public debt securities as collateral. Disruptions in the public debt market could thus expose these firms to liquidity risk.
- *Provider of access to financial infrastructure:* Banks often function as access provider to key financial infrastructure for NBFIs, credit unions, and cooperative banks. In some cases, smaller banks rely on bigger banks for access. In this way, disturbances in individual banks can affect the access of NBFIs and smaller banks to key financial infrastructure.
- *Interlinked payment systems:* Most countries have put in place real-time gross settlement (RTGS) payment systems or are in the process of doing so. In most cases, the wholesale RTGS payment system is at the core of the financial infrastructure, while other settlement systems depend on the RTGS system for settlement. The malfunctioning of RTGS would

¹⁹ In jurisdictions using International Financial Reporting Standards (IFRS), held-to-maturity securities are valued at historical costs. "Available-for-sale" securities are reported at fair value, with unrealized gains and losses excluded from earnings and reported in a separate component of shareholders' equity (Other Comprehensive Income). A deviation from mark-to-market valuation may shield banks and other financial institutions from the immediate hit of investment losses, but it comes at a higher risk of accumulating latent losses in the financial system if the loss of value of the securities is permanent rather than temporary.

cause payment flows to stop, with very serious consequences for banks' liquidity management and availability of payment services to the general public, because the retail payment system typically settles in the RTGS system. Similar issues would arise for security settlement.

As financial systems mature and deepen, new interconnections build up, particularly between financial institutions and at the interface of financial institutions and financial markets. The following list describes a number of interconnections that often are found in more advanced financial systems:

- *Funding linkages between financial institutions through the interbank market:* As financial systems evolve, banks usually start drawing on new funding sources in addition to existing ones (that is, deposits). As a consequence, the interbank market becomes increasingly important for purposes of market funding and liquidity management. This can leave banks more exposed to the risks of disrupted funding markets—as occurred during the initial stages of the subprime crisis, when uncertainty about the distribution of losses caused banks to hoard liquidity and the main funding markets came to a near-standstill. In many countries, banks are also important providers of liquidity to other financial entities, such as brokerage firms (often through repo markets), or through their participations in money market funds. If banks experience liquidity difficulties, they may cease to roll over their positions, exposing these entities to potential liquidity distress.
- *Contingent credit lines (CCLs) among financial institutions:* CCLs not only play an important role in the functioning of short-term capital markets, but they are also widely used in bank lending. Parent banks often extend significant amounts of CCLs to their (foreign) subsidiaries, thereby functioning as an insurance instrument against liquidity distress at the level of the subsidiary. Nonetheless, the CCLs may also function as a contagion channel, when the guarantor is a financial institution that participates in the resolution of liquidity difficulties of the beneficiary institution.
- *Exposure of financial institutions to market risk:* The interface between financial institutions and financial markets typically strengthens as financial systems mature. Banks often become more active investors, expanding their investment portfolio and thus leaving banks increasingly exposed to adverse financial market developments, which may significantly affect capital or liquidity. For instance, a drastic increase in equity prices and foreign exchange rate volatility may cause a substantial hike in margin requirements, prompting financial institutions to deliver a significant amount of additional liquid collateral.
- *Derivative markets and risk management:* The deepening of financial markets often also coincides with the development of the over-the-counter derivative markets, which are a key hedging instrument for both financial institutions and non-financial corporates against interest and foreign exchange risk. A sustained malfunctioning in these markets can thus negatively impact the capacity of financial institutions and the larger non-financial corporate to adequately manage these risks. Adverse financial market developments can also expose the owners of derivative instruments to significant losses, particularly when used for speculative purposes.

The World Bank has assisted various countries in developing a contagion matrix tailored to the specific characteristics of their financial systems. This task requires considerable effort. The starting point is a thorough stocktaking of potential contagion channels. This exercise should be backed up to the extent possible with relevant data. The relevance of each contagion channel is then evaluated on the basis of a set of supporting indicators, and should also take into consideration the effectiveness of any applicable risk mitigants.²⁰

While the contagion matrix focuses on mapping interconnectedness within the financial system, it can be extended to capture the linkages with the real economy. As the global financial crisis illustrated, systemic crises can severely erode the capacity of the financial system to support the real economy through their impact on available liquidity and solvency buffers. In a bid to restore liquidity and capital buffers, banks may respond by constraining the growth of risk-weighted assets, which leads to credit rationing that often disproportionately hits sectors that carry a higher risk weight (such as uncollateralized loans to SMEs). The decline in credit growth, which is often accompanied by an increase in interest rates, dampens the economic outlook. Besides the loss of access to financial services, additional damage to the real economy may arise as a result of financial losses incurred by the nonfinancial sector. This channel refers to the negative wealth effects for households, nonfinancial corporations, and the government that arise as a direct result of the particular crisis event. In the case of a bank failure, households and nonfinancial corporations may have uninsured deposits that can be only partially recovered. Households' financial wealth or disposable income may also have a considerable exposure to developments in the financial markets, for example through defined-contribution pension systems or through unit-linked insurance policies. Unhedged debtors may be faced with increasing repayments because of adverse interest and exchange rate movements.

Conversely, a deteriorating real economy can put pressure on the financial sector, primarily through deteriorating asset quality and rising loan delinquencies. The feedback loop from a deteriorating real economy to the financial system can kickstart a new round of financial sector distress, and financial institutions can be faced with fresh losses affecting capital adequacy.

Using Composite Indexes to Assess the Cyclical Component of Systemic Risk

Interest in countercyclical financial regulation, aimed at smoothening the financial cycle, has surged recently. The significant real economic costs precipitated by a collapse in bank lending and financial asset prices experienced in the global financial crisis have increased policymakers' and academics' interest in various kinds of policies and regulations aimed at smoothening the financial cycle (Ren 2011; Lim and others 2011). The postcrisis financial regulatory agenda contains countercyclical elements, in the form of the countercyclical capital buffers as stipulated in Basel III. Other examples include anticyclical provisioning, as pioneered by Spain and more recently introduced by a group of mostly Latin American countries.

²⁰ As an illustration, the relevance of linkages between financial institutions through the interbank linkage may be assessed on the basis of the size of interbank assets/liabilities in relation to overall capital and liquidity buffers, with collateral as a potential risk mitigant.

An effective use of countercyclical regulation requires the authorities to adopt a forward-looking perspective about the level of systemic risk in the financial system. Besides an assessment of the stage of the financial cycle, this involves identifying the imbalances and vulnerabilities that further down the road are most likely to cause systemic distress, with damaging consequences for the financial sector and the real economy.

However, the challenges in identifying such systemic threats are considerable, considering that risks to financial stability are not easily measurable, and there is no widely accepted comprehensive model for measuring systemic risk. In the specific case of emerging economies, the task of monitoring financial stability is often complicated by the presence of rapid structural changes as financial systems deepen and diversify. This is problematic because an effective use of countercyclical financial regulation requires policymakers to distinguish between activation and release phases. Given the uncertainty in measuring systemic risk and the transmission channels of macroprudential tools, most policymakers are understandably reluctant to rely solely on a rules-based framework. At the same time, exclusive reliance on discretionary measures is not advisable as this may prevent authorities from overcoming the bias for inaction that tends to prevail. More conclusive guidance could help overcome the inaction bias, while assisting policymakers in the calibration of macroprudential tools and policies.

Composite financial stability indexes can serve as a useful complement to the analytical toolkit by contributing to a more conclusive macroprudential analysis. Such indexes can be constructed on the basis of a range of supporting data series, with each composite index assessing a separate aspect of financial stability. On the basis of a set of carefully selected supporting indicators, a composite financial stability score can be calculated. The score for each index is constructed by converting a range of indicators into percentile ranks based on the history of the series. The composite scores can be tracked over time, and indicative stress levels can be set; this can be useful in informing policymakers as to when to act, communicating to the public about financial stability risks, and thereby serving as a useful supplement to the more descriptive sections of the FSR.

At the same time, it is important to be mindful about the limitations of such indexes. Each of the composite indexes covers a particular aspect of financial stability, but complex linkages among various sectors are typically not captured. In addition, some of the informative value of outliers is lost, because indexes constructed on the basis of percentile rankings show more moderate increases when new observations far surpass historical values. Financial stability indexes are therefore best seen as an addition to the analytical toolkit, rather than as a substitute for existing analytical frameworks. A detailed analysis of the resilience of both financial entities and real economic and financial conditions is still required, as are quantitative assessments and qualitative judgment.

Several central banks already use indexes for to monitor financial stability, including the Central Bank of Turkey, the Hungarian National Bank, the Norges Bank, and the Reserve Bank of New Zealand. In addition, the European Central Bank has developed a composite indicator for systemic stress on the basis of a series of high-frequency financial market indicators. The use of indexes for purposes of monitoring financial stability was originally pioneered by the

International Monetary Fund (IMF) in 2007 in the Global Financial Stability Risk Map (Dattels and others 2010).

A first decision is the selection of indexes that are to be constructed. The appropriate selection of indexes depends, among other considerations, on the structural characteristics of the financial system and the authorities' preferences regarding comprehensiveness and coverage. However, it can be useful to make a conceptual distinction between three different types of indexes.

- *Stress indexes*: A first set of indexes measures the contemporaneous stress level in the system, usually on the basis of a series of high-frequency financial market data, such as volatility in equity and fixed income markets, sovereign bond spreads, interbank lending spreads, credit default swap spreads of (parent) banks, and foreign exchange (forex) and interest rate swap spreads where available. The stress index can also help policymakers in signaling turning points from “normal” to “crisis” mode (and vice versa).
- *Vulnerability indexes*: A second set of indexes is designed to pick up on vulnerabilities and imbalances that within the policy horizon (for example, one to two years) could translate into systemic threats. It is helpful to construct an index that tracks the financial cycle based on the behavior of credit and asset prices, particularly property prices, considering that peaks in the financial cycle tend to be closely associated with systemic banking crises (Borio 2012). In a similar vein, it can be useful to construct indexes for the financial position of households and nonfinancial corporates, taking into consideration such indicators as DTI ratios, debt service ratios, and exposure to interest and/or exchange rate risk. A sustained weakening of the financial position of households and corporates can set the stage for a marked deterioration of asset quality further down the road, eventually putting severe stress on the banking system's liquidity and solvency buffers.
- *Resilience indexes*: The last set of indexes is meant to measure the resilience of banks and other financial entities in the face of adverse shocks. In the banking sector, this would cover a broad range of prudential indicators measuring capital, asset quality, and earnings indicators, as well as the liquidity outlook.²¹ A similar index may be created for non-deposit taking financial entities.

The next step is to select the series of indicators on the basis of which each composite index can be constructed. The selection process usually involves several iterations before a satisfactory specification is found. In deciding on the specification, it is important to keep the following requirements in mind:

- *Variables with an unambiguous relation to financial stability*: In selecting the indicators, it is important to ensure that each variable has an unambiguous relation to financial stability. The inclusion of variables that do not have such a clear-cut interpretation in

²¹ Such liquidity and capital indexes can be usefully complemented by various kinds of stress tests, which produce outcomes that are specific to individual banks.

terms of financial stability will obfuscate the composite indexes, and will likely affect their accuracy in signaling episodes of financial distress.

- *Separating “vulnerability” indicators from “stress” indicators:* Vulnerability indicators (such as the loan-to-deposit ratios) tend to signal elevated financial stability risks in the upturn of the financial cycle when imbalances are building up, while stress indicators (such as banks’ funding costs) may spike only once imbalances start unwinding. It is preferable not to mix these two categories under a single financial stability index, because both types of indicators demonstrate opposing trends, flattening the composite index when combined.
- *Sufficient data history:* The indicators need to have sufficient data history to allow for a proper time series analysis, ideally on the basis of through-the-cycle data, so that long-term average sets a benchmark that is as reliable as possible. As a rule of thumb, applying a minimum of eight years of data history is suggested.²²
- *Avoiding trending:* Indicators that exhibit natural trending behavior (such as the private-credit-to-GDP ratio) yield skewed outcomes and are therefore best replaced by logarithms or simple growth rates.²³

Various kinds of data availability problems can greatly complicate the selection of indicators and the subsequent construction of the index. The indicator of interest may simply be unavailable or may not be considered reliable. In addition, the production of the indicator may involve a considerable time lag, the periodicity may be too low, and/or the time series may be too short to allow for a meaningful analysis. Data series may also be subject to frequent structural breaks, with similar distortionary effects. Although these problems may affect all areas, they tend to be especially prevalent in the household and corporate sectors. It is worthwhile to look for potential alternative indicators that may be collected by agencies other than the central bank or prudential supervisory agency, such as the statistical office, credit bureau, or cadaster, or data collected by financial institutions. As an illustration, in countries that do not have a housing price indicator, it may be feasible to reconstruct an average LTV ratio for newly provided mortgage loans. This also highlights the importance of efforts at improving data coverage for these sectors where data availability is especially problematic. Appendix A presents a comprehensive list, along with detailed suggestions for financial stability dimensions and supporting indicators.

A statistical method for transforming the supporting indicators into an index should be selected. There are several options for transforming a set of supporting indicators into an index; all have specific advantages and disadvantages. In most cases, aggregation starts with the

²² Eight years may even be on the low side. Borio (2012) finds that the financial cycle lasts 16 years, on average, for a sample of advanced countries.

²³ The trend behavior of the data series implies that the latest observation tends to be in the tail end of the distribution; thus by default, it receives an extreme score.

transformation of individual indicators through standardization.²⁴ The standardized indicators can then be transformed into a composite index by taking the average of the standardized scores of the indicators, or by applying principal component analysis. However, the implicit assumption that the supporting indicators are normally distributed is problematic, particularly during periods of severe stress. It is therefore worthwhile to explore alternative approaches to transforming data series into index scores, in a manner that is less vulnerable to the distributional properties of the underlying indicator. A possible alternative is to use means-of-order statistics (Holló, Kremer, and Lo Duca 2012). This approach is discussed in box 3.2.

Box 3.2 Transforming Data Series into a Composite Financial Stability Index through Means-of-Order Statistics

Means-of-order statistics is a relatively simple technique for transforming data series into an index score. The starting point is to rank the data series in such a way that the higher ranking observations correspond to higher risk to financial stability. Taking the example of credit growth, higher rates of credit growth reflect a booming financial cycle, and therefore are associated with higher risk to financial stability. The data should thus be ranked in ascending order.

The position of a specific observation in the ranking order determines the index score that it receives. The first ranking observation (which represents minimum financial stability risk) receives a score of 0; the highest ranking observation (representing the highest financial stability risk) receives a score of 1. For a sample size n , the sample can be compartmentalized in $(n-1)$ percentiles, while r represents the position of a particular observation in the overall ranking. Subsequently the index score corresponds to $[r/(n-1)]$. Each observation thus represents a $1/(n-1)$ increment over the observation that precedes it in rank.^a

Means-of-order statistics has the advantage of being less sensitive to the distributional properties, but that comes at the price of losing some of the informational content of outliers. Transformation through means-of-order statistics does not require the raw data to be normally distributed. However, in the process of transformation, some of the information content of outliers gets lost, as the indexes' scores of outliers based on percentile rankings will be somewhat muted.

For financial stability monitoring purposes, the latest observation of any data series is the most relevant. The desired "real time" property can be introduced by computing the financial stability index score for the indicator that is being investigated based on the most recent observation. In the process of adding new observations, the sample is expanded, one observation at a time. The indicator is thus transformed into an index recursively over an expanding sample.

²⁴ Standardized scores are obtained by subtracting the sample mean from the raw score and dividing this difference by the sample standard deviation.

The next step is to compute the composite financial stability index score, based on the index scores obtained for the individual indexes. The most straightforward manner to calculate the composite financial stability index is by taking the unweighted mean of the index scores for the individual indicators, on the basis of which the composite index is constructed. The composite index may also be calculated as a weighted average of the supporting indicators or time-varying weights, by applying portfolio theory to the aggregation of the individual indicators (as is done in Holló, Kremer, and Lo Duca 2012).

A related but simpler alternative for means-of-order statistics is the construction of a predefined number of equal-sized intervals. As is the case with means-of-order statistics, the data are ranked in such a way that the higher-ranking observations correspond to higher risk to financial stability. Subsequently, the data series is divided into a number of percentiles, in such a manner that each percentile contains an equal number of observations. By adding the latest observation for a particular indicator to the ranked data, it can be bracketed into a particular percentile, each of which corresponds to a financial stability score (for instance, 6 intervals if financial stability risks are scaled on a 0 to 5 scale). Aggregation of the individual indicators into the composite index follows a similar approach as for means-of-order statistics. This methodology is applied by the Norges Bank (Dahl and others 2011).

a. Continuing with the example of credit growth, and assuming a sample size n of 101 observations, the sample can be compartmentalized into $(n-1)$ (that is, 100) percentiles. Each observation thus represents a 0.01 increment over the observation that precedes it in rank. Assuming that the latest figure on credit growth ranks 85th in the ranking, its index score corresponds to 0.85 [$85/(101-1)$], signaling a historically high rate of credit growth, and thus a relatively high financial stability risk. Instead of using a 0–1 scale, alternative scales are possible. For example, if a 0–5 scale is used, the index scores can be obtained by using the formula above and multiplying the scores by 5.

The next step is to validate the specification of the composite financial stability index, which usually involves several iterations. After selecting the individual indicators on the basis of which the composite financial stability index is constructed, the individual indicators can be converted into index scores, and the composite financial stability index can be computed. It can then be ascertained whether the composite indexes behave as expected. As noted, the typical pattern is that a composite index that consists of stress indicators will likely signal relatively low levels of financial stability risk in the upturn of the financial cycle, but may spike suddenly in the face of financial distress. By contrast, vulnerability indexes that are based on indicators that measure levels of indebtedness, leverage, or the evolution of asset prices will likely display rising levels of financial stability risk in the upturn of the financial cycle, followed by gradually decreasing levels of risk in the downturn. Lastly, resilience indicators tend to follow the financial cycle indicators, but with a significant lag. It usually takes several iterations before a satisfactory

specification has been found. A more rigorous but analytically more challenging alternative is to use econometric techniques.²⁵

Once the various composite indexes have been specified, the results can be graphically summarized in a single diagram and presented in the FSR. Following the approach in the IMF's Global Financial Stability Map, a radar (or cobweb) style diagram can be constructed, wherein each axis represents a composite index. For a given point in time, the scores across all composite financial stability indexes can be plotted, summarizing the financial stability outlook in a single screenshot (see box 3.3 and figure B3.3.1). Scores further away from the origin of the diagram represent higher levels of financial stability risk.

Box 3.3. Applying Financial Stability Indexes: The Cobweb Model of El Salvador

This section describes the experiences of El Salvador, where the authorities have constructed a series of composite financial stability indexes with World Bank assistance. The work was undertaken in close cooperation with the Banco Central de Reserva (BCR) and the Superintendencia del Sistema Financiero (SSF). The SSF and the BCR jointly conduct systemic risk assessments on a quarterly basis, using the newly established methodology. Once a year, the results are published by BCR in its Informe de Estabilidad Financiera. The analysis then serves as a point of departure for the formulation of risk-mitigating policies in the Comité de Riesgo Sistémico (CRS), in which high-level representatives from the BCR, SSF, the Ministry of Finance, and the deposit insurance agency are represented.

Nine composite indexes have been created, each of which was based on a series of supporting indicators. The following indexes were constructed: capital and earnings; liquidity and funding; structure of the financial system; NBFIs; macroeconomic conditions; financial conditions; the financial cycle; households; and non-financial corporates. The process of selecting supporting indicators for the composite indexes involved several iterations to validate the specification, so as to ascertain whether it picked up on previous episodes of financial turmoil, particularly the 2008 financial crisis.

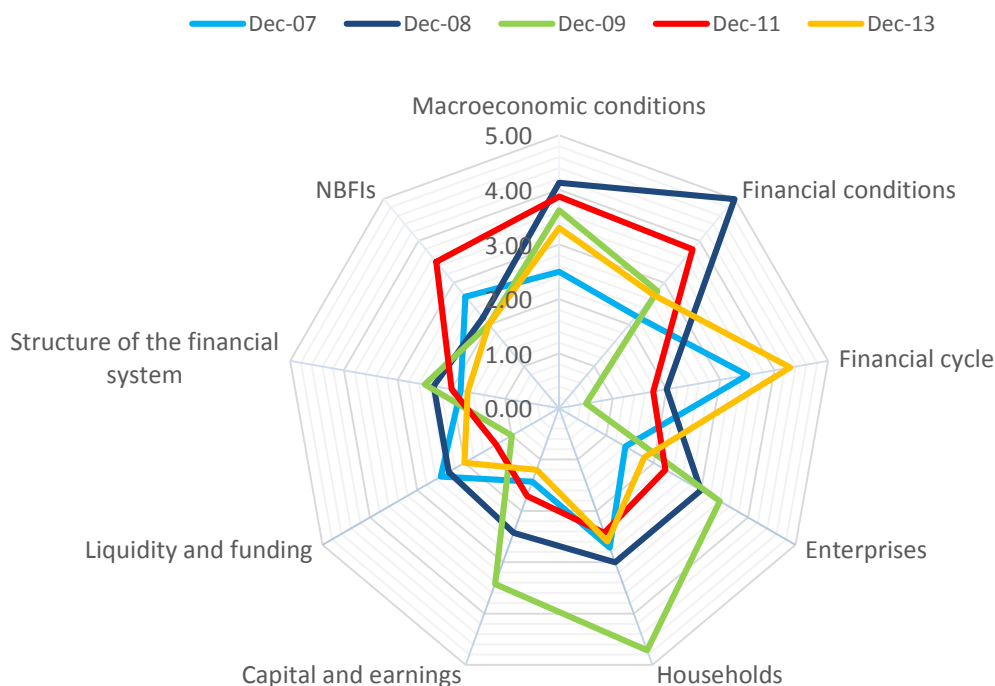
The indexes were constructed using the simplified alternative to the means-of-order statistics. Time series were built for each of the supporting indicators, maximizing the length and the number of observations and ensuring that a full cycle was captured. The data series were then ranked so that higher values correspond to higher financial stability risks. Six equally sized intervals were then created. In this way, the latest observation could be assigned a 0–5 financial stability score. The scores for the nine composite indexes were tabulated by calculating the unweighted mean of the supporting indicators.

²⁵ This typically involves the creation of a financial stress index (FSI) gauging the level of stress in the financial system at any given point in time, usually on the basis of a series of high-frequency financial market data. Subsequently crisis episodes are identified and FSI crisis thresholds are set. Finally, the explanatory power of the various indexes in driving the FSI can be assessed.

Overall, the results were encouraging, but additional efforts are needed to enhance data coverage. Figure B3.3.1 plots the outcomes of the exercise for five different years (December 2007–December 2011). It displays the buildup of imbalances in the run-up to the 2008, including rising household indebtedness, which took place against the backdrop of favorable macroeconomic and financial conditions and an upturn in the financial cycle. The model also illustrates how 2008 marked the turn of the financial cycle, with a marked slowdown in credit growth, deleveraging households and sharp deterioration in the macroeconomic outlook.

Obviously, data availability determines the range of indicators available for financial stability monitoring. The exercise in El Salvador highlights the importance of efforts to strengthen data coverage, particularly with regard to the household and corporate sectors. In addition, the lack of an indicator for housing prices is a pressing data gap.

Figure B3.3.1 The Salvadoran Cob Web Model



Source: Banco Central de Reserva de El Salvador

4. Practical considerations

Besides establishing the analytical underpinnings of financial stability monitoring, policymakers also need to give some thought to more practical aspects. Responsibilities for conducting macroprudential analysis need to be assigned to specific agencies. In addition, macroprudential analysis needs to be embedded in an institutional framework, aimed at ensuring that the

outcomes of the analysis are translated into effective risk-mitigating policies. The authority responsible for conducting macroprudential analysis should also give thought as to how the outcomes of the exercise are to be communicated. While these aspects are dealt with in greater detail elsewhere (see, for example, Damodaran and Lee 2014), this section provides a concise set of recommendations for putting the components of the framework described in the previous section to practical use.

The presence of a robust institutional framework is key to translating macroprudential analysis into policymaking. The literature on the topic has expanded rapidly in the last few years. While a detailed discussion is beyond the scope of this paper, Nier and others (2011) and the CGFS (2011) list a number of institutional requirements of an effective macroprudential policy framework.

The designation of a single macroprudential authority or group of authorities is a core element of the institutional framework. In practice, the central bank is the most common authority of choice, either as the single macroprudential authority or as the lead authority in a multiagency, committee arrangement. Committee structures can be especially helpful in jurisdictions where regulatory responsibilities are dispersed. The main rationale for providing central banks a central role is that they are relatively shielded from political and industry pressures, and that (in their capacity as monetary authority and payment systems overseer—and often also as a prudential supervisor) they have an important advantage in developing a systemwide perspective. In addition, in their capacity as monetary authority, they are well-placed to assess the interaction between macroprudential and monetary policy.

The macroprudential authority needs to be provided with a clear mandate and adequate powers, matched with strong accountability. The macroprudential authority needs a strong mandate to conduct unbiased risk assessments and to empower it to pursue unpopular lean-against-the-wind policies in the upturn of the financial cycle. In order to truly adopt a systemwide perspective, the macroprudential authority's monitoring powers need to cover the bulk of the financial system. The macroprudential authority should also have sufficient powers to propose risk-mitigating measures, including for entities and sectors that are not directly under its purview. It should have powers to monitor compliance and to enforce measure in case follow-up is unsatisfactory. These broad powers should be balanced with strong accountability, wherein the macroprudential authority not only communicates about the financial stability outlook, but also reports about the effectiveness of measures that have been undertaken as part of its macroprudential mandate.

The responsibility for conducting macroprudential analysis is usually assigned to central banks, often with a central role for dedicated financial stability departments. Many central banks have set up dedicated financial stability departments, which are a natural point for anchoring responsibilities for financial stability surveillance. Even so, the involvement of other departments—including the research, monetary, financial market, and payment systems departments—is highly desirable. In countries where the central bank is not responsible for prudential supervision, the responsibility for macroprudential analysis may be shared with the prudential regulator.

The team responsible for macroprudential analysis needs access to a broad range of data. Macroprudential analysis is a very data-intensive exercise, and data availability is often a constraining factor in strengthening macroprudential analysis. A thorough stocktaking of data availability is therefore a useful starting point for establishing a framework for macroprudential analysis. This can be helpful in identifying gaps and prioritizing measures to address them. An area where data gaps often occur is the NBFIs sector, where the frequency of prudential reporting tends to be lower and the lags in producing data longer than for the banking sector. In addition, the analysis of the financial position of the household and enterprise sector is often impeded by lack of available data. For these sectors, it is likely that external sources will need to be used. A potential data source is the credit reference bureau, which may contain relevant information about the leverage, indebtedness, assets, income, and liabilities of households. Even when data are available, adequate access needs to be ensured. It may be particularly challenging to obtain access to confidential microprudential data, particularly if the central bank does not undertake supervisory responsibilities.

Another decision relates to the periodicity of macroprudential analysis, recognizing that the components presented in the previous section serve different monitoring purposes. The analysis of the time series dimension of systemic risk needs to be conducted most frequently. In practice, most countries undertake the assessment twice a year and report on the outcomes in an FSR at least once per year. Updates of the list of systemic banks and of the contagion matrix can be undertaken less often—typically once per year—since structural changes in the financial system usually take longer to materialize.

Elements of the framework for identifying systemic banks and the contagion matrix can be usefully included when conducting the periodic assessment of the time series dimension of systemic risk. The contagion matrix can be useful in thinking through the systemic impact of a particular stress scenario, because it helps in analyzing the likely direction and intensity of any contagion effects. Quantitative tools such as stress tests can be used to further substantiate the likely impact of stress scenarios on individual financial institutions.

Overall, the staffing and resource implications of putting in place a robust framework for macroprudential analysis are considerable, but still worthwhile. The significant investment requires a strong commitment on behalf of the implementing country. It is important that the implementation costs are seen against the background of the potential costs of financial crises, which can undo years of economic growth and progress in fighting poverty. This implies that any policy that contributes to reducing the likelihood of a crisis and enhancing the quality of the crisis response is likely to be cost-efficient.

Appendix A. Suggested Financial Stability Indexes and Supporting Indicators

This appendix provides more detailed suggestions regarding the selection of financial stability indexes and their supporting indicators. The proposals below are suggestions based on an informal comparison of various FSRs. As explained in the main text, these suggestions are not clad in stone. To ensure a good fit, it is important that the specification captures country-specific circumstances, either by dropping indicators that are not considered important or by adding additional ones. As explained, a conceptual distinction can be made between stress indexes, vulnerability indexes, and resilience indexes.

Stress Indexes

- *Financial conditions:* Stress indexes look at a range of easily available high-frequency financial market indicators, capturing the sentiment in global as well as regional and local financial markets. Relevant global financial markets indicators include the Merrill Lynch Option Volatility Estimate (MOVE) and the Board Options Exchange volatility index (VIX). The MOVE index measures the implied volatility of one-month-ahead U.S. treasury options and can be considered an indicator for future volatility in the bond market. The VIX (also known as the “fear index”) denotes expected equity volatility. The JP Morgan Emerging Markets Bond Index Global (EMBI Global) tracks total returns for traded external debt instruments in the emerging markets. Country-level spreads are indicative of market perception about the riskiness of individual countries and regions.²⁶ Additional indicators include the Libor–OIS spread, measuring financial markets’ perceptions of credit risk of the banking sector.²⁷ These indicators may be supplemented by volatility indexes for local capital markets and stock exchanges, provided that there is sufficient activity in these segments to warrant the monitoring of these indicators. Closer to the (local) banking system, it may also be useful to monitor interbank lending spreads, credit default swap spreads of (parent) banks, and forex and interest rate swap spreads, where available.

Vulnerability Indexes

- *Financial cycle:* Vulnerability indexes contain a range of indicators aimed at assessing the stage of the financial cycle. The time-varying component of systemic risk is to a large extent driven by credit, leverage, and asset price cycles. The index should signal increasing financial stability risk in the upturn of the financial cycle, when imbalances are building up. The financial cycle index can be a helpful input for deciding whether to activate or release countercyclical financial regulation and more ad hoc lean-against-the-wind measures. As suggested by Borio (2012), the index can be constructed on the basis of a variety of indicators looking at the behavior of credit and financial assets, particularly property.

²⁶ The EMBI Global includes U.S. dollar-denominated Brady bonds, loans, and Eurobonds with an outstanding face value of at least \$500 million.

²⁷ The London interbank offer rate (Libor) is the rate at which banks indicate they are willing to lend to other banks for a specified term of the loan. The overnight indexed swap (OIS) rate corresponds to the federal funds rate. The term Libor-OIS spread reflects what banks believe is the risk of default associated with lending to other banks.

Particular emphasis is put on the credit-to-GDP gap (credit gap), defined as the difference between the credit-to-GDP ratio and its long-term trend. Where available, bank lending surveys contain valuable information about the risk perception of senior loan officers.²⁸ It is also worthwhile to monitor real estate prices closely, although in many emerging markets reliable real estate indexes are not available. As an alternative, transactional data on newly concluded mortgage loans can also contain valuable information, such as the LTV and DTI ratios. Rapid increases occurring in the upswing of the financial cycle reflect a relaxation of loan approval criteria and therefore signal increased risk of financial instability. Lastly, the net inflow of short-term speculative capital (portfolio investments) expressed as a share of GDP is also indicative of the financial cycle, with rapid increases occurring during the upturn.

- *The financial position of households*: It is useful but often challenging to develop an index for the financial position of households, to complement the financial cycle index. The analysis of the household sector is often impeded by lack of data, often warranting the use of indicators from sources beyond the central bank, such as the statistical office, the credit bureau, or household surveys that some countries undertake annually. Drehmann and Juselius (2013) highlight the importance of debt service ratios for the nonfinancial sector, capturing the proportion of interest payments and mandatory repayments of principals relative to income for the household sector, which can be interpreted as an important indicator for the health of households' balance sheets, and a harbinger of a deterioration of the financial stability outlook. Household indebtedness should ideally be defined in a comprehensive manner, covering residential mortgage debt, and the full range of consumer loans (including credit card loans, auto loans, and various kinds of consumer credit). The proportion of foreign currency–denominated loans and the share of adjustable interest rate loans are also worth monitoring, because households are usually not hedged against the risk of adverse movements in currencies and rates.²⁹ Where available, indicators for net household wealth (assets minus liabilities) are also relevant: the asset side covering financial wealth (such as savings, deposits, and securities) and real wealth (land and dwellings). Data availability permitting, the share of overindebted households whose debt-to-disposable-income ratio exceeds a certain threshold may also be included.
- *The financial position of nonfinancial corporates*: Similar to the analysis of households, it is important to assess the health of the balance sheet of nonfinancial enterprises. As is the case with the household sector, data coverage can be problematic, and external data sources may need to be consulted. A first relevant indicator is the debt service ratio for firms, wherein interest and mandatory principal repayments can be expressed as a share of turnover.³⁰ In addition, it may be worthwhile to monitor the proportion of foreign-currency-denominated loans, with particular focus on nonhedged corporate borrowers, data permitting. Profitability indicators, including the return on equity (RoE) and return on assets (RoA) for the corporate sector, sales growth, and the growth of inventories, can also contain

²⁸ See for instance, the ECB's bank lending survey <http://www.ecb.int/stats/money/surveys/lend/html/index.en.html>.

²⁹ If data allow, it may also be useful to monitor the proportion of household loans that is subject to an interest rate adjustment within the next year.

³⁰ Alternatively, if turnover data are not available, corporate indebtedness can be expressed as a share of GDP.

useful information if available. Some countries also produce indexes for the corporate sector's outlook—such as the purchasing manager index in the United States—which may be worthwhile monitoring. Lastly, data on the number of corporate bankruptcies are usually easily available and contain useful information.

- *Macroeconomic conditions:* Complementing the financial cycle, household, and nonfinancial corporate indexes, it is important to assess macroeconomic conditions, comprising a range of easily available data on real economic activity, monetary conditions, public debt sustainability, and the external position. Relevant indicators include economic growth and—for open economies—economic growth in the main trading partners and price development for key export products or services. The inflation rate, real interest rates, and the yield curve spread (for instance, the difference between short-term government paper and long-term bonds)³¹ are indicative of the prevailing monetary conditions. Indicators for public debt sustainability are the level of public indebtedness, the actual or structural government deficit, and/or the amount of public debt that is falling due over the next year—all expressed as a share of GDP. The sustainability of the external position can be assessed on the basis of the current account position, external indebtedness, and—if available—the net investment position,³² all expressed as a percentage of GDP. Other indicators include reserve coverage of imports (expressed as a ratio or in terms of months of import coverage) and the real exchange rate. Particularly for countries with persistent current account deficits, capital inflows are worthwhile monitoring, such as the proportion of the deficit that is covered by more stable foreign direct investment (FDI).

Resilience Indexes

- *Capital, earnings, and asset quality of the banking system:* Financial stability analysis is incomplete without an assessment of the resilience of financial entities, particularly banks, to absorb adverse shocks, including credit losses. Such an assessment should comprise basic indicators of solvency such as the capital adequacy ratio for the banking sector, the core capital adequacy ratio, the leverage ratio, or a combination of these elements. In addition, it should include indicators of asset quality, such as the proportion of overdue and restructured loans in the loan portfolio, and the provisioning rate. Lastly, indicators of profitability should be included, assessing the capacity of the banking system to absorb losses through earnings. Relevant indicators include RoE and RoA, and the intermediation margin (the difference between average lending and deposit rates). The availability of these indicators is usually not problematic, but the data cannot always be taken at face value. The banking sector's solvency indicators are frequently inflated due to underprovisioning for bad loans or uncontrolled restructuring. Under these circumstances, corrections in the data may be necessary to arrive at more reliable solvency measures.

³¹ The yield curve spread is defined as the spread between the interest rates on long-term government bonds (for instance, ten-year) and short-term government paper (for instance, three months).

³² The net investment position is defined as the difference between a country's external financial assets and its liabilities. Lower values indicate higher risks to financial stability.

- *Liquidity and funding of the banking system:* In addition to assessing the banking sector's resilience in the face of credit losses, it is also important to analyze the capacity of the banking system to absorb a shock on the liability side of the balance sheet through higher costs or reduced availability of funding. In deciding on the range of supporting indicators, it is important to take into consideration the funding profile of banks. In most developing countries, deposits are the main funding source, with wholesale funding (including the interbank and repo market) following at considerable distance. Among the relevant liquidity indicators are loan-to-deposit ratios, the ratio of liquid assets to short-term liabilities, and the reliance of the banking sector on back-up liquidity sources (such as parent bank funding). Where available, Basel III liquidity indicators, including the net stable funding ratio (NSFR) and the liquidity coverage ratio (LCR), could be constructed.³³ The usual pattern is that liquidity imbalances build up in the upturn of the financial cycle, when the expansion of the loan book usually outpaces the growth of stable sources of funding, particularly deposits. Once the financial cycle turns, the liquidity imbalances unwind as credit growth slows down. For countries characterized by high levels of currency substitution, the metrics above may also be calculated in the relevant national and foreign currencies.
- *Soundness of NBFIs:* This index is meant to measure the financial soundness of various kinds of non-deposit taking financial institutions, such as insurance companies and pension funds. A frequent problem is that NBFIs report less often than the banking sector and that prudential data have a longer time lag. It may therefore be necessary to revisit the reporting requirements that apply to the NBFIs sector to ensure the timeliness and comprehensiveness of the reports. Among the indicators to be included are measures of solvency. This typically involves the backing of liabilities to policyholders (technical provisions), taking into account the level of guarantee with conservatively valued eligible assets. Other relevant indicators include the RoE and RoA, and measures of the volatility of investment returns. For the insurance sector, the ratio of paid insurance claims to received premiums is relevant. For the pension sector, the ratio of contributors to beneficiaries is relevant, particularly for defined-benefit pay-as-you-go systems.

³³ The NSFR has a time horizon of one year and measures the sustainability of the maturity structure of assets and liabilities. The LCR measures the sufficiency of the buffer of high-quality liquid assets in the face of a stress scenario lasting for one month.

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