A Framework for Financial Stability

The framework developed in this chapter seeks to integrate the analytical and policy elements of financial stability, building on the characteristics of finance and the definition of financial stability developed in earlier chapters. A key part of the framework is an assessment that brings together macroeconomic, monetary, financial market, supervisory, and regulatory input. The purpose of this framework is to provide a coherent structure for the analysis of financial stability issues to

- foster early identification of potential risks and vulnerabilities;
- promote preventive and timely remedial policies to avoid financial instability;
- resolve instabilities when preventive and remedial measures fail.

The ultimate goal of the framework is to prevent problems from occurring or to resolve problems if prevention fails. While this chapter touches on resolution, its main focus is prevention.

The framework is designed to go beyond the traditional “shock-transmission” approach that is the basis of many existing policy-oriented frameworks. In this shock-transmission approach, the system would either be presumed to remain in a state (or path) of equilibrium if undisturbed or adjust to a different, perhaps less desirable, state (or path) of equilibrium if and when it experiences a shock. Instead, the focus here is on identifying and dealing with the buildup of vulnerabilities prior to downward corrections in markets, prior to problems within institutions, or prior to failures in financial infrastructure. This approach implicitly assumes that a shock that may eventually trigger such adjustments is usually less relevant itself when compared to the actual imbalances that were present in the financial system when the shock occurred. This approach also accords with the view that financial stability should be viewed as a continuum, in which
imbalances may develop and either dissipate through self-corrective mechanisms or accumulate to the point of moving the financial system outside the range of stability.

As will be discussed in this chapter, the key to prevention is the early identification and analysis of risks to stability and of potential sources of vulnerability in the financial system before they lead to unsustainable and potentially damaging imbalances and consequences. Along with identifying potential sources of risks and vulnerabilities, it is also necessary to attempt to calibrate their intensity and potential for leading to financial-system problems and possible systemic effects.

The key to resolution is to have mechanisms in place and policy tools available to remedy situations in which the financial system seems to be in the early stages of moving toward instability. Such tools might include moral suasion and intensified supervision or market surveillance or both. Should remedial measures fail, or undetected endogenous factors or unanticipated exogenous factors lead to instability, tools should be available for resolving problems and instabilities quickly and with minimum collateral damage, either to the financial system or the economy. Such tools would include emergency liquidity assistance.

Various works have tried to tackle some or all of these issues in the past, but none of these approaches has gained wide acceptance within the profession. An increasing number of central banks and other policymaking institutions, including the IMF, cover financial stability issues in periodicals published once or twice a year, and some of them provide a rudimentary discussion of their analytical structure. At the international level, the IMF and the World Bank have launched the Financial Sector Assessment Program (FSAP), which examines selected countries’ financial soundness and assesses their compliance with financial system standards and codes (see International Monetary Fund and World Bank, 2003).

The next section of this chapter discusses the financial-stability challenge more precisely than in previous chapters, and examines the possible relationship between efficiency and stability and the need for a systemwide approach. The succeeding section outlines an overarching framework for

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61Crockett (1996) undertook an early and extensive survey of the underlying literature. Some analyses are formulated in academic or theoretical terms, paying only limited attention to policy implications (Davis, 2002; Mishkin, 1999). Other studies take an institutional approach, by discussing regulatory regimes (Das, Quintyn, and Chenard, 2003; Llewellyn, 2001), or investigating specific responsibilities of central banks (Oosterloo and de Haan, 2003).

safeguarding financial stability in which both prevention and resolution of financial problems and crises are key objectives. This section first places financial-stability work in a broader economic and financial context, then sketches out the vital parts of the framework, focuses on the prevention and resolution parts of the framework, and finishes by examining policy implications. This is followed by a discussion of some of the more practical challenges in making financial-stability assessments, first by outlining criteria for disciplining the process of information gathering, monitoring, and assessing, and then by examining the formidable measurement and modeling issues in making assessments. The final two sections briefly outline some of the immediate and difficult challenges ahead in assessing financial stability, and draw conclusions.

What Is the Financial-Stability Challenge?

There are many ways to characterize the challenges faced in achieving and maintaining financial stability. Moreover, the nature of the challenge will depend to some extent on the structure and maturity of the economic system. Although what follows can be adapted to all financial systems, for mature financial systems the financial-stability challenge can be characterized as

maintaining the smooth functioning of the financial system and maintaining the system’s ability to facilitate and support the efficient functioning and performance of the economy; and having in place the mechanisms to prevent financial problems from becoming systemic or from threatening the stability of the financial and economic system, but without undermining the economy’s ability to sustain growth and perform its other important functions.

The challenge is not to prevent all financial problems from arising. First, it is not practical to expect that a dynamic and effective financial system would avoid instances of market volatility and turbulence, or that all financial institutions would be capable of perfectly managing the uncertainties and risks involved in providing financial services and enhancing financial stakeholder value.

Second, it would be undesirable to create and impose mechanisms that are overly protective of market stability or that overly constrain risk-taking by financial institutions. Constraints could be so intrusive and inhibiting that risk-taking could be reduced to the point where economic efficiency is inhibited. Moreover, the mechanisms of protection or insurance could, if poorly designed and implemented, create the moral hazard of even greater risk-taking.
The phrase “but without undermining the economy’s ability to sustain growth and perform its other important functions” is an important component of the challenge of financial stability. The achievement and maintenance of financial stability should be balanced against other, perhaps higher-priority objectives such as economic efficiency. This balance reflects the notion that finance is not an end in itself but plays a supporting role in improving the ability of the economic system to perform its functions.

**Efficiency and Stability**

That the challenge is a balancing act can be seen by considering that the likelihood of systemic problems could be limited by a set of rules and regulations that restrict financial activities in such a way that the incidence or likelihood of destabilizing asset-price volatility, asset market turbulence, or individual bank failures could be reduced if not eliminated. However, this type of “stability” would likely only be achieved at the expense of economic and financial efficiency. This reasoning leads to the impression that there is a trade-off between achieving economic and financial efficiency on the one hand, and economic and financial stability on the other. That is, if one is concerned solely with stability, it may be possible to achieve and maintain it by trading off some efficiency.

The possibility of a trade-off can be illustrated by narrowing the definitions of stability and efficiency. Consider a market for a good whose price is sensitive to incoming information, a condition that applies to many asset prices. The variability of the asset price could, in principle, be limited by the imposition of restrictions in the market that would inhibit the ability of traders to price-in every small piece of information. However, from a trader’s and investor’s perspective, such restrictions would be inhibiting the efficiency of the market’s ability to price and allocate resources in the presence of uncertainty.

It is possible, however, to try to maintain efficiency, and even enhance it, while at the same time allowing the financial system room to innovate, evolve, and better support the economic system. If the cost of these dual objectives is greater asset-price volatility or capital flow volatility, it is up to society to choose a point along this trade-off.

Some have characterized the difference between the U.S. financial system and the European financial system as the choice of different points along this trade-off. The U.S. system is more market oriented in that the financing of both household and corporate activities is accomplished more through markets than in Europe, where there is much greater reliance on bank
funding than on tradable securities (although this is changing). While one might argue that the U.S. system of finance has led to greater economic productivity and efficiency, this “greater efficiency” is accompanied by greater asset market volatility and turbulence, and a greater observed tendency to financial stress.

The Need for a Systemic Approach

From a broader perspective, the challenge of achieving and maintaining financial stability goes well beyond the stability of asset prices, or prices more generally. Authorities, central banks in particular, should still be concerned with asset-price volatility, and price volatility more generally, because they do determine the value of money. However, the challenge of financial stability is broader than, and in fact encompasses, the need to limit the impact of price instability on the functioning of the overall financial system. In fact, if the financial system is stable, it will be able to tolerate higher levels of asset-price volatility, as well as other financial problems, including problems in financial institutions. To jump immediately to the highest level of generality, the challenge of financial stability is to manage the risk of the occurrence of a systemwide problem, that is, to manage systemic financial risk (defined in Chapter 5).

Defining and Operationalizing a Financial Stability Framework

A financial system is one part of a larger economic, social, and political system. It is affected by economic, social, and political developments, and in turn affects the performance of the economy and the well-being of society more generally. That is, finance takes place within a context. So, too, does the work of safeguarding financial stability, and so, too, does the framework developed here.

To illustrate the financial-stability framework’s context, Figure 6.1 presents a stylized view of factors affecting financial system performance. As observed in Part I of this book, finance helps the economic system allocate resources, manage risks, and absorb shocks, while the presence of market imperfections implies a role for public sector policy. In the figure, this is indicated by the financial system’s links with the real economy and policy. An explicit distinction is made between imbalances that arise within the financial system and those that may originate or be exacerbated by disturbances from outside the system. This distinction is primarily motivated by
differences in policy implications, as explained below. A crucial element of the financial-stability framework is the interaction between analysis and policy formulation and implementation.

**Overview of Framework**

A natural point of departure in defining and operationalizing a framework is the analysis of potential risks and vulnerabilities in the financial system, guided by the definition of financial stability as a continuum. This analysis of risks and vulnerabilities should be comprehensive and ongoing, examining all factors that influence the workings of the financial system—covering the macro-economy, financial markets, financial institutions, and financial infrastructure—and should be aimed at early identification of financial vulnerabilities. Subsequently, an assessment should be made indicating to what extent these vulnerabilities pose a threat to financial stability and what policy responses may be appropriate.

The financial system’s position within the continuum of financial stability (discussed in Chapter 5) might rest within any of three zones, with resulting implications for policy. First, the financial system may be assessed to be broadly in a zone or corridor of stability and likely to remain so in the near future. In this case, the appropriate policy is mainly preventive, aimed at maintaining stability by relying on both private sector market-disciplining mechanisms and official supervision and surveillance.
Second, the financial system may be within a corridor of stability but moving toward a boundary with instability, for instance, because imbalances are starting to develop or because of changes outside the financial system. Safeguarding the stability of the system may then call for remedial action—through moral suasion and more intense supervision, for example.

Third, the financial system may be outside the corridor of financial stability and unable to perform its functions adequately. In that case, policies should be reactive (possibly including crisis resolution) and aimed at restoring stability. Within this third category, the financial system could be further judged either to be in a position in which self-corrective processes and mechanisms are likely to move the system back toward the corridor of stability or, alternatively, to need prompt remedial and even emergency measures to move it back to a zone of stability.63

The main elements of this financial-stability framework—the analysis, assessment, and three possible policy stances—are summarized in Figure 6.2. Obviously, owing to the multifaceted nature of financial stability, the distinction between the policy categories will seldom be clear-cut, as illustrated by the gradual change from light (passive) to dark (active).

Assessments could be classified a number of other ways. Financial conditions and potential difficulties could be delineated according to their intensity, scope, and potential threat to systemic stability. For example, potential financial difficulties can be thought of as falling into one of the following fairly broad categories:

- difficulties in a single institution or market not likely to have system-wide consequences for either the banking or financial system;
- difficulties experienced by several relatively important institutions involved in market activities with the real possibility of spillovers and contagion to other institutions and markets;
- problems likely to spread to a significant number and different types of financial institutions and across usually unrelated markets for managing liquidity needs, such as forward, inter-bank, and even equity markets.

Problems occurring within each of these categories would overlap to some extent and also occur along a continuum. They would also require dif-

63As Kindleberger (1996, p. 4) puts it: “markets work well, on the whole, and can normally be relied upon to decide the allocation of resources and, within limits, the distribution of income, but . . . occasionally markets will be overwhelmed and need help.”
ferent diagnostic tools and policy responses, ranging from doing nothing, to intensifying supervision or surveillance of a specific institution or market, to liquidity injections into the markets to dissipate strains, to interventions into particular institutions.

Prevention: Financial-Stability Analysis and Assessment

Because prevention is one of its main objectives, the analysis of financial stability involves a continuous examination of potential risks and vulnerabilities that may threaten the health of the financial system and the flow of economic activity. To prevent problems from occurring or becoming significant enough to pose a risk to financial stability, the approach taken should be a continuous process of information gathering, technical analysis, monitoring, and assessment. Because of the links between the real economy and the financial system, and between the various components of the financial system, this continuous process is most useful if it encompasses both economic and financial dimensions, and institutional knowledge about institutions, markets, and the financial infrastructure. As already noted, the process needs to be comprehensive and analytical (see the top bar in Figure 6.2). Ongoing and more fundamental research into the changing structure of the financial system and its changing links to the real economy, as well as the further development of measurement techniques for detecting growing imbalances and calibrating risks and vulnerabilities, are vital for keeping the critical monitoring function up to date.

The analytical process involves gathering and monitoring information about the macro-economy (and, at times, microeconomic functions) and about various aspects of the financial system through supervisory, regulatory, and surveillance mechanisms. Each of the financial-system monitoring components could involve both macro- and micro-prudential characteristics. For example, in gathering information about and monitoring individual institutions, the supervisory process could be aided by knowledge about the economy’s position in the business and credit cycles and about how markets have been performing overall, because the macro-economy and markets provide the background against which the operational performance of individual institutions should be assessed. Likewise, an assessment of the condition of financial markets depends on whether the major institutions operating in the markets are well capitalized and profitable. Trade-offs again emerge, even in the assessment process, in safeguarding financial stability.

The reason for gathering and analyzing information, and for continuously monitoring the various components of, and influences on, the
financial system is to systematically and periodically make assessments about whether the financial system is performing its main functions within the corridor of financial stability. As noted in the previous section, such an assessment could lead to three conclusions, each of which has quite different implications for action (see Figure 6.2).

The assessment of risks and vulnerabilities should be comprehensive, as described in Table 6.1. An operationally significant distinction can be made between sources of risk that are present or may develop within the financial system, and sources of risk that may originate in and emanate from the real economy and be transmitted to the financial system. These different sources
of risks tend to have different policy implications. The size and likelihood of endogenous imbalances can typically be influenced by the financial authorities through regulation, supervision, or adequate crisis management. By contrast, aside from macroeconomic policies that are subject to long, varying, and uncertain lags, external disturbances can hardly be influenced. Rather, the scope for policy is mostly limited to reducing the impact of external disturbances on the financial system, for instance, by maintaining the capacity to absorb shocks and establishing backup systems to protect vital information.

In keeping with the broad definition of the financial system and its main constituent components outlined in Chapter 5, endogenous sources of risk

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<tr>
<th>Endogenous</th>
<th>Exogenous</th>
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<tr>
<td>Institutions based</td>
<td>Macroeconomic disturbances</td>
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<tr>
<td>Credit</td>
<td>• Economic environment risk</td>
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<td>Market</td>
<td>• Policy imbalances</td>
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<td>Liquidity</td>
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<td>Interest rate</td>
<td>Event risk</td>
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<td>Currency</td>
<td>• Natural disaster</td>
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<tr>
<td>• Operational risk</td>
<td>• Political events</td>
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<td>• Information technology weaknesses</td>
<td>• Large business failures</td>
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<td>• Legal or integrity risk</td>
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<td>• Reputation risk</td>
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<td>• Business strategy risk</td>
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<td>• Concentration risk</td>
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<td>• Capital adequacy risk</td>
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Market based

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<tr>
<td>• Counterparty risk</td>
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<td>• Asset price misalignment</td>
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<td>• Run on markets</td>
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<tr>
<td>Credit</td>
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<td>Liquidity</td>
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<td>• Contagion</td>
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Infrastructure based

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<tr>
<td>• Clearance, payment, and settlement system risk</td>
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<tr>
<td>• Infrastructure fragilities</td>
<td></td>
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<tr>
<td>Legal</td>
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<tr>
<td>Regulatory</td>
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<tr>
<td>Accounting</td>
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<tr>
<td>Supervisory</td>
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<tr>
<td>• Collapse of confidence leading to runs</td>
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<tr>
<td>• Domino effects</td>
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can arise either in financial institutions, or in financial markets, or in the infrastructure, or in any combination. The endogenous and exogenous sources of risks and vulnerabilities outlined in Table 6.1 are summarized in the following sections.

**Risks in financial institutions**

First, risks and vulnerabilities may develop in financial institutions. For instance, problems may initially arise at a single institution and subsequently spread to other parts of the financial system, or several institutions may be affected simultaneously because of similar exposures. Traditional financial risks such as credit, market, and liquidity risks, and interest rate and foreign currency exposure may be present in financial institutions, and if they materialize could hamper the process of reallocating financial resources between savers and investors.\(^\text{64}\) Institutions are also prone to operational, legal, and reputation risks. Furthermore, business strategy and a concentration of exposures can make financial institutions sensitive to adverse developments in particular areas, while a decline in economic capital reduces institutions’ absorption capacity.

**Financial market risk**

Financial markets are a second source of endogenous risk, not only because they offer alternative sources of finance to nonfinancial sectors but because they systemically link financial institutions and, more directly, savers and investors. Obvious examples of risks emanating from market activities are counterparty risk and asset-price misalignments. Financial markets are also vulnerable to runs and contagion. During the 1990s and the early years of the 2000s, financial systems and the global financial system became more market oriented, through both an increase in financial institutions’ market activities and exposures, and greater participation by nonfinancial corporations and households in markets. Hence, market-based risks are becoming more relevant for financial stability. At the same time, the role and relative importance of safety nets is also changing. Traditionally, deposit insurance and lender-of-last-resort facilities address problems arising at individual institutions and prevent these from spreading through the financial system. Because market-based vulnerabilities immediately

\(^{64}\)Interest-rate and foreign-currency exposures may also be seen as examples of market risk and be subsumed within this category of risk.
affect a substantial part of the financial sector, the appropriate instruments are also becoming more generalized, for instance, through liquidity injections in the financial system (White, 2003). A thorough understanding of market vulnerabilities is important for effective implementation of such instruments.

Financial infrastructure risk

Financial infrastructures are a third important endogenous source of risk, in part because they link market participants, but also because they provide the institutional framework in which financial institutions and markets operate. In payment systems, several risks may develop related to clearing and settlement. These often originate in the financial institutions participating in the system, and are in that sense related to institution-based vulnerabilities. Examples are operational failures, concentration risk, and domino effects. To the extent that financial infrastructure is itself generally run by a financial institution, infrastructural vulnerabilities may also stem from institution-specific financial risks. Other examples of infrastructure-based risks are weaknesses in the legal system and the accounting system. Such vulnerabilities may directly affect a large part of the financial sector.

Exogenous risks

Finally, vulnerabilities may be exogenous, that is, originate outside the financial system. For instance, disturbances may arise at the macroeconomic level, such as oil price shocks, technological innovations, and macroeconomic policy imbalances. These exogenous macroeconomic disturbances can pose risks for financial stability because they can directly influence the ability of economic and financial actors (households, companies, and even the government) to honor their financial obligations. More generally, coherent and consistent macroeconomic (that is, monetary and fiscal) policies are critical requirements for achieving and maintaining financial stability. Furthermore, microeconomic events, such as a failure of a large company, may undermine market confidence and create imbalances that affect the whole financial system. Other examples of exogenous disturbances are a sudden introduction or withdrawal of trade restrictions, political events (including terrorist actions and wars), and natural disasters (earthquakes, floods).

Financial-stability analysis covers all these endogenous and exogenous sources of risks and vulnerabilities, and thus requires that individual parts of the financial system (financial markets, institutions, and infrastructure)
and the real economy (households, firms, the public sector) be systematically monitored. The analysis must also take into account cross-sector and cross-border links, because imbalances often arise due to a combination of weaknesses from different sources. For instance, operational failures in payment systems may be caused by problems in financial institutions, and a large business failure (such as Enron) may be linked to weaknesses in the accounting system. The number and importance of cross-links is increasing as a result of the main trends—financial deepening, integration, and complexity—described in Chapter 1. Financial institutions are becoming more exposed to financial markets and other sectors, which increases the scope for contagion and underscores the importance of a comprehensive approach to the financial system as a whole.

**Judging the scope and impact of vulnerabilities**

Along with endogenous and exogenous sources of risk, another policy-relevant issue is the initial scope of vulnerabilities and their eventual impact on the greater financial system. Two extreme cases serve as examples. First, financial stress may initially arise at the micro level and subsequently spread over the financial system. The most obvious examples are a bankruptcy of a large nonfinancial company, or a bank failure, which can affect other parts of the financial system through interbank exposures and confidence effects. At the other extreme, developments may immediately have the potential to affect a major part of the economy—a systemic problem, for instance, such as the destruction of a vital part of an economy's payments and settlement infrastructure as might have occurred in the absence of swift remedial measures in the aftermath of the events of September 11, 2001. Investors can often protect themselves against micro-level disturbances through insurance or diversification of exposures, which also reduce the risk of contagion and systemic crises. For systemic risks, however, insurance either does not exist or tends to be prohibitively expensive, implying that official intervention may have a role in reducing the impact of systemic crises.

Although Table 6.1 provides a long list of sources of risks to financial stability, it is not exhaustive and would need to be updated as the structure of finance changes over time. For example, the liberalization, integration, and globalization of financial systems experienced in recent decades probably changed the nature of systemic risk, meaning that a broader, more comprehensive set of indicators is required to assess systemic risk. Specifically, the increasing market orientation of financial systems and the improvement of risk diversification instruments—through activities such as hedging, credit

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risk transfers, and securitization of bank loans—may have lowered risk concentrations and thereby reduced the likelihood of individual bank failures and related traditional domino-effect systemic risks. After all, banking institutions now shed risk more easily into a more complete set of markets and across a more diversified group of nonbank institutional and individual investors. However, the systemic benefits of this greater sharing of risks may be somewhat offset by a greater vulnerability to systemwide shocks, because the aggregate exposure to financial markets has surged, implying a potentially larger simultaneous influence of extreme adverse events in these markets.

The analysis of financial stability corresponds somewhat to macro-prudential analysis (see, for example, Evans and others, 2000). Standard indicators are

- balance sheet data reflecting sectoral (household and corporate) financial positions;
- ratios between net debt and income;
- measures of counterparty risk (such as credit spreads);
- measures of liquidity and asset quality (such as nonperforming loans);
- open foreign exchange positions;
- exposures within individual sectors with special attention to measures of concentration.

These are mostly micro-prudential indicators, aggregated to the macro level. Thus, dispersions within these aggregates warrant analysis.

To cover the entire financial system, a broader set of indicators would also monitor conditions in important markets, including interbank money, repurchase, bond, equity, and derivatives markets. Relevant indicators include

- measures of market liquidity (such as bid-ask spreads);
- asset price expectations (as embedded in futures, forward, and other derivative prices);
- uncertainty and risk (as reflected in historical and implied asset-price volatilities);
- asset-price sustainability (as indicated by market depth and breadth as well as deviations in asset-pricing models, fundamentals-based models of equilibrium prices, or price-earnings ratios).

A basic compilation of some of these variables is provided by the Core and Encouraged Set of Financial Soundness Indicators promoted by the IMF (Table 6.2). Complementary indicators may also be derived for how well the financial infrastructure is functioning, including payment system...
Table 6.2. IMF Financial Soundness Indicators: Core and Encouraged

<table>
<thead>
<tr>
<th>Core Set</th>
<th>Encouraged Set</th>
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<tr>
<td><strong>Deposit-taking institutions</strong></td>
<td><strong>Deposit-taking institutions</strong></td>
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<tr>
<td><strong>Capital adequacy</strong></td>
<td>Capital to assets</td>
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<tr>
<td>Regulatory capital to risk-weighted assets</td>
<td>Large exposures to capital</td>
</tr>
<tr>
<td>Regulatory Tier I capital to risk-weighted assets</td>
<td>Geographical distribution of loans to total loans</td>
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<tr>
<td>Nonperforming loans to total gross loans</td>
<td>Gross asset positions in financial derivatives to capital</td>
</tr>
<tr>
<td>Nonperforming loans net of provisions to capital</td>
<td>Gross liability positions in financial derivatives to capital</td>
</tr>
<tr>
<td>Sectoral distribution of loans to total loans</td>
<td>Trading income to total income</td>
</tr>
<tr>
<td><strong>Asset quality</strong></td>
<td>Personnel expenses to noninterest expenses</td>
</tr>
<tr>
<td>Nonperforming loans net of provisions to capital</td>
<td>Spread between reference lending and deposit rates</td>
</tr>
<tr>
<td>Sectoral distribution of loans to total loans</td>
<td>Spread between highest and lowest interbank rate</td>
</tr>
<tr>
<td><strong>Earnings and profitability</strong></td>
<td>Customer deposits to total (non-interbank) loans</td>
</tr>
<tr>
<td>Return on assets</td>
<td>Foreign currency–denominated loans to total loans</td>
</tr>
<tr>
<td>Return on equity</td>
<td>Foreign currency–denominated liabilities to total liabilities</td>
</tr>
<tr>
<td>Interest margin to gross income</td>
<td>Net open position in equities to capital</td>
</tr>
<tr>
<td>Noninterest expenses to gross income</td>
<td></td>
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<tr>
<td><strong>Liquidity</strong></td>
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<tr>
<td>Liquid assets to total assets (liquid asset ratio)</td>
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<tr>
<td>Liquid assets to short-term liabilities</td>
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<tr>
<td><strong>Sensitivity to market risk</strong></td>
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<tr>
<td>Net open position in foreign exchange to capital</td>
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\(^1\) Or in other markets that are most relevant to bank liquidity, such as foreign exchange markets.

figures for incidents (failures due to hardware, software, or connectivity problems), stop sendings, slowdowns, and queuing, as well as nonsettlements. In addition to conditions these indicators might highlight, infrastructural issues relating to the legal, regulatory, accounting, or supervisory fields may primarily arise in reaction to situations of financial tension.
Finally, macroeconomic variables such as economic growth, investment, inflation, the balance of payments, and nonfinancial asset prices may indicate a buildup of imbalances.

**Developing analytical and measurement tools**

Greater understanding and analysis of sources of imbalances and the mechanisms through which they can be magnified could significantly improve the process of assessing financial stability in several other important areas, all of which are discussed in greater detail in the next two sections of this chapter (on practical challenges in making assessments and remaining challenges in designing and implementing the framework). First, early warning systems composed of sets of financial-market indicators can play a role in weighing the importance of different indicators for financial stability and in anticipating financial stress, both within and across classes of financial institutions and within and across the various securities markets. Second, financial stability analyses need to examine not only potential disturbances, but also the degree to which such disturbances can be absorbed by the financial system. In particular, the different factors that can cushion or contain a shock need to be taken into account, such as the size of capital buffers, the reliability of reinsurance facilities, and the presence and functioning of fire walls, safety nets, and backup systems. Third, because the development of analytical tools for financial stability assessments is still in a formative stage, the assessment function must also involve the continuous improvement of methods for monitoring and assessing the sustainability of developments in financial markets and institutions, and for bringing together separate, partial analyses. Fourth, financial stability assessments are complicated by nonlinearities and the need to focus on exceptional but nonetheless plausible events. Hence, it is often necessary to consider distributions of variables (especially the left tail) and to analyze what happens if risks manifest themselves simultaneously. Finally, and within this context, stress tests are becoming a useful tool to give an overall picture of the resilience of parts of the economy under extreme conditions. As discussed further in the next section, while stress tests may be carried out for individual financial institutions, perhaps the banking system, and perhaps even individual sectors, the use of stress tests for the financial system as a whole would be difficult at this stage. The difficulty stems from a scarcity of appropriate data and empirical models. The remaining challenge ahead is to develop systemwide stress tests that take account of financial sector interconnections and of second-round effects that financial institutions have on each other and the real economy.
Policy Implications: Prevention, Remedial Action, and Resolution

The three stages of policy implications presented in Figure 6.2 are somewhat similar to the way a doctor examines a patient. Imagine someone who is in good health with no indications of illness. Within the framework, the health of this person would be in the prevention mode, meaning that he or she should try to maintain a healthy condition by continuing to consume balanced meals, do enough exercise, refrain from smoking, and so on. Signs that the patient’s condition is deteriorating (increasing weight or shortness of breath, for example) change the situation. This is the remedial stage: even though the patient is not yet ill, preemptive action may be needed to ensure that he or she remains healthy. The doctor will intensify regular checkups, recommend a better diet and exercise, and use moral suasion to improve the patient’s lifestyle. If the patient nonetheless falls ill, intervention (intensive care, medicine, surgery) will be needed. Just as a doctor’s actions range from pure prevention to remedial action and, in the ultimate case, serious intervention, financial authorities’ policies will intensify as the financial system moves toward—or eventually crosses—the boundary of stability.

As with a healthy patient, the financial system is in the preventive mode in the absence of significant indications that it may become unstable in the near future. Existing policies should be maintained and updated for structural changes to prevent future imbalances. In itself, the surveillance of financial markets, institutions, and infrastructure constitutes an important element of preventive policy (in the health metaphor, this is similar to regularly checking one’s weight, blood pressure, and pulse, or going to the dentist). Specifically, tight surveillance will stimulate a judicious management of financial risks. Obviously, surveillance must be coupled with the overall financial-stability assessment. For instance, innovative financial trends such as securitization and the development of derivatives markets are changing the way risks are spread over financial market participants, and may therefore require timely adjustments in both how risks and vulnerabilities are analyzed and assessed, and how existing policy instruments are designed and implemented.

In this context, surveillance and other policy instruments, such as supervision, regulation, official communication, and macroeconomic policies, are key to sustaining a situation of financial stability (as summarized in the Prevention column of Table 6.3). By way of illustration, the trend toward greater complexity implies that transparency deserves more attention, while level playing field problems due to cross-sector and cross-border integration may be addressed by international standards and codes (prominent exam-
ples being the Basel Accord\(^{65}\) for banking supervision and the Lamfalussy Standards\(^{66}\) for payment systems). Furthermore, support may be given to private sector initiatives that enhance financial stability, for example, through self-regulation or improvement of the financial infrastructure. A recent example of an improvement to the financial infrastructure, with central bank involvement, is the creation of the Continuous Linked Settlement (CLS) bank, which has significantly lowered the risks related to foreign currency transactions (Herstatt risks\(^{67}\)).

The situation changes if the financial system is close to, or at the boundary of, the range of stability. For instance, imbalances may be building up because of rapid credit growth in combination with excessive asset-price inflation and declining banking system capital; even if immediate risks are absent, problems may become acute if such imbalances continue to expand. Another example is a sudden change in the financial system’s domestic or external environment, for instance, due to a sovereign default by a neighboring country. Because of such changes, an initially robust financial system may soon be near the boundary of the financial stability corridor.

In such a situation, the appropriate policies are not just preventive but should also influence or correct actual developments (see Table 6.3, Remedial action column). Policy instruments such as surveillance and supervision need to be intensified to get a firmer grip on these developments. Furthermore, to avoid risks related to bank and liquidity runs and to contagion, it may be useful to strengthen instruments such as safety nets. Other policy tools such as moral suasion and adjustments in macroeconomic

\(^{65}\)The Basel Committee was formed in 1974 under the auspices of the Bank for International Settlements. Its members are the central bank authorities of the Group of Ten countries. The first Basel Accord, published in 1988, called for banks to hold minimum capital of 8 percent of risk-weighted assets as a cushion against credit risk and market risk. Basel II, announced in 2004, refines those minimum capital requirements, calls for supervisory review of an institution’s internal assessment process and capital adequacy, and requires disclosure to strengthen market discipline as a complement to supervisory efforts.

\(^{66}\)The Lamfalussy Standards were established in 1990 by the Committee for Interbank Netting Systems of the Central Banks of the Group of Ten Countries (chaired by Alexandre Lamfalussy). The Lamfalussy Standards attempt to reduce risk in bank settlement (netting) systems by setting forth procedural, legal, and operational goals. The need for such standards was precipitated by the growing number of settlement transactions, the growing size of electronic net fund transfer systems, and the growing worldwide interdependencies between the systems, all of which contributed to a growing risk within the systems.

\(^{67}\)Settlement risk is sometimes called Herstatt risk, after the circumstances surrounding the failure of the Herstatt Bank, in Germany. One day in 1974, Herstatt Bank had taken in all its foreign currency receipts in Europe, but had yet to make any of its U.S. dollar payments. At the end of the business day in Germany, German banking regulators closed down the bank. Counterparties were left holding unsecured claims against the insolvent bank’s assets.
policies may also be beneficial. In practice, this intermediate stage of remedial policy is probably the most ambiguous one. It is inherently difficult to assess vulnerabilities that have not yet manifested themselves, and perhaps even harder to identify, motivate, and implement the appropriate remedial instruments in the absence of financial instability. The buoyant Dutch housing market in the mid-1990s is a good example of the remedial action phase (see Box 6.1).

The final stage of policy relates to situations of financial instability—the financial system cannot adequately perform its functions (in terms of the health metaphor, the patient is seriously ill). In particular, banks may not finance profitable projects, asset prices may be far removed from their intrinsic values, or payments may not be settled in a timely manner or at all. In extreme cases, financial instability may even spark a run on financial institutions and markets or lead to hyperinflation, a currency crisis, or a stock market crash.

In such situations, policies are generally reactive or, in the case of a financial crisis, focused on crisis resolution. Surveillance and supervision are further intensified, while more activist policies may be needed to restore the system’s capacities and to boost confidence (Table 6.3, Resolution column). These situations typically call for discretionary measures that are dif-

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Box 6.1. Remedial Action: Dutch Housing Market Boom in the 1990s

In the second half of the 1990s, both house prices and mortgage lending roughly doubled in the Netherlands. Of primary importance among the various factors causing the boom, households’ borrowing capacity had been augmented by historically low interest rates and strong income growth, in combination with a significant loosening of mortgage lending criteria. Demographic developments (the number of households increased), greater use of the very generous tax treatment of mortgage interest payments (fully deductible from income tax, leading to low, or even negative real interest rates), and an insufficient supply of new dwellings all contributed. Furthermore, these factors mutually reinforced each other, as loan-to-value (LTV) ratios typically rose to above 100 percent, implying that higher house prices were accommodated by higher borrowing capacity and vice versa.

Given the adverse repercussions of the housing market collapse in the early 1980s in the Netherlands as well as in other countries, an important issue was whether this development could become a threat to financial stability. The unbridled credit growth prompted the central bank—which is also the banking supervisor—to investigate the underlying causes and possible risks. In the period 1999–2000, an intensive survey was carried out among Dutch banks (DNB, 2000). The assessment that was made on the basis of this survey, and the policy conclusions that were drawn, fit under the “remedial action” category in Figure 6.2. While the financial sector’s solidity was considered beyond dispute, it was also stressed that the Dutch economy had become more vulnerable and that some developments were leading to further imbalances. Hence, in terms of the framework, the financial system was considered within the range of financial stability, but moving toward its boundary.

A variety of remedial policies were implemented. The surveillance of the housing market and mortgage market was intensified. Banks’ regular reporting requirements on mortgages were extended and financial institutions were encouraged to develop stress tests to assess more precisely potential risks in their mortgage portfolios. By publicizing its concerns about the sustainability of housing market developments, the central bank also exercised moral suasion. Moreover, De Nederlandsche Bank launched regular surveys among households to gain a better insight into their uses of mortgage loans and possible risks. Several measures were also taken to get a better grip on the dynamics underlying the rapid increase in mortgage lending. In some cases, supervisors gave banks’ administrative organizations and internal controls extra attention. In addition, the generous fiscal treatment of mortgage payments was put to discussion and a maximum LTV limit of 100 percent was proposed to break the self-reinforcing spiral of credit growth and higher house prices. These steps were clearly remedial—they were aimed at preemptively reducing the buildup of imbalances, rather than at directly intervening to resolve a crisis.

ficult to specify deductively and that authorities may be reluctant to detail for strategic reasons (for example, to avoid moral hazard through constructive ambiguity). Examples are forbearance, the activation of financial safety nets, and both institution-targeted or systemwide liquidity injections. In addition, official communication and macroeconomic policies can help prevent excessive financial market turbulence. An illustration of policies in the crisis resolution phase is provided by the financial authorities’ reactions to the September 11, 2001, terrorist attacks (see Box 6.2).

Practical Challenges in Making Financial-Stability Assessments

The potential measures and possible states of stability and instability are innumerable, thus, some practical boundaries need to be set to ensure the utility of the assessment process. In addition, models of stability or instability are complex, of necessity. These two issues are addressed in the following discussion.

Disciplining the Assessment Process

While categories of possible assessments may be easy to discuss in principle, they are difficult to identify in actual practice. For example, how should the boundary of stability be defined and measured? When does an isolated small problem threaten to become a systemic one? A bias to be prudent and overreach in identifying potential sources of both risk and vulnerability may intrude, leading to an overestimation of their likelihood and importance. Thus, some ground rules or guidelines must be established for disciplining the continuous process of information gathering, analysis, and monitoring, and most important, for identifying sources of risks and vulnerabilities. A checklist of disciplining principles for identifying risks and vulnerabilities and for assessing where along the stability spectrum the financial system might be could include the following:

- Is the process systematic?
- Are the identified risks plausible?
- Are the identified risks systemically relevant?
- Can links and transmission (or contagion) channels be identified?
- Have risks and links been cross-checked?
- Have the identification of risks and the assessment been time consistent?

In practice, and as discussed somewhat in the previous section on prevention, the process of assessing financial stability entails a systematic iden-
Box 6.2. Crisis Resolution: Terrorist Attacks on September 11, 2001

Policy actions taken in response to the terrorist attacks on the Twin Towers are a good example of crisis resolution. Because the attacks hit the world’s main financial center, the stability of the international financial system was at stake. In addition to the damage in New York itself, the problems could have easily spread due to financial links and behavioral reactions in financial markets.

Policymakers immediately needed to assess the situation and the threats to financial stability. While the international payments systems continued to work smoothly, money markets were not operating properly, as reflected by insufficient liquidity. Given the crucial role of these markets, this risked causing serious damage to the financial system as a whole. Hence, in terms of the framework advanced in this book, the financial system was crossing the boundary of financial stability, implying that intervention was needed to resolve the crisis.

The following corrective measures were taken: First, central banks communicated that, if necessary, almost unlimited liquidity would be made available. Large liquidity injections by the U.S. Federal Reserve (about US$80 billion) and the Eurosystem (70 billion euro) were sufficient to keep the system afloat. Second, a swap agreement was arranged between the European Central Bank and the Federal Reserve—making another US$50 billion available in the subsequent days—in part to reduce the potential for cross-border contagion. Third, the New York Stock Exchange was closed for a week. Finally, both the Federal Reserve and the Eurosystem decided to cut their main interest rates by 50 basis points, which also gave relief to financial markets.

These measures successfully and promptly restored financial stability. The liquidity injections were only temporarily necessary and were easily reversed afterward. In many respects, the policy reactions to the terrorist attacks were similar to official responses to earlier financial crises (Neely, 2004). The next step, in line with Figure 6.2, was to insert the feedback from restored financial stability into the analysis and assessment phase. Several initiatives were subsequently launched to strengthen the financial system’s ability to react to and prevent future disturbances, including measures to combat the financing of terrorism.

an assessment is to be made. Financial-stability assessments should systematically and periodically monitor each of these sources of risks, both individually and collectively, by including cross-sector and cross-border links.

Calling attention to the main sources of financial-stability risk and vulnerability does not necessarily aim at identifying the most likely future scenarios. Instead, it entails the identification of all potential sources of risk and negative events, even if these are remote and unlikely. To preserve discipline in an exercise that essentially involves determining what could go wrong, a key consideration is the *plausibility* of the risks identified. For example, an analysis of conditions in the household and corporate sectors might reveal that a sizable drop in the rate of output growth could, by significantly lowering income and profits, cause a significant rise in household and corporate loan default rates, and thereby threaten the smooth functioning of the financial system. However, if the constellation of economic fundamentals underpinning the pace of economic activity suggests that the likelihood of recession is very low, such an assessment would carry limited value. Ideally, a rigorous determination of the plausibility of a source of risk would be achieved if the probability of a disruptive event occurring could be reasonably estimated. In current practice, given data, measurement, and methodological limitations (discussed later in this chapter), in most cases a ranking of the plausibility of the various identified risks must be based on qualitative judgments derived from very limited information.

While it is desirable to consider seriously all plausible sources of risk to financial stability, it is also desirable to distinguish sources that could prove to be *systemically relevant* from sources that are unlikely to prove costly. For example, the plausible risk of an asset market correction would be regarded as relatively benign if it posed only a minor threat to the financial condition of the household, corporate, and financial sectors. However, if the risk was judged to threaten the solvency of a significant portion of any one of these sectors it could prove to be more costly from a systemic perspective. The challenge is to distinguish between those threats to financial stability that, should they crystallize, carry a high probability of a significant disruption to real economic activity from those that are likely to prove self-correcting without having a material impact either on the level of activity or the process of resource allocation. As implied by the examples, determining the systemic relevance of a particular set of risks can be achieved if a reasonable judgment—quantitatively supported, if possible—can be made about the likely real economic costs, given materialization of the risks. Ideally, the expected losses (for example, resulting from the product of the probability of the event and the cost, given materialization) could lead to a ranking of the importance of the various plausible risks identified. Realisti-
cally, formidable practical challenges remain in assessing and estimating the likelihoods of typically low-probability events actually occurring and in measuring the associated costs. As discussed later, costs are also difficult to estimate, but at least the history of financial events could, in principle, allow for the calibration of potential costs.

Once plausible and systemically relevant sources of financial-stability risk and vulnerability have been identified, it is important to avoid partial equilibrium analysis. For example, in calibrating the financial-stability implications of the risk of a sharp drop in equity prices, the analysis needs to go far beyond its potential impact on financial markets: it would need to examine the implications for household balance sheets, future corporate funding, and so on. More generally, an internally consistent framework for financial-stability analysis requires an identification of the links and the channels of contagion within the financial sector and also between financial and nonfinancial sectors. Because a financial system comprises many parts (markets, institutions, and infrastructure), the overall degree of financial stability will depend not only on the degree of stability of each of its constituent parts but also on their links and channels of contagion. This calls for a comprehensive approach to collecting and processing information on all the important sectors of the economy and the financial system.

Because the process of identifying sources of risks and vulnerabilities is to some extent contrarian—it identifies what could go wrong—the burden of proof should arguably be higher than that required for the prediction of the most likely outcome. Hence, financial-stability analysis should involve rigorous cross-checking of the assessment through the use of a wide range of alternative analytical tools, models, and data sources, including a continuous dialogue with market participants.

Concerning time consistency, further discipline in the process of identifying risks and vulnerabilities can be achieved if the horizon over which a given risk is most likely to materialize can be assessed. The empirical literature has shown that it can be a challenging, if not impossible, task to predict the timing of crises. This should not preclude attempts to determine whether a given plausible source of risk has a near-, medium- or long-term likelihood of materializing. Making such determinations systematically and periodically for the same sets of risks can serve to improve accountability in the financial-stability assessment process. Some risks may ultimately prove to be self-correcting without posing any systemic threat, and it is important to understand why. If the “false signal” resulted from a more orderly than predicted unwinding of an imbalance or from a structural change such as better risk management that strengthened the financial system thereby mitigating the risk, this information can serve to improve future assessments.
Measurement and Modeling Issues

So far, the discussion has dwelled on three important aspects of producing a comprehensive assessment of financial stability. The first entails forming a judgment about the individual and collective strength and robustness of the constituent parts of the financial system— institutions, markets, and infrastructures. The second involves systematically identifying the plausible and systemically important sources of risks and vulnerabilities that could pose challenges to financial stability in the future. The third is an appraisal of the potential costs—that is, the ability of the financial system to cope—should some combination of the identified risks and vulnerabilities materialize.

Thus far, the ability to measure and model strength and robustness, or to calibrate the plausibility and importance of the various risks, or to appraise quantitatively the potential costs should risks materialize have been ignored. Each of these areas poses formidable measurement and modeling challenges, so much so that in actual practice many shortcuts and qualitative judgments must be made to produce an overall assessment. This section discusses some of the remaining challenges of measurement and modeling; however, it barely scratches the surface in this important and uncharted territory.

For most macroeconomic or monetary policy objectives (low unemployment, external or budgetary equilibrium, price inflation, and so forth) there is a widely accepted, measurable indicator or set of indicators that define and measure deviations from the objective, even if still subject to methodological and analytical debate, or outright controversy. Both macroeconomics and monetary economics took some 20 to 30 years of practice, trial-and-error, measurement-and-modeling development, and fundamental research to arrive at this point. As noted in the first chapter, financial-stability analysis is still in its infancy. Thus, by contrast, there are no widely accepted measurable indicators of financial stability that can be monitored and assessed over time. In part, this reflects the multifaceted nature of financial stability, because it relates to both the stability and resilience of financial institutions, and to the smooth functioning of financial markets and settlement systems over time. Moreover, these diverse factors need to be weighed in terms of their potential ultimate influence on real economic

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68 Sets of indicators have been developed, and are widely used, for assessing the soundness of banking institutions. See, for example, the IMF Soundness Indicators, both core and encouraged sets in IMF and World Bank, 2003, and the IMF’s guide on financial soundness indicators in IMF, 2004.
activity. The lack of measurable indicators reflects the relatively young age of the discipline of assessing financial stability. Because measurement is not highly developed yet, it is reasonable to view the current practice of assessing financial stability as more of an art form than as a rigorous discipline or science.

Each of the three main conceptual aspects of the notion of financial stability—resource allocation, risk pricing and management, and absorptive capacity—poses challenges for measurement. Take the simple example of measures of solvency for judging the potential resilience and absorptive capacity of an individual financial institution or bank. Even if balance sheet capital (that is, the difference between assets and liabilities) provides a good indication of near-term shock absorption capacity, bank solvency may not be a sufficient measure for capturing the forward-looking dimensions of financial stability. If high solvency reflects forgone lending opportunities in a highly competitive industry, then, through future profit erosion and loss of market share, the foundations may be laid for future weaknesses in the bank. To take a financial market example, while low asset-price volatility could be indicative of stable conditions in a financial market, it may alternatively signal a failure in the price discovery process. Should this lead to a misallocation of financial resources, it may sow the seeds of vulnerabilities that threaten financial stability in the future.

Challenges in measuring financial-system stability reach well beyond the challenges of measuring the degree of stability in each individual subcomponent of the financial system. Financial stability requires that the constituent components of the system—financial institutions, markets, and infrastructures—be jointly stable. Weaknesses and vulnerabilities in one component may or may not compromise the stability of the system as a whole, depending on size and links—including the degree and effectiveness of risk sharing between different components. Moreover, because different parts of the system perform different tasks, aggregating information across the system poses challenges. For example, in diversified financial systems—in which both financial institutions and markets are important providers of finance—no commonly accepted way has been developed to aggregate information on the degree of stability in both the banking system and financial markets to form an overall assessment of system stability. If the banking system is functioning well but financial markets exhibit signs of strain, the overall assessment of financial-system stability is likely to be ambiguous, particularly if the respective shares of the two components as providers of finance are similar. The more complex and sophisticated a financial system, the more complex the task is likely to be of precisely measuring overall stability.
Measurement challenges in identifying risks and boundaries to financial stability can be illustrated by examining the Minsky (1977) financial instability hypothesis. In this hypothesis, as an economy enters an upswing, risk premiums are steadily eroded as managers of firms and banks discover that the majority of conservatively financed projects are succeeding. Gradually, two characteristics emerge: “Existing debts are easily validated and units that were heavily in debt prospered: it paid to lever” (Minsky, 1977, p. 12). As a result, prevailing risk premiums begin to be considered excessive. Lenders and borrowers begin to take on greater risks and, fueled by credit and optimism about future profits, both growth in investment and exponential increases in asset prices occur. At some point, excesses occur, and the conditions that underpinned the boom eventually trigger its collapse. Overinvestment begins to reduce the return on capital, bankruptcy rates begin to rise, firms scale back on investment, and consumers reassess their capacity to repay debt. As optimism gives way to pessimism, aggregate demand in the economy falls sharply and asset prices plummet, possibly inducing a financial crisis.

An implication of this hypothesis is that the inferences for risks to financial stability that can be drawn from some imbalance indicators may, at certain points in the cycle, be rather benign but, for a small change in the same direction, suddenly pose a significant threat following the breach of a key threshold. In practice, the challenges to mapping such hypotheses into empirical frameworks for measurement can be significant. For instance, theory may not offer good answers to questions such as, at what pace of growth does robust and productive investment become overinvestment? Ultimately, the answers to such questions are likely to be settled not theoretically but empirically.

Analytical frameworks are required to help guide measurement, for example, by identifying and suggesting the sets of variables and conditions that could underpin threats to financial stability. Presently, no general-equilibrium models or comprehensive systemwide approaches exist for identifying measures of, and risks to, financial stability. Alternatively, some practitioners employ partial approaches, relying on the analysis of individual indicators of financial imbalances. Sometimes such assessments are based on “rule of thumb” thresholds derived from longer-term historical averages or from cross-country comparisons. Here, too, important measurement (and modeling) issues can arise. Many imbalance indicators

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Footnote: A rare exception can be found in Haldane (2004), who develops a general-equilibrium model for deriving a simple financial stability “indicator” that is related to monetary stability.
can be interpreted in either of two ways, each one of which has different implications (perhaps cycle-dependent) for financial-stability assessments. As discussed, high bank solvency, while possibly indicating a stable bank, could instead be the harbinger of emerging vulnerabilities. Narrow spreads across a wide range of fixed income markets could indicate perceptions of low credit risks in these markets but also may reflect a mispricing of risks—as proved to be the case prior to, and following, the near collapse of Long-Term Capital Management in 1998. High price-earnings ratios in equity markets might indicate a stock price bubble but could alternatively reflect an accurate expectation for future strengthening of corporate sector profitability. Similarly, while high non–financial sector debt ratios might be indicative of heightened credit risks facing banks they could also be a reflection of a welfare-enhancing relaxation of liquidity constraints together with a favorable assessment of long-term economic prospects by private economic agents. These examples serve to illustrate that in the absence of a broad range of indicators and an understanding of the broader economic and financial environment in which indicators are being measured, excessive reliance on single-indicator analyses can lead to unsound financial-stability assessments.

Ambiguities that can arise in single-indicator analyses of risks and vulnerabilities can be remedied. While identifying financial imbalances ex ante can be challenging, progress can be made by combining the information contained in individual indicators such as credit growth and asset prices (see Schinasi and Hargraves, 1993a and, more recently and rigorously, Borio and Lowe, 2002). Other cross-checking approaches can involve looking beneath the surface of aggregate data by examining micro data. For instance, a question of whether abnormally high aggregate household debt ratios pose acute credit risks for banks may be easily settled if micro data on households reveal that the most indebted households also have sufficient financial buffers to protect them from sharp changes in interest costs or employment income. Overall, the best assurance of a robust financial-stability assessment is to base it on a wide range of data sources.

An important component of a financial-stability assessment is an appraisal of the ability of the financial system to cope with problems, should plausible risks materialize. Stress testing is a common way to perform such appraisals. Stress testing can be based on a range of techniques, including sensitivity and scenario analyses. These approaches—increasingly used by

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70See, for instance, Sveriges Riksbank (2004).
individual financial institutions—\textsuperscript{71}—are also being used at an aggregated macro level for assessing systemic stability. The IMF has introduced macroeconomic stress testing as a key element in its Financial Sector Assessment Program (FSAP).\textsuperscript{72} Sensitivity tests are ordinarily designed to isolate the likely impact of selected risk factors such as changes in interest or exchange rates. Scenario analyses tend to be richer, involving simultaneous moves in a number of risk factors. The scenarios can be based on historical episodes of financial stress or on hypothetical events that are considered plausible, or on sets of such events. Because such approaches often have a high degree of internal consistency, they can make an important contribution to the understanding of the systemic relevance of financial risks.

While methodological advances have been made, macro stress-testing techniques as currently practiced have several limitations. The impacts of scenarios can be gauged both through bottom-up approaches—aggregating information on how a range of institutions would weather a plausible but challenging scenario—or at an aggregate level, perhaps employing a macro-econometric model. Combining the two approaches can facilitate cross-checking and more reliable assessment. However, a limitation of both approaches is that potential second-round effects of scenarios tend to be ignored because the underlying models pay insufficient attention to macro-financial interaction (as discussed in Hoggarth and Whitley, 2003). Thus, the overall impacts of adverse disturbances could well be underestimated. For instance, during a decline in the pace of economic activity sufficiently large to challenge the robustness of the banking system, weakened banks might face an increase in funding costs or a withdrawal of deposits (or both) that put further downward pressure on profits. At the same time, faced with deterioration in the creditworthiness of their customers, banks might be inclined to tighten lending terms and conditions. These events would most likely have second-round effects on aggregate demand and output, potentially leading to further losses in the banking system. Moreover, a disturbance sufficiently large to cause the failure of a large financial institution might have a direct impact on the capital, or even solvency, of other counterparty banks. Macro stress testing is generally not capable of assessing the importance or gauging the magnitude of these second-round effects.

\textsuperscript{71}See Committee on the Global Financial System (2005).
\textsuperscript{72}See IMF and World Bank (2003); Blaschke and others (2001).
Financial-stability assessments carry a higher degree of uncertainty than that ordinarily associated with forecasts based on macro-econometric models. This higher uncertainty results from the formidable practical challenges to measuring, modeling, and assessing the consequences of rare events. First, if past crises were prevented or tackled by policy actions, assessments of the likely costs of a selected scenario, based on simulations drawn from historical data sets, will likely prove to be biased unless sufficient account is taken of policy reaction functions. It is doubtful that past policy responses to episodes of financial stress could be summarized by a mechanical reaction function, particularly if the authorities were mindful of avoiding the moral hazards that typically follow from predictable behavior. Moreover, even in cases that did not prompt policy responses, the frequency of crises in historical data sets may be too low to facilitate precision in estimating the likely “policy neutral” consequences of a stylized scenario.

Second, confidence intervals around the expected output losses associated with the materialization of a specified scenario may either be not well defined statistically, or not defined at all. For instance, simulations based on historical episodes tend to be founded on statistical relationships that reflect the central tendency of, rather than the tails of, probability distributions. Moreover, for hypothetical scenarios with no basis in the past, it may not be possible to compute a confidence interval around the simulation because the events themselves may be subject to so-called Knightian uncertainty (Knight, 1921), or unquantifiable risk.

Third, most macro-econometric models used for stress testing tend to be built on the basis of log-linear relationships. For simulations, this means that a doubling of the size of a shock will result in a proportionate change in the effect. However, in reality, unpredictable nonlinearities may surface, for instance, due to threshold effects.

Fourth, as witnessed during the near collapse of Long-Term Capital Management in 1998, unexpected links—such as correlations between financial markets that do not ordinarily tend to be correlated—may surface during crises. Given such uncertainties, the real economic costs associated with a particular scenario could well prove to be larger than those predicted by an empirical model. Such considerations would suggest that the output of any stress-testing exercise should only be viewed as indicative of how, or if, the financial system would endure adverse disturbances, as opposed to an accurate quantitative assessment of actual effects on the system or its constituent parts. To avoid complacency, a high degree of caution and judgment is called for in forming financial assessments and in uncovering links.
The literature concerning measurement of the costs of financial instability is just in its formative stage and has tended to focus on the rising incidence of bank crises and their considerable costs.\textsuperscript{73} Even defining a systemic financial crisis is not straightforward and, once defined, several elements must be taken into account in assessing the costs (as shown by Hoggarth and Saporta, 2003). In measuring costs, it is particularly important to be mindful of feedback: banking crises can be caused by sluggishness in the pace of economic activity but they can, in turn, be the cause of an economic slowdown or recession. A challenge for measurement is to disentangle the feedback effects and isolate the quantitative impact of the crisis on the economy. The costs associated with banking crises can include losses faced by stakeholders—including shareholders, depositors, and other creditors—in the banks that have failed. Taxpayers may face costs if there is public sector resolution of the crisis. If, because of rising risk aversion or the rationing of credit, borrowers lose access to funds or face difficulties in accessing other sources of finance, economic activity may be adversely affected. The incomes of depositors may also be adversely affected if banks seek to widen spreads by lowering deposit interest rates to recoup loan losses. Finally, if the payments system is impaired because consumers become reluctant to make deposits with banks, the overall adverse impact on economic activity may be magnified. For measurement, whether the overall costs should be gauged by losses in GDP, the fiscal costs, or some combination of the two is not clear cut. The impact on the broader macroeconomy of some crises may have been avoided because of early resolution, resulting in the incurrence of fiscal costs. For other crises there may have been no direct fiscal implication but a significant impact on economic activity.

Although the wealth effects and costs of the bursting of asset-price bubbles can be gauged, less progress has been made in determining the costs of financial market turbulence and dislocation. Possible channels would include the direct and indirect effects of loss of access to funds for borrowers in capital markets, or the costs of refunding short-term obligations at higher cost with financial institutions, as well as the redistributive effects of asset-price changes, which could, in extreme situations, have direct impacts on the capital, or even solvency, of banks.

\textsuperscript{73}See Bordo and others (2001), and Garcia-Herrero and Del Río (2003) for work on increasing numbers of bank crises. See Lindgren, Garcia, and Saal (1996), Hoggarth and Saporta (2003), and Barrell, Davis, and Pomerantz (2005) on the costs of bank crises.
Remaining Challenges in Design and Implementation

To advance the practice of financial-stability assessment from an art to a science, progress is needed on at least three fronts: data, models, and the understanding of links.

Data

A priority for data gathering must be micro balance sheet data covering financial institutions, households, and firms. While a picture of the aggregate risks borne within each of these sectors can be useful for financial-stability analysis, far more important is an understanding of the way in which the risks are distributed across sectors and especially whether pockets of vulnerabilities can be pinpointed. In mature economies, the availability and comprehensiveness of such data is mixed, particularly for the household sector.

It has become fashionable to employ financial-stability assessment indicators that are based on the prices of securities. In principle, if markets are efficient, indicators derived from securities prices—such as credit spreads, distances-to-default, volatilities implied by options prices, and so on—should contain invaluable information for such purposes. Securities prices should contain the collective expectations of the multitude of market participants for the underlying fundamentals governing valuations. If those market participants also have an eye on the possible impacts of the same risks and vulnerabilities that the public authorities are watching market indicators could reveal information on the ability of the financial system to weather plausible adverse disturbances. For instance, using risk-neutral densities, options prices can even facilitate the extraction of market-based probabilities of the occurrence of prespecified asset-price movements over prespecified horizons. However, the analysis risks circularity because a comprehensive financial-stability assessment should attempt to gauge whether there are plausible risks of market dislocations resulting from mispricing while inferences on market expectations are built on the assumption that prices are always “correct.” More and better data on quantity indicators, such as indicators of liquidity, leverage, market positioning, and so forth, would shed light not only on the indicator properties of securities prices for financial-stability assessments but also on the vulnerabilities prevailing within financial markets.
Models

Two areas where more and better analytical research on financial-stability modeling appears necessary include models for identifying risks and vulnerabilities (early warning systems) and models for assessing the consequences of adverse disturbances. The literature raises doubts that models will ever be capable of predicting crises, particularly when it comes to the precise timing. Nevertheless, this should not inhibit the development of models for assessing vulnerabilities. For example, early warning systems can play a role in weighing the importance of different indicators for financial stability and in anticipating financial stress, both within and across classes of financial institutions and within and across the various securities markets. Sets of financial market indicators provide important information that captures developments beyond these markets themselves. Various potential risks in large parts of the economic and financial system are immediately reflected in variables such as bond spreads and stock prices. Moreover, based on past experience, even simple single indicator approaches can be useful for gauging risks to financial stability (Campbell and Shiller, 2001). Ongoing work also holds promise for the development of more comprehensive frameworks for pinpointing the sets of variables (see International Monetary Fund, 2004a) and the conditions that raise the likelihood of financial stress (see, for example, Borio and Lowe, 2002). As for the prediction of crises, advances in other disciplines in the modeling of discontinuous processes, such as the prediction of earthquakes, may offer insights for financial-stability assessment.

Ideally, to accurately assess the likely impacts of adverse disturbances, dynamic general equilibrium modeling frameworks capable of measuring possibly nonlinear interaction within and between financial and nonfinancial sectors of the economy, including at the global level, would be needed. Although current tools fall far short of such a model, the implementation of macroeconomic stress-testing frameworks, such as those increasingly applied in the context of IMF FSAPs, have undoubtedly advanced the development of internally consistent frameworks for assessing the resilience of financial systems to adverse disturbances. Sources of risk and vulnerability can be quantitatively mapped into their impacts on bank balance sheets,

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75Blaschke and others (2001) review issues of measurement and methodology in stress testing, as well IMF FSAP experiences.
both individually and on a systemwide basis. However, reflecting the limitations of underlying models, current practices tend to ignore the second-round effects of financial crises. Current practices also tend to focus exclusively on the banking system when a broader definition of the financial system requires an understanding of the likely impacts on other financial institutions and on the functioning of financial markets and infrastructures. Further work needs to be conducted not only on the modeling of economic-financial interactions, the complexity of which exhibits a tendency to increase over time, but also on interactions within the financial system itself.

**Links**

Finally, a good understanding of links is crucial for financial-stability analysis. To ensure that important links are not missed in a financial-stability assessment, both the financial system and the sources of potential risk and vulnerability should be defined broadly. For instance, although alertness grew in the late 1990s and in 2000 of the vulnerability of the U.S. stock market to an abrupt correction, the general awareness of the possible impact on the European insurance industry—one of the places where the subsequent market tumble hurt the most—was rather limited. Little macro-prudential surveillance of the industry was being undertaken at the time. Micro balance sheet data, especially on exposures, can be helpful for identifying the relevance of links both between economic and financial sectors and within the financial system itself. As financial institutions strengthen disclosure, data availability in this area may improve over time. Cross-correlation analysis of securities prices can also be helpful for making inferences on links and channels of contagion, although sight should not be lost of the fact that during crisis periods correlations may differ markedly from those prevailing when markets are operating smoothly.

**Conclusion**

In recent years, financial stability has explicitly become a key objective for public policy. It is argued that finance fosters the processes of consumption, production, wealth accumulation, and risk diversification, but is subject to market failures that justify a public sector role. In this context, financial stability is defined as a situation in which the financial system efficiently allocates resources between activities and across time, assesses and manages financial risks, and absorbs shocks.
In practical terms, finance was shown in Chapter 1 to have become more important over the past decades, both quantitatively and relative to money. In addition, the financial system has become more interwoven and complex. Driving factors are the deregulation, liberalization, and globalization of financial markets. As a result, financial innovation has surged, as evidenced by the spectacular rise in securitization and derivatives, and financial activities have increasingly taken on cross-sector and cross-border dimensions. These developments have strengthened the links between financial institutions and markets, but have also complicated the analysis of financial vulnerabilities.

The analytical framework presented in this chapter takes these developments into account. An important part of the framework is the assessment of financial stability, which is considered as a continuum of possible states with ambiguous boundaries. The process of assessment should be based on a wide-ranging analysis of the system’s different constituent elements (financial institutions, markets, and infrastructure) as well as on the interaction among these elements and with the external environment (the macro-economy). Depending on the assessment’s outcome, policy implications fall into three broad categories—prevention, remediation, resolution—each aimed at maintaining or restoring financial stability, that is, aimed at keeping the financial system within the corridor of stability. While many of these elements relate to activities that have always been part and parcel of the work of central banks and supervisory bodies, the framework emphasizes the importance of undertaking these activities using a systemwide viewpoint.

Indeed, policymakers’ approaches to financial stability as an objective in itself are changing. Monitoring, analysis, assessment, and policymaking are becoming more encompassing, focusing on the financial system as a whole rather than its individual segments, as the system itself becomes more interwoven and interdependent. The change in approach is also reflected in changes to the institutional organization of supervisory tasks, as many countries are integrating supervision into broader, cross-sectoral structures. In addition, considerable emphasis is being placed on international cooperation, for instance, the development of international codes for the supervision of banks and insurance firms (under the Basel and Solvency Accords) and for payment systems (the Lamfalussy Standards). A related initiative is the recent establishment of the Financial Stability Forum, which brings together the relevant national authorities from mature financial markets to identify and discuss weak spots in the international financial system.

The challenges that lie ahead for financial-stability analysis concern both measurement and theory, although this chapter has focused more on the former. The challenges are formidable, in part because financial-stability
assessments must not only take stock of disturbances as they emerge, but also identify and examine the vulnerabilities that could lead to such disturbances in the future. A forward-looking approach is required to identify the potential buildup of financial imbalances and to account for transmission lags in policy instruments. The real difficulty is that financial crises are inherently difficult to predict, in part because of contagion effects and likely nonlinearities in both the buildup of imbalances and their transmission to the real economy. In addition, financial-stability risks often reflect the far-reaching consequences of unlikely events, implying that the focus is not the mean, median, or mode of possible outcomes but the entire distribution of outcomes, in particular the “left tail.”

While macro stress-testing techniques are improving knowledge in determining the systemic relevance of plausible risks to financial stability, these techniques have important limitations, including shortcomings in the modeling of economic-financial interaction and feedback as well as the uncertainty that surrounds estimates of potential costs. Until these limitations are sufficiently addressed, the best and most pragmatic assurance of robust financial-stability assessment is to use an eclectic approach that draws upon inputs from a wide range of data sources, indicators, and models.

Looking forward, the rapid pace of financial structural changes evident since the mid-1980s is likely to continue. The shift to a larger, more integrated, leveraged, complex, and market-based financial system will continue to change the nature of financial risks. In this respect, the framework proposed in this book should be seen as a flexible tool that can be used to interpret changes and translate these into policy implications. A major challenge is to develop a deeper understanding of how the different dimensions of financial stability interact with each other and the real economy, and how these interactions are influenced by policy actions. More specifically, efforts should be focused on broadening the available data, improving the empirical tools (methodologically and analytically), and developing wide groups of indicators from which some predictive power can be derived, while also linking developments under these indicators to specific instruments. This is a heavy agenda. Undoubtedly, practical experiences will also show the way.