INTERNATIONAL MONETARY FUND

Macroprudential Analysis: Selected Aspects
Background Paper

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List of Abbreviations

BIS	Bank for International Settlements
CGFS	Committee on the Global Financial System
EBIT	Earnings Before Interest and Tax
EBITDA	Earnings Before Interest, Tax, Depreciation, Amortization
ECB	European Central Bank
FSAP	Financial Sector Assessment Program
FSI	Financial Soundness Indicator
FSSA	Financial System Stability Assessment
G-10	Group of Ten
GDP	Gross Domestic Product
IAIS	International Association of Insurance Supervisors
IOSCO	International Organization of Securities Commissions
NBFI	Nonbank Financial Intermediary
NPL	Nonperforming Loan
OTC	Over-the-Counter
RAROC	Risk-adjusted Return on Capital
ROA	Return on Assets
ROE	Return on Equity
VaR	Value at Risk

I. INTRODUCTION

1.   Substantial progress has been made during recent years in the identification and use of indicators of financial system soundness as well as methods to analyze these measures. We refer to them as financial soundness indicators (FSIs),[1] and macroprudential analysis, respectively. The Fund has been building up experience with macroprudential analysis in the past few years as part of its surveillance, technical assistance and policy development work, and more recently in the context of the Financial Sector Assessment Program (FSAP).[2] An initial, relatively broad set of indicators was identified in this earlier work, comprising aggregated microprudential indicators of the health of financial institutions, macroeconomic variables associated with financial system vulnerability, and market-based indicators. Table 1 provides a summary list of these indicators. A consultative meeting on macroprudential indicators was held at Fund headquarters in September 1999, with high-level experts from central banks, supervisory agencies, international institutions, the academia, and the private sector discussing their experiences in using, measuring, and disseminating indicators of financial system soundness. The state of knowledge in these areas and proposals for further work were discussed at a Board meeting in January 2000.[3]

2.   Since the review, substantial work has been done to determine the analytical and empirical relevance of FSIs. A number of background papers were prepared for this purpose. In particular, these papers focused on developing analytically correct definitions of specific FSIs; studying the theoretical and empirical underpinnings of the relationship between macroeconomic and financial variables; examining methods of macroprudential analysis, including stress testing, sectoral balance sheet approaches, and Value-at-Risk (VaR) techniques; and exploring the role of nonbank financial intermediaries, the corporate sector, and real estate markets in assessing financial system vulnerabilities.

3.   This paper summarizes the main outcomes of this work and other relevant literature on the subject with a view to supporting the selection of specific FSIs to be used in Fund monitoring of financial systems.

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[1] The expression "financial soundness indicators" will be used interchangeably with "macroprudential indicators."

[2] *Financial Sector Assessment Program—A Review: Lessons from the Pilot and Issues Going Forward* (www.imf.org/external/np/fsap/2001/review.htm). For further details on the FSAP, see also Hilbers (2001).

[3] The papers submitted for Board discussion were published as Evans, Leone, Gill, and Hilbers (2000).

Table 1. Initial List of Macroprudential Indicators

Aggregated Microprudential Indicators	Macroeconomic Indicators
Capital adequacy	Economic growth
Aggregate capital ratios	Aggregate growth rates
Frequency distribution of capital ratios	Sectoral slumps
Asset quality	Balance of payments
(a) Lending institution	Current account deficit
Sectoral credit concentration	Foreign exchange reserve adequacy
Foreign currency-denominated lending	External debt (including maturity structure)
Nonperforming loans and provisions	Terms of trade
Loans to loss-making public sector entities	Composition and maturity of capital flows
Risk profile of assets	Inflation
Connected lending	Volatility in inflation
Leverage ratios	Interest and exchange rates
(b) Borrowing entity	Volatility in interest and exchange rates
Debt-equity ratios	Level of domestic real interest rates
Corporate profitability	Exchange rate sustainability
Other indicators of corporate conditions	Exchange rate guarantees
Household indebtedness	Lending and asset price booms
Management soundness	Lending booms
Expense ratios	Asset price booms
Earnings per employee	Contagion effects
Growth in the number of financial institutions	Financial market correlation
Earnings/profitability	Trade spillovers
Return on assets	Other factors
Return on equity	Directed lending and investment
Income and expense ratios	Government recourse to the banking system
Structural profitability indicators	Arrears in the economy
Liquidity	
Central bank credit to financial institutions	**Market-based indicators**
Deposits in relation to monetary aggregates	
Loans-to-deposits ratios	Market prices of financial instruments, incl. equity
Maturity structure of assets and liabilities/liquid	Indicators of excess yields
asset ratios	Credit ratings
Measures of secondary market liquidity	Sovereign yield spreads
Indicators of segmentation of the money market	
Sensitivity to market risk	
Foreign exchange risk	
Interest rate risk	
Equity price risk	
Commodity price risk	

Source: *Macroprudential Indicators and Data Dissemination—Background Paper* (SM/99/295, Supplement 1), p. 5.

4.   Macroprudential analysis is a key building block of any policy framework on vulnerability analysis. It is a methodological tool that helps to quantify and qualify the soundness and vulnerabilities of financial systems.[4] It uses aggregated microprudential data to obtain direct information on the current health of financial institutions; stress tests and scenario analysis to determine the sensitivity of the financial system to macroeconomic shocks; market-based information—such as prices and yields of financial instruments and credit ratings—as complementary variables conveying market perceptions of the health of financial institutions; and qualitative information on institutional and regulatory frameworks to help to interpret developments in prudential variables (Figure 1). Structural data— including on the size of the main segments of the financial system relative to GDP or total financial assets, ownership structure and concentration—typically supplement the analysis.[5]

Figure 1. Components of Macroprudential Analysis

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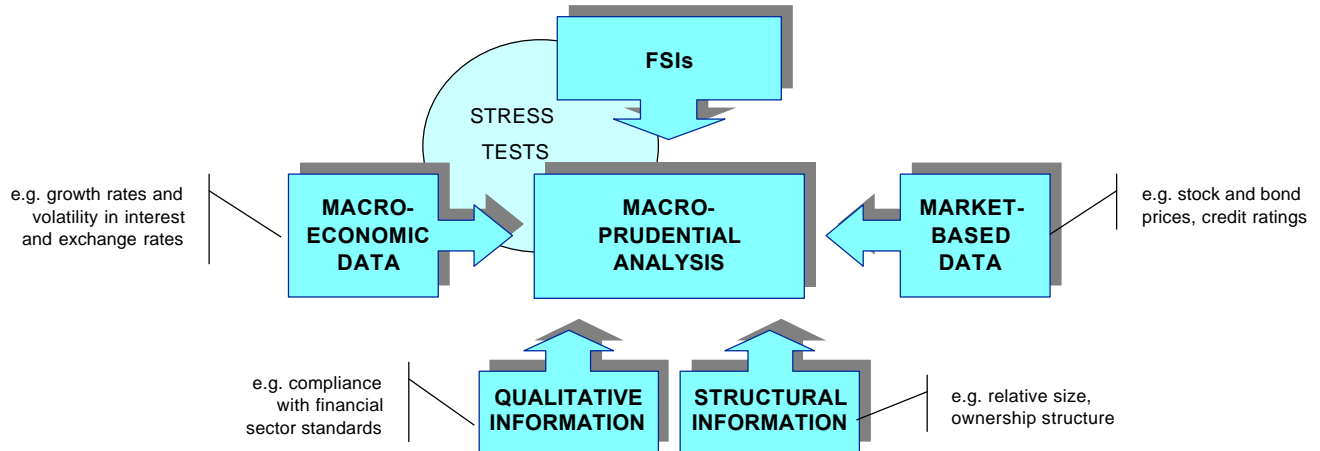
[4]Macroprudential analysis focuses on the health and stability of financial systems, whereas microprudential analysis deals with the condition of individual financial institutions. See also Crockett (2000) for details.

[5]Other organizations focusing on macroprudential analysis also look at various classes of indicators of financial system vulnerability. For instance, at the European Central Bank (ECB) level, the semi-annual analyses of the condition of the European banking sector produced by the Working Group on Macroprudential Analysis of the Banking Supervision Committee examine indicators of risk concentration (credit growth, sectoral concentration, short-term and foreign exchange lending, liquidity, exposure to emerging markets), competition (margins), profitability, asset quality, capital adequacy, financial health of the corporate and household sectors, stock prices, and macroeconomic and monetary conditions (growth, interest rates, etc.).

5.   Of these broad categories of information, the focus of this paper is on aggregated microprudential data and to some extent on selected market indicators. There is no universally accepted definition of financial soundness, or macroprudential, indicators. Broad definitions include all possible indicators related to financial system soundness, including relevant macroeconomic indicators (such as exchange and interest rates, and balance of payments data) and market-based indicators (such as stock prices of financial institutions, credit spreads, and credit ratings). This paper adopts a somewhat narrower definition, which includes mainly aggregated microeconomic indicators of the health of financial institutions and indicators of the health of the major clients of financial institutions (the corporate and household sectors). Indicators of key developments in markets in which financial institutions operate—such as the breadth and depth of the interbank and securities markets, and developments in, and bank exposure to, the real estate markets—are also included.

6.   There are clear linkages between macroprudential analysis and early warning systems and other analytical tools—currently in use or under development at the Fund—to monitor vulnerabilities and prevent crises. Early warning systems generally focus on vulnerabilities in the external position, using macroeconomic indicators as key explanatory variables.[6] Macroprudential analysis focuses on vulnerabilities in domestic financial systems, using FSIs as the most significant statistical building block. While FSIs aim to predict banking and currency crises and may ultimately be an important component of early warning systems, measurement and/or availability problems have so far made it difficult to incorporate them systematically.[7]

7.   An in-depth understanding of national financial systems requires intertemporal as well as cross-sectional analyses. Caution needs to be applied in both, however. Shifts in regulations such as accounting and provisioning norms can lead to breaks in time series and affect the robustness of intertemporal comparisons. Differing accounting, prudential, and statistical standards as well as differences in the structure of financial systems typically make cross-country comparisons of FSIs difficult. Peer group analysis—the analysis of domestic intermediaries within a group (e.g., by size or market niche)—often provides important insights and can supplement cross-country comparisons. The use of benchmarks and thresholds for the level of FSIs would also help to analyze FSIs. However, benchmarks are most often country-specific and shifts in their levels are difficult to discern as they occur.

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[6]See in particular Berg, Borensztein, Milesi-Ferretti, and Patillo (1999), and *Debt- and Reserve-Related Indicators of External Vulnerability,* Public Information Notice No. 00/37 (www.imf.org/external/np/sec/pn/2000/pn0037.htm).

[7]For the purpose of estimation of a robust early warning system, a variable must be reasonably comparable over time and across countries. See Berg, Borensztein, Milesi-Ferretti, and Patillo (1999).

8.   The organization of this paper is as follows. Chapter II looks at the definition and interpretation of indicators of the current health of the banking system, primarily derived by aggregating indicators of the health of individual banks. Indicators of specific sectors and markets that can have an impact on financial system stability—specifically, nonbank financial intermediaries (NBFIs), the corporate sector, households and real estate markets— are discussed in Chapter III. Chapter IV looks at methods for the analysis of FSIs, notably stress testing as a key component of macroprudential analysis. Qualitative aspects of macroprudential analysis are the subject of Chapter V. Chapter VI concludes.

II. BANKING SYSTEM

9.   This chapter reviews recent work that would support the selection of particular FSIs for the banking system. First, it looks at empirical work—at the Fund and elsewhere—on financial institutions' characteristics and behavior that may affect the vulnerability in the financial system. Second, it reviews evidence in support of the selection and definition of specific FSIs that are most relevant for analysis of financial stability. Conclusions on the selection of specific indicators are reported in italics.

A. Bank Behavior and Vulnerabilities

10.   Financial systems are exposed to a variety of risks, and the extent of exposure to these risks depends on the portfolio characteristics of individual banks, their systemic importance, the linkages with other institutions and markets, as well as the size and nature of the risks. Typically, an individual portfolio will be vulnerable to shocks to credit risk, liquidity risk, and market risk (including interest rate, exchange rate, equity price and commodity price risks). Market risk and credit risk shocks can affect the portfolios of financial institutions either directly through changes in the value of financial assets that are marked-to-market, or indirectly through changes in the financial position of debtors that reduce credit quality. Shocks to depositor or investor confidence may create liquidity problems that also affect the balance sheet of financial institutions. These shocks are eventually reflected in the profitability and capital adequacy of financial institutions. Financial system vulnerability increases when shocks hit portfolios that are not liquid, hedged or diversified enough, and when there is insufficient capital to absorb the shocks.[8]

11.   Recent papers have attempted to deepen our knowledge of financial institutions' characteristics and behavior that may increase the probability of crises. In their study, which is based on work done for the South Africa FSAP mission, Barnhill, Papapanagiotou and Schumacher (2000) conclude that while market risk, credit risk, portfolio concentration and asset/liability mismatches are all important risk factors, in many countries credit quality is the most important source of vulnerability during periods of financial stress. Hence, particularly in the less sophisticated financial systems, the main channel through which shocks affect the risk profile of financial institutions is a collapse in borrowers' creditworthiness. These results

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[8]Systemic liquidity provision and the functioning of the interbank markets can also affect the ability of the system to absorb shocks.

point to the need to emphasize, in the selection of a core set of FSIs, the quality of the loan portfolio of financial institutions, while at the same time monitoring the importance of nonlending activities in the generation of bank income.

12.   Cortavarría, Dziobek, Kanaya, and Song (2000) review evidence that bank behavior may actually amplify financial crises.[9] Procyclical effects can be transmitted through three channels: capital, credit and provisions. In times of recession, banks are likely to incur higher levels of loan losses, and consequently lower capital, than when the economy is strong. Moreover, retained earnings from bank profits, which add to Tier 1 capital, also tend to fall during a recession and rise in boom periods. Evidence of procyclical behavior through shifts in credit supply can be found in the credit crunch literature,[10] which postulates that increased risk perceptions during a crisis and a shortage of bank capital lead to downward shifts in the supply of loans. On the other hand, loan standards typically become more relaxed during economic expansions. A complicating factor in almost all the empirical evidence on this issue is the regulatory response during banking distress (tightening regulations), which may itself produce a procyclical effect during a downturn. However, from a policy perspective, this regulatory response is often intended to bring credit expansion to a more sustainable path.

13.   Provisioning systems with a focus on ex post factors (such as interest past due) may also amplify financial crises. During an expansion, default rates typically fall, and banks relying mainly on ex post criteria respond by reducing the level of provisions, showing higher profits and distributing more dividends. During the following contraction, when default rates rise, banks are suddenly faced with the need for higher provisions, which reduce capital, financial strength, and the ability to lend, thus contributing to a protracted downturn. While empirical evidence of these effects is rather weak, provisioning may indeed provide incentives for banks to engage in procyclical behavior.

14.   Delgado, Kanda, Mitchell Casselle, and Morales (2000) highlight that the availability of foreign currency loans to domestic borrowers influences the assessment of risks. Banks generally transfer currency risk to borrowers who commit to debt-service payments in foreign currency, regardless of the currency denomination of their revenue. However, this exposure compounds credit and currency risks, since by not refinancing or hedging the obligation, the borrower remains exposed to an exchange rate risk that translates into a credit risk to the lender. Counterparty exposure also results from the risk that the domestic currency market value of the collateral backing the obligation declines. In this case, the borrower does not face direct exchange rate risk; however, the bank is exposed to a potential credit risk in the event of industry- or company-specific adversities, as the collateral no longer covers the obligation. Because the same demand factors support domestic activities and asset prices (see Chapter III.D), it is not unusual that countries experience both effects simultaneously.

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[9]For a recent discussion of procyclicality of the financial system, see also Borio, Furfine and Lowe (2001).

[10]See for instance Agénor, Aizenman and Hoffmaister (2000).

15.   Dziobek, Hobbs, and Marston (2000) analyze the determinants of bank liquidity—defined as the degree to which a financial institution is able to meet its obligations under normal business conditions. Volatility in the depositor (and creditor) base depends on the type of depositor, insurance coverage, and maturity. Banks that rely on a narrow or highly volatile funding base are more prone to liquidity squeezes. Household deposits are typically more stable than, for instance, the deposits of institutional investors or corporate entities. Deposit concentration (i.e., fewer, larger-size deposits) can also be indicative of volatility. Deposit insurance increases the stability of the deposits it covers, with the important caveat that insurance schemes that are not credible may not have this effect. On the external front, foreign financing, for instance through commercial credit lines, and deposits of nonresidents (either in foreign or domestic currency) can become highly volatile in situations of distress and make the financial system vulnerable to external shocks or adverse developments in the domestic economy. As regards instrument maturity, the longer the time before the liability matures (in terms of remaining maturity), the more stable is the funding; however, in countries where banks are required to meet early withdrawal requests with only minor penalties, maturity may be less relevant to determining funding stability.

16.   Ultimately, the liquidity properties of assets and liabilities depend on a country's liquidity infrastructure and the resulting systemic liquidity. Dziobek, Hobbs and Marston (2000) develop a framework for assessing the adequacy of arrangements for market liquidity. The components of a balanced liquidity infrastructure are largely institutional in nature—including the existence of legal contract rights and information disclosure. Prevailing monetary arrangements, design aspects of central bank instruments, and arrangements for payments and money market operations also bear directly on banks' ability to manage short-term liquidity. For instance, high transaction costs resulting from rigid instrument design and trading rules can discourage trades and contribute to price volatility. Foreign exchange regulations—such as capital controls and prudential controls on open foreign currency positions—can affect access to foreign currency liquidity. For example, overly tight limits on net positions in foreign exchange can constrain banks' ability to manage liquidity through currency conversion. Restrictions on the use of currency derivatives also limit the incentive for developing hedging mechanisms that can improve management of liquidity and other types of risks.

17.   Bank involvement in off-balance sheet activities also has implications for systemic financial risks. Schinasi, Craig, Drees and Kramer (2000) review the key features of modern banking and, in particular, over-the-counter (OTC) derivatives markets that are relevant for assessing their soundness.[11] Internationally active financial institutions have become exposed

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[11]Compared with exchange-traded derivatives markets, OTC derivatives markets—in which transactions are not cleared through a centralized clearinghouse—have the following features: management of credit risk is decentralized at the level of individual institutions; there are no formal centralized limits on individual positions, leverage or margining; there are no formal rules for risk and burden sharing; and there are no formal rules or mechanisms for ensuring market stability and integrity. On OTC derivatives markets, see also International Monetary Fund (2000b), Chapter IV.

to additional sources of instability because of their large and dynamic exposures to credit risks embodied in their OTC derivatives activities. Although modern financial institutions still derive most of their earnings from intermediating, pricing and managing credit risk, they are doing increasingly more of it off-balance sheet. For example, a simple swap transaction is a two-way credit instrument in which each counterparty is both a creditor and a debtor. But there are important differences from traditional banking. The credit exposures associated with derivatives are time varying and depend on the price of underlying assets. Hence, financial institutions need to assess the potential change in the value of the credit extended (by marking it to market), and form expectations about the future path of the underlying asset price. This, in turn, requires an understanding of the underlying asset markets. Moreover, Breuer (2000) notes that off-balance sheet positions can build up financial institutions' leverage that is not explicitly recorded on balance sheet. The creditor and debtor relationships implicit in OTC derivatives transactions between financial institutions can create situations in which the possibility of isolated defaults can threaten access to liquidity of key market participants—similar to a traditional bank run. The rapid unwinding of positions, as all counterparties run for liquidity, is characterized by creditors demanding payment, selling collateral and putting on hedges, while debtors draw down capital and liquidate other assets. This can result in extreme market volatility.

B. Banking Indicators

18.   The variety of risks to which banks are exposed justifies looking at aspects of bank operations that can be categorized under the CAMELS framework. This involves the analysis of six groups of indicators of bank soundness: Capital adequacy, Asset quality, Management soundness, Earnings, Liquidity, and Sensitivity to market risk. This section looks at specific indicators within these categories, with two caveats. First, management soundness is not dealt with explicitly in the section. While this aspect is key to bank performance and, to some extent, is reflected in financial institutions' accounts, its evaluation is primarily a qualitative exercise. Its analysis is an integral part of banking supervision, and will be touched upon briefly in Chapter V on qualitative issues. Second, measurement of bank off-balance sheet positions will be dealt with both under capital adequacy (as they affect leverage) and under asset quality (as they affect credit risk).

19.   While implicitly the indicators reviewed in this section refer to the consolidation of bank accounts at the national level, it is important to note that for internationally active banks, the assessment of soundness should ideally include the consolidation of financial statements of foreign branches and affiliates. In this regard, as Baldwin and Kourelis (2001) point out, analysts should be aware of potential differences across national boundaries in the treatment of loan loss provisioning, asset and liability valuation, recognition of income and expenses, and deferral of gains and losses. Due attention should be paid to the accounting standards used in each country, and consolidation should be performed following uniform accounting standards.

Capital adequacy

20.   Capital adequacy and availability ultimately determine the robustness of financial institutions to shocks to their balance sheets. Aggregate risk-based capital ratios (the ratio of

regulatory capital to risk-weighted assets) are the most common indicators of capital adequacy, based on the methodology agreed to by the Basel Committee on Banking Supervision in 1988.[12] Simple leverage ratios—the ratio of assets to capital, without differential risk-weights—often complement this measure. An adverse trend in these ratios may signal increased risk exposure and possible capital adequacy problems. In addition to the amount of capital, it may also be useful to monitor indicators of capital quality. In many countries, bank capital consists of different elements that have varying availability and capability to absorb losses, even within the broad categories of Tier 1, Tier 2, and Tier 3 capital.[13] If these capital elements can be reported separately, they can serve as more reliable indicators of the ability of banks to withstand losses, and help to put overall capital ratios into context.

21.   The Basel Committee's minimum standards for risk-weighted capital adequacy were originally intended to apply only to internationally active banks, but are now used in most countries—industrial, emerging, and developing—and for most banks. Recent proposals have been put forward by the Basel Committee to update this standard, to account for the rapid development of new risk-management techniques and financial innovation.[14] These proposals introduce greater refinement into the existing system of risk weighting, to relate its categories more accurately to the economic risks faced by banks—including as measured by banks' own internal ratings systems, or, less elaborately, based on ratings from external rating agencies. However, improved risk measurement comes at the expense of comparability. Under the new proposal, each bank's estimation of credit risk can differ, which, being reflected in different risk-weighted assets and capital ratios would make aggregation of individual bank ratios problematic. This issue has not so far been tackled explicitly in the Basel proposal.

22.   Well-designed loan classification and provisioning rules are key to obtaining a meaningful capital ratio. Loan classification rules determine the level of provisioning, which affects capital both indirectly (by reducing income) and directly (through inclusion of general provisions, to some extent, in regulatory capital).[15] Moreover, in most G-10 countries banks

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[12]The Basel Committee's 1988 risk-measurement framework assigns all bank assets to one of four risk-weighting categories, ranging from zero to 100 percent, depending on the credit risk of the borrower. The Basel Capital Accord requires internationally active banks in BIS member countries to maintain a minimum ratio of capital to risk-adjusted assets of 8 percent.

[13]Tier 1 capital consists of permanent shareholders' equity and disclosed reserves; Tier 2 capital consists of undisclosed reserves, revaluation reserves, general provisions and loan-loss reserves, hybrid debt-equity capital instruments, and subordinated long-term debt (over five years); Tier 3 capital consists of subordinated short-term debt (two to five years). See Basel Committee on Banking Supervision (1988, 1998).

[14]See Basel Committee (2001).

[15]The Basel Capital Accord allows banks to include general provisions in Tier 2 capital, up to 1.25 percent of (risk) assets.

are required to deduct specific provisions (or loan-loss reserves) from loans—that is, credit is calculated on a *net* basis—which reduces the value of total assets and hence of capital (a residual—assets minus liabilities; see Box 1).

Box 1. The Valuation of Capital

Bank capital (or equity) equals assets minus liabilities. Since capital (equity) is a residual, it cannot be measured directly, and its quantification requires that each item affecting its level be evaluated—including assets, liabilities, off-balance sheet commitments, and other items. The valuation of assets is the most important component, and different methods are needed to evaluate the main categories of assets (loan portfolio, securities, fixed assets, other assets). Methodological issues include: (1) market value vs. book value, (2) replacement value vs. yield-based value, and (3) going concern value vs. liquidation value. Valuation of liabilities is more straightforward, although the valuation of some elements of Tier 2 regulatory capital (notably subordinated debt and hybrid instruments) may be complicated. The impact of off-balance sheet items on capital is particularly difficult to evaluate because of the mostly contingent nature of these items. Finally, a wide range of other items also needs to be taken into account, including hidden reserves and losses in the form of unbooked transactions, goodwill, franchise value, and financial damages and penalties linked with pending legal cases.

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23.   Simple leverage ratios—the ratio of assets to capital, without differential risk-weights—are also meaningful indicators and are often used, as Cortavarría, Dziobek, Kanaya, and Song (2000) point out. Financial institutions' leverage increases when bank assets grow at a faster rate than capital, and is particularly useful as an indicator for institutions that are primarily involved in lending activities.

24.   The analysis in Breuer (2000) highlights that explicitly including off-balance sheet positions produces a more accurate measure of bank leverage. To assess leveraged positions in off-balance sheet transactions resulting from a derivative contract, the basic derivative instruments—forwards and options—can be replicated by holding (and in the case of options, constantly adjusting) positions in the spot market of the underlying security, and by borrowing or lending in the money market. This replication of the contract maps the individual components into own-funds equivalents (equity) and borrowed-funds equivalents (debt), which can be used to measure the leverage contained in long and short forward positions and option contracts. This on-balance sheet asset equivalent of the exposure is also called the current notional amount. Overall leverage ratios, defined as on-balance sheet assets plus off-balance sheet exposures (gross or net), can be obtained following this method.

> ⇒   *Indicators covered in this section suggest two main measures are important for tracking capital adequacy: the ratio of regulatory capital to risk-weighted assets (the Basel capital adequacy ratio), and the ratio of assets to capital (the leverage ratio). In countries where bank derivatives trading is considered of systemic importance, it is also advisable, when monitoring leverage ratios, to adjust for off-balance sheet items.*

Asset quality

25.   Risks to the solvency of financial institutions most often derive from impairment of assets. This section looks at indicators that directly reflect the current state of bank credit portfolios,[16] including information on loan diversification, repayment performance and capacity to pay, and currency composition. Indicators of asset quality need to take into account credit risk assumed off-balance sheet via guarantees, contingent lending arrangements, and derivatives—a subject covered at the end of the section. The quality of financial institutions' loan portfolios is also directly dependent upon the financial health and profitability of the institutions' borrowers, especially the nonfinancial enterprise sector. Indicators of the financial strength of corporate and household borrowers are discussed in detail in Chapter III.

26.   The ratio of nonperforming loans (NPLs) to total loans is often used as a proxy for asset quality of a particular bank or financial system. Cortavarría, Dziobek, Kanaya and Song (2000) note that in many countries, including most G-10 countries, assets are considered to be nonperforming when (1) principal or interest is due and unpaid for 90 days or more; or (2) interest payment equal to 90 days or more have been capitalized, refinanced or rolled over. Some countries use forward-looking classification criteria, which focus on repayment capacity and cash flow of the borrower, and mirror more accurately the current economic value of a loan, therefore providing better quality indicators. For countries that are using the standard classification system,[17] NPLs are often defined as loans in the three lowest categories (substandard, doubtful, loss). Nevertheless, the classification criteria vary across countries; hence available measures of NPLs are not always comparable across countries and not even over time. In addition, some countries count only the unpaid portion of the loan, rather than the entire loan, as nonperforming. Meaningful cross-country comparisons of national NPL figures would require a common definition of NPLs.

27.   A notion of asset quality geared toward the capacity of a bank to withstand stress should also consider the level of provisions. Provisions can be general—for possible losses not yet identified—or specific—for identified losses (loan-loss reserves). The definition and rules concerning general and specific provisions vary across countries, although standardized levels seem to gravitate toward 20 percent, 50 percent and 100 percent for substandard, doubtful and loss categories.[18] In some countries banks are also required to hold a general provision, sometimes calculated as 1 percent of standard-quality loans. The coverage ratio—

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[16]Credit (assets for which the counterparty incurs debt liabilities) is a more comprehensive concept than loans, and includes loans, securities other than shares, and miscellaneous receivables.

[17]This usually includes five categories: standard, special mention, substandard, doubtful and loss.

[18]Collateral could be taken into account in establishing provisions, and a conservative value of the collateral could be deducted from the loan amount.

the ratio of provisions to NPLs—provides a measure of the share of bad loans that have already been provisioned. An important indicator of the capacity of bank capital to withstand NPL-related losses is the ratio of NPLs *net* of provisions to capital.[19]

28.   In situations of systemic banking distress, figures on restructured loans (and loan recoveries) are used as indicators of progress with NPL management. Trends in NPLs should be looked at in conjunction with information on recovery rates—for example, using the ratio of cash recoveries to total nonperforming loans. Such information points to the level of effort or the ability of financial institutions to cope with high NPL portfolios.

29.   Lack of diversification in the loan portfolio signals an important vulnerability of the financial system. Loan concentration in a specific economic sector or activity (measured as a share of total loans) makes banks vulnerable to adverse developments in that sector or activity. This is particularly true for exposures to the real estate sector (see Chapter III.D). Country- or region-specific circumstances often determine the particular sectors of the economy that need to be monitored for macroprudential purposes.

30.   Exposure to country risk can also be important in countries that are actively participating in the international financial markets. Data on the geographical distribution of loans and credit allows the monitoring of credit risk arising from exposures to particular (groups of) countries, and an assessment of the impact of adverse events in these countries on the domestic financial system through contagion.

31.   Concentration of credit risk in a small number of borrowers may also result from connected lending and large exposures. Monitoring of connected lending is particularly important in the presence of mixed-activity conglomerates in which industrial firms control financial institutions.[20] Credit standards may be relaxed for loans to affiliates, even when loan terms are market-based. Connected lending can be measured against capital, the definition of what constitutes a connected party is usually set in consideration of the legal and ownership structures prevalent in a particular country. This makes this indicator often difficult to use in cross-country comparisons.

32.   The assessment of large exposures, usually calculated as a share of capital, aims at capturing the potential negative effect on a financial institution should a single borrower experience difficulties in servicing its obligations.[21] Baldwin and Kourelis (2001) note that it

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[19]The accounting treatment of provisions needs to be considered when looking at NPL ratios. As indicated above, in most G-10 countries, banks are required to deduct specific provisions from loans, which adjusts the value of loans in response to changes in quality. In these cases, NPLs should be measured as a percentage of gross, rather than net, loans.

[20]See Baldwin and Kourelis (2001).

[21]Exposure refers to one or more loans to the same individual or economic group. There is no standard definition of "large." In some countries, it refers to exposures exceeding 10 percent of regulatory capital.

is important to monitor this indicator at the level not only of individual banks and the aggregate financial sector, but also of financial groups. If a number of affiliates have dealings with the same borrower, the group's credit risk exposure could well be underestimated if taken on a solo basis. Moreover, members of a group may sell loans to affiliated entities in advance of a periodic reporting in order to obscure their true exposure.

33.   In countries where domestic lending in foreign currency is permitted, it is important to monitor the ratio of foreign currency-denominated loans to total loans. Delgado, Kanda, Mitchell Casselle and Morales (2000) note that ideally, a measure of risk from domestic lending in foreign currency should identify loans to unhedged domestic borrowers. In these cases, hedging would also include "natural hedges," or borrowings for which the adverse exchange rate impact on domestic currency obligations is compensated by a positive impact on revenue and profitability.[22] The level of this ratio is related to that of foreign currency-denominated deposits to total deposits, although differences may be observed, notably when sources of foreign currency financing are available from lines of credit and other capital inflows. Hence, foreign currency loans should also be monitored as a share of foreign currency deposits and other foreign currency funding. It should be noted, however, that due to the compound nature of credit and currency risk in foreign exchange-denominated lending, even institutions with a balanced foreign exchange position face risks when engaging in this type of lending.

Impact of off-balance sheet operations

34.   Monitoring bank soundness requires tracking the risks involved in off-balance sheet operations (via guarantees, contingent lending arrangements, and derivative positions). As a general rule, these operations should be brought on-balance sheet for the purpose of calculating FSIs. However, financial derivatives and off-balance sheet positions present special problems in evaluating the condition of financial institutions, because of the lack of reporting of positions in some countries, inadequate counterparty disclosure, high volatility, and the potential for spill-over effects. Such concerns have led the accounting profession to move toward explicit recognition of virtually all derivatives on balance sheets using a market value or equivalent measure of value (e.g., using delta-based equivalents).[23] International standards have also been proposed for the recognition, valuation, and disclosure of information on derivatives.[24]

35.   Derivatives and, in particular, OTC derivatives, can contribute to the buildup of vulnerabilities and should be explicitly monitored. While the institutions that intermediate the bulk of transactions in OTC derivatives markets are a limited number of large internationally

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[22]See also the discussions in Chapter III.B.

[23]The delta-normal method uses the linear derivative to approximate the change in portfolio value, and the normal distribution as the underlying statistical model of asset returns.

[24]See Basel Committee on Banking Supervision and IOSCO (1998).

active institutions (including commercial banks), smaller-scale interbank and interdealer activity account for a significant share of daily turnover.[25] This is because of the low cost and flexibility of OTC derivatives, which makes them efficient vehicles for position taking and hedging. Data on notional amounts of OTC derivatives transactions are common indicators in this area.

⇒   *Indicators highlighted in this section as important in assessing bank asset quality include NPLs to total loans, NPLs net of provisions to capital, sectoral distribution of loans to total loans, connected lending to capital, large exposures to capital, and, where applicable, foreign currency-denominated loans to total loans. Ideally, indicators should be constructed using figures for "exposures" (on- and off-balance sheet) rather than just loans, for instance as a share of total assets.*

Earnings and profitability

36.   Accounting data on bank margins, income and expenses are widely used indicators of bank profitability. Common operating ratios, for instance, are net income to average total assets—also known as "return on assets" (ROA)—and net income to average equity—also known as "return on equity" (ROE).[26]

37.   Vittas (1991) notes that three types of operating ratios may be used in analyzing the performance of banks: operating asset ratios, operating income ratios and operating equity ratios. The first relates all incomes and expenses to average total assets, the second to gross income, and the third to average equity. A summary of terms used in income statements can be found in Table 2.

Table 2. Income Summary

+ Interest income
– Interest expenses
= Interest margin (net interest income)
+ Noninterest income
= Gross income
– Noninterest expenses
= Net income

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[25]Schinasi, Craig, Drees, and Kramer (2000) report that in 1998 contracts between the major players accounted for roughly one-half of notional principal in interest rate derivatives, and one-third in foreign exchange derivatives.

[26]The ratios can be calculated with various income measures, for example before or after provisions and before or after tax charges and (net) extraordinary items.

38.   Differences in capital structure, business mix, and accounting practices across countries, among individual banks and over time, need to be considered in analyzing bank performance, and highlight the need to look at several operating ratios at the same time. Differences in capital structure refer to differences in bank leverage. Banks with lower leverage (higher equity) will generally report higher operating asset ratios (such as ROA), but lower operating equity ratios. Hence, an analysis of profitability based on operating equity ratios (such as ROE) disregards the greater risks normally associated with high leverage. Operating income ratios may also be affected by leverage; notably the interest margin and net income ratios will be higher, while the noninterest income and noninterest expenses ratios will be lower for banks with lower leverage (higher equity). The reason for this is that banks with higher equity need to borrow less to support a given level of assets and thus have lower interest expenses, which results in higher net interest and net income.

39.   Differences in business mix derive from differing combinations of high- and low-margin business—for example retail banking, which is associated with higher lending rates, lower deposit rates and higher operating costs, and wholesale corporate banking. In this case, an analysis based on interest margins and gross income only may be misleading, since two banks may show wide differences in these ratios and still have equal ROA and ROE. Such an analysis disregards the fact that high margin business involves high operating costs. In the same vein, banks that offer a wider range of services, such as investment banks, will have much higher operating costs but also higher noninterest income.

40.   Accounting practices that distort operating ratios cover such issues as the valuation (and revaluation, in the presence of inflation) of assets, the treatment of reserves for depreciation, employees' pensions, loan-loss provisions, and the use of hidden reserves. The possible impact of these factors needs to be taken into account in interpreting the ratios.

41.   Returns can also be calculated on a risk-adjusted basis. The risk-adjusted return discounts cash flows according to their volatility: the more volatile the cash flow, the higher the discount rate and the lower the risk-adjusted return. Risk-adjusted return on capital (RAROC) states the return on capital required to offset losses on the underlying asset should volatility cause its value to decline (by two or more standard deviations). RAROC is particularly useful to banks in evaluating businesses and products according to their place along a risk/return spectrum, so as to correctly price a transaction and manage the risk-adjusted return. At the individual transaction level, RAROC is calculated as the ratio of interest margin associated with the operation (e.g., a loan) to loan value multiplied by the potential loss. At the aggregate level, it can be computed as interest margin to assets multiplied by the potential loss. Estimating the potential loss requires data on historical default and recovery rates and banks' ability to liquidate the assets (liquidity risk).

> ⇒   *Relying too heavily on just a few indicators of bank profitability can be misleading. While ROA, ROE and interest margin (and noninterest expenses) to gross income remain the key measures, they should ideally be supplemented by the analysis of other operating ratios.*

Liquidity

42.   The level of liquidity influences the ability of a banking system to withstand shocks. Common measures of liquidity include liquid assets to total assets (liquid asset ratio), liquid assets to short-term liabilities, or loans to assets as a crude measure.[27] The definition of liquid assets differs across countries, but in general terms, it refers to cash and its equivalents—any asset that is readily convertible to cash without significant loss. These indicators reflect the maturity structure of the asset portfolio, and can highlight excessive maturity mismatches and a need for more careful liquidity management. Loan to deposit ratios (excluding interbank deposits) are also sometimes used to detect problems—a high ratio indicating potential liquidity stress in the banking system. These ratios may also reflect loss of depositor and investor confidence in the long-term viability of the institutions.

43.   Information on the volatility of bank liabilities can supplement the information provided by liquidity ratios. Dziobek, Hobbs, and Marston (2000) propose a funding volatility ratio calculated as volatile liabilities minus liquid assets to illiquid assets (total assets minus liquid assets). A positive ratio indicates risk, since volatile liabilities are not fully covered by liquid assets. In practice, however, there are problems in applying this ratio, since it is difficult to know which assets should be classified as liquid and which liabilities should be classified as volatile.[28] More generally, bank liabilities that are subject to the risk of reversal of capital flows, such as external credit lines and deposits of non-residents, should be monitored closely, for instance through indicators of the size of this type of funding in total bank liabilities. Such indicators of exposure to international capital movements reflect the relevance of macroprudential analysis for assessments of external vulnerability.

44.   As bank liquidity depends on the level of liquidity of the overall system, it is important to monitor measures of market liquidity. The focus may be on the treasury bill or central bank bill market, or on other markets that are most relevant to the liquidity of bank assets. Market liquidity can be captured by indicators of the tightness, depth and resilience of a market.[29] Tightness indicates the general cost incurred in a transaction irrespective of the level of market prices, and can be measured by the bid-ask spread (the difference between prices at which a market participant is willing to buy and sell a security). Depth denotes the volume of trades possible without affecting prevailing market prices, and is proxied by the

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[27]Indicators of the maturity structure should distinguish between domestic and foreign liabilities and indicate the currency denomination of the liabilities.

[28]The need to further develop broad principles for quantifying funding liquidity risk was recently highlighted by the Multidisciplinary Working Group on Enhanced Disclosure of the Financial Stability Forum. See Financial Stability Forum (2001).

[29]See Committee on the Global Financial System (1999). It should be noted that in times of particular financial distress, dealers may not be willing to make a market at all in certain securities. Such instances can be captured through surveys of primary security dealers. See Nelson and Passmore (2001).

turnover ratio.[30] Resilience refers to the speed at which price fluctuations resulting from trades are dissipated; while there is still no consensus on an appropriate measure, one approach is to examine the speed of the restoration of normal market conditions after trades.

45.   Where foreign currency transactions are relevant, liquidity management can be complicated if the availability of foreign currency is limited and interbank foreign exchange lines are vulnerable to disruption. In these cases, it is also important to measure the liquidity of foreign exchange markets, and monitor its determinants. Foreign exchange liquidity will also depend on developments in the external sector, which is subject to the risk of reversal of capital flows (see above) or to the adequacy of foreign exchange reserves. More generally, sectoral balance sheet developments—such as in some indicator of reserve adequacy or corporate liquidity—could indicate build up of liquidity stress in the same or other sectors.[31]

46.   Standing central bank facilities, which are accessed at the initiative of banks, provide liquidity to banks (usually against collateral), and are an essential component of the liquidity infrastructure. On the other hand, a large increase in central bank credit to banks and other financial institutions—as a proportion of their capital or their liabilities—often reflects severe liquidity (and frequently also solvency) problems in the financial system. Jácome, Leone, and Madrid (2001) point out that beyond the traditional lender-of-last-resort role of the central bank, which is supposed to address limited liquidity problems, monetary authorities often get involved in banking crisis resolution because they are the most important (if not the only) source of large funds immediately available.[32] This participation usually implies providing liquidity support beyond best practices, injecting capital resources (in cash or bonds) to distressed institutions, and financing debt rescheduling and relief to the corporate sector. Monitoring central bank lending to financial institutions, therefore, can be important. It should be noted, however, that these types of support are not always easily identifiable in central banks' financial statements, limiting the potential usefulness of this indicator to recognize banking liquidity (and solvency) problems.[33]

47.   The dispersion in interbank rates is a highly relevant indicator of liquidity problems and bank distress. Very often, banks themselves first detect problems as they are exposed, or potentially exposed, to troubled institutions in the interbank market. High dispersion in interbank rates—measured, for instance, by the spread between highest and lowest rates in the market—may signal that some institutions are perceived as risky by their peers. As

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[30]The turnover ratio is the ratio of the average trading volume over a given period of time to the outstanding volume of securities.

[31]See Chapter IV.C for further discussion of sectoral balance sheet analysis.

[32]Also, governments may feel tempted to shift to central banks the cost of bank resolution, at least partially, so as to hide these costs within the central bank balance sheet.

[33]Such transactions may also have important implications for the conduct of monetary policy and the financial position of the central bank, as described in Jácome, Leone, and Madrid (2001).

supplying banks can control their interbank positions through price and quantitative controls, high-risk institutions may be forced to engage in aggressive bidding for deposits. Changes in interbank credit limits or an unwillingness of some institutions to lend to other ones may indicate serious concerns.

> ⇒ *While liquid assets to total assets (the liquid asset ratio) and liquid assets to liquid liabilities remain the main indicators of bank liquidity, this section shows that "indirect" measures are also important and should be regularly monitored. These include indicators of systemic liquidity, such as bid-ask spreads and turnover ratios, central bank lending to deposit-taking institutions, and the dispersion in interbank rates (measured by the highest-to-lowest rate spread). Selected macroeconomic or sectoral balance sheet indicators could also signal liquidity pressures.*

Sensitivity to market risk[34]

48.   Banks are increasingly involved in diversified operations, all of which involve one or more aspects of market risk. In general, the most relevant components of market risk are interest rate and exchange rate risk. Moreover, in some countries, banks are allowed to engage in proprietary trading in stock markets, which results in equity price risk. Bank exposure to commodity price risk derived from the volatility of commodity prices varies significantly among countries, but is generally relatively small. Interest rate, exchange rate, equity price and commodity price risks can be assessed by calculating net open positions according to the methodology proposed by the Basel Committee on Banking Supervision.[35]

- The most accurate indicator of sensitivity to interest rate risk is the duration of assets and liabilities.[36] The greater the duration or "average" life mismatch between assets and liabilities, the greater is the risk. Alternatively, the average repricing period can be used to assess interest rate risk. The average repricing period refers to the average time to repricing for floating rate instruments, and remaining time to maturity for fixed rate instruments.

- The most common measure of foreign exchange exposure is the net open position. According to the Basel Committee on Banking Supervision, a bank's

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[34]See Chapter IV.A for a discussion of the stress tests that are used in measuring sensitivity to market risk.

[35]See Basel Committee on Banking Supervision (1997, 1998).

[36]Duration is the average (cash-weighted) life of an asset or liability. It is the point where the weights (cash flows) are in balance—graphically on a bar chart (where bars represent cash flows by maturity), it is the point of balance (in months/years) for the cash flows from an asset or liability. A discussion of the duration model can be found in Chapter IV.A. A currency breakdown of duration can help identify a maturity mismatch in foreign currency.

net open position in each currency should be calculated as the sum of the net spot position, the net forward position, guarantees, net future income and expenses not yet accrued but already fully hedged, the net delta-based equivalent of the total book of foreign currency options, and any other item representing a profit or loss in foreign currencies, depending on accounting conventions.

- The starting point for measuring a bank's equity risk exposure is its net open position in each equity. Equity derivative positions must be converted into notional equity positions (e.g., using delta-based equivalents).[37]

- Indicators of commodity price risk can be constructed that are similar to those for equity risk, by looking at the absolute size of the investment in each commodity.

⇒ *This section highlights some of the indicators and analytical methods used to measure sensitivity to market risk. Important indicators include the duration of assets and liabilities, and net open positions in foreign currency and equities.*

III. OTHER SECTORS AND MARKETS

49.   Indicators of the health of financial systems should not simply look at the banking sector. Experience shows that risks to financial system stability can derive from developments in nonbank financial intermediaries (NBFIs), the corporate sector, households, and real estate markets.

A. Nonbank Financial Intermediaries

50.   The presence and growth of nonbank financial intermediaries (NBFIs) has raised macroeconomic and prudential issues, most recently during the Asian crisis. NBFIs—finance companies, collective investment schemes, insurance companies and others—can build up substantial vulnerabilities and risks that often go undetected, partly owing to nontransparent disclosure practices and inadequate oversight. The collapse of NBFIs during the Asian turmoil (e.g., in Korea and Thailand) contributed directly or indirectly to a systemic crisis in the financial system. Accordingly, there is a need for a better awareness of the role of NBFIs in financial system stability, and better monitoring of their condition.[38]

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[37]For details on the methodology, see Basel Committee on Banking Supervision (1998).

[38]A related issue, which is not explicitly covered in this paper, is that of offshore financial centers and the risks involved in the operations of these centers through links to domestic financial systems. See for instance *Offshore Financial Centers—IMF Background Paper* (http://www.imf.org/external/np/mae/oshore/2000/eng/back.htm).

NBFIs behavior and vulnerabilities[39]

51.   In many advanced countries, NBFIs already play a large enough role in the financial system to be considered systemically important, while elsewhere their fast growth implies that they may be systemically important in the near future. NBFIs and banks often have ownership and investment linkages that make each subsector vulnerable to adverse developments in the other. Loss of consumer and investor confidence in NBFIs, even when their size remains relatively unimportant, can potentially undermine confidence in the entire system. Moreover, the systemic risks arising from a particular class of NBFIs—the highly leveraged financial institutions—were highlighted by market turmoil following the near-failure of a large hedge fund in 1998. The size and growth in the operations of NBFIs raises a number of issues relating to the overall structure and functioning of financial systems, and thus have implications for financial system stability as well as for monetary and exchange rate policy.

52.   NBFIs are typically not subject to the same prudential requirements as banks. Lower (or no) capital adequacy requirements increase NBFIs vulnerability in the event of shock. In addition, differential treatment may produce regulatory arbitrage and cause NBFIs to grow at the expense of banks, thus potentially increasing the vulnerability of the system (since NBFIs may potentially invest in riskier projects without the commensurate increase in necessary provisions and reserves). Preferential prudential treatment also decreases NBFIs' cost of funds and potentially allows them to offer higher funding rates than banks, hence attracting funds away from banks.

53.   Competition between banks and nonbanks on the deposit side is of particular concern when NBFIs can issue short-term financial instruments that can rapidly convert liabilities into means of payment. The existence of such quasi-deposits affects monetary operations since it may lead to an underestimation of money demand and a change in the money multiplier, thus reducing the effectiveness of reserve requirements as a monetary policy instrument and complicating monetary programming.[40]

54.   The lending and funding operations of NBFIs can have an impact on a country's external debt, reserves, and exchange rate if they are carried out in foreign currency on a significant scale. Similarly, in financial systems with relatively thin foreign exchange and securities markets, the transactions of collective investment schemes, hedge funds or securities firms can have a significant impact on the reserves, exchange rate, and securities

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[39]This section is based on Blaschke, Das, and Dattels (2001).

[40]In many countries, due to the nature of the instruments issued by NBFIs, their liabilities are not included in the narrow monetary aggregates (M1, M2), which typically include the transferable deposit liabilities of the banking sector (mostly commercial banks). The liabilities of NBFIs are often included in wider monetary aggregates (M3, M4), or are not included in monetary aggregates at all. In countries with substantial nonbank quasi-deposits, the wider monetary aggregates (M3, M4) need to be monitored for monetary policy purposes.

prices. The build-up or liquidation of large positions can lead to high volatility in financial markets. Thus, indicators of gross and net positions of NBFIs in foreign exchange and securities may be important depending on the size of the positions relative to the overall market.

Indicators for nonbank financial institutions

55.   The development of specific FSIs on the NBFI sector would help to monitor, and raise awareness of, potential risks emanating from this sector. Such indicators should include the size of the NBFI sector—NBFI assets to total financial assets—to determine its systemic importance. The size threshold in terms of systemic importance would vary from country to country depending on the institutional setting, such as the manner in which NBFI raise funds from the public (and to which segments of the public—small savers or wholesale investors). One way to measure relative importance would be to look at the liability side, and especially quasi-deposit liabilities, which are arguably more "systemically sensitive." The use of indicators such as NBFI assets to GDP is also revealing. Rapid expansion of credit and accumulation of assets in general, and in the NBFI sector in particular, may indicate the potential for problems in this sector. Accordingly, indicators of the growth in credit would be important. Another indicator of possible problems relates to over expansion (and therefore unhealthy competition), which could be signaled by the growth in the number of NBFIs as well as by declining profit margins and/or capital.

56.   Specific FSIs for the NBFI sector—resulting from the aggregation of balance sheet and income statement data by type of institution—would be useful in helping to gauge the health of NBFIs and detect the existence of potential risks. However, work on NBFIs is at an earlier stage than that on banks and more needs to be done to identify FSIs for the sector.[41] These indicators could include capital to asset ratios (to measure gearing and capital cushion) or risk-weighted equivalents if available. Balance sheet or intermediation risk ratios could include liquid asset ratios and sector concentration ratios (to detect exposure to real estate or industrial sectors). NBFIs can be active in international markets or engage in foreign currency lending, making net foreign exchange exposure to capital an important indicator. Finally, the sustainability of the sector might be gauged by returns on equity and assets, and other operating ratios. While to some extent similar to those used for banks, such indicators would need to pay due attention to the balance sheet and income characteristics of each subcomponent of the sector—such as finance (and leasing) companies, securities firms, collective investment schemes, and insurance companies. In the case of finance companies, for instance, indicators need to be adjusted to the basic characteristics of receivables (including off-balance sheet risks) and the mix of funding sources. In the case of insurance,

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[41]The Financial Stability Forum recently recommended disclosure of a series of indicators for securities firms, insurance companies and leveraged investment funds, in addition to banks. These included indicators of market risk, funding liquidity risk, and credit risk, as well as information of the nonlife insurance sector. These indicators are aimed at disclosure at the individual institution level. The Forum recognizes the need for further development of risk assessment concepts and methods in this area. See Financial Stability Forum (2001).

the indicators need to capture the specificity of each insurance market (i.e., health, life, property/casualty and reinsurance).

⇒ *Recent experience confirms the NBFIs' potential systemic role and the need to monitor their health and vulnerabilities. Data availability remains a key constraint in this area. Information about the NBFI sector—notably the unregulated entities—is generally difficult to obtain, assemble and aggregate in a way that is consistent and comparable across countries. While indicators exist that can capture the size and importance of NBFIs in the economy, more research and analysis is needed to develop a set of FSIs that captures the specificities of these intermediaries.*

B. The Corporate Sector

57.   The quality of financial institutions' loan portfolios is directly dependent upon the financial health and profitability of the institutions' borrowers, especially the nonfinancial enterprise sector. The key role played by the corporate sector in recent episodes of financial sector distress is a reminder of the importance of monitoring developments in this sector. This section reviews recent literature on firms' characteristics and behavior that may increase the probability of crises. It also reviews evidence in support of the selection of specific FSIs for the corporate sector.

Corporate behavior and vulnerability

58.   Recent theoretical and empirical work on the corporate sector and financial distress has looked at how firms respond to macroeconomic shocks, and how this response in turn affects financing and investment decisions of the corporate sector and, through those decisions, the macroeconomy. The variables identified in some of this work are listed in Table 3. Much of this literature has focused on two aspects that are key to ensuring the repayment of corporate obligations: corporate net worth and cash flow, and marketable collateral. The "financial accelerator" approach stresses the role of microeconomic rigidities that occur due to informational asymmetries, where corporate net worth plays the role of collateral and helps to overcome incentive problems in lending. In these studies, macroeconomic shocks affect the real sector through corporate balance sheet effects.[42] The "collateral" approach stresses macroeconomic rigidities in the form of underdeveloped domestic financial markets and lack of internationally acceptable collateral. In these studies, crisis susceptibility is due to shortfall in collateral that is necessary in order to get domestic and foreign financing.[43]

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[42]See for instance Bernanke and Gertler (1995), Krugman (1999), Kim and Stone (2000), and Gertler, Gilchrist, and Natalucci (2000). For a review of this literature, see Stone and Weeks (2001).

[43]See for instance Kiyotaki and Moore (1997), and Caballero and Krishnamurthy (2000).

59.   Through the two channels of corporate balance sheets and collateral, the corporate sector is exposed to shocks such as a fall in asset prices, an increase in interest rates, or a slowdown in growth. Levels of corporate leverage influence the ability of firms to withstand these shocks, as empirically documented in a recent study by Kim and Stone (1999). The more leveraged and the less liquid the corporate sector, the more vulnerable it is to shocks. Large corporate debts denominated in foreign currency make firms also vulnerable to real devaluations, which affect their net worth and can render the economy financially fragile.[44]

Table 3. Determinants of Corporate Vulnerabilities

	Financial Accelerator Models				Collateral Models	
	BG(95)	K(99)	KS(99)	GCN(00)	KM(97)	CK(00)
Structural vulnerabilities						
Access to nonbank financing	X					
Corporate governance						X
Legal infrastructure						X
Macroeconomic shocks						
Interest rate changes	X			X		X
Exchange rates changes				X		
Capital flows/Liquidity		X	X			X
Domestic demand		X		X		
Terms of trade		X				X
Deflation			X	X		
Productivity					X	
Corporate sector indicators						
Leverage	X	X	X	X	X	X
Foreign Debt		X	X	X		
Short-term or floating rate debt	X		X			
Liquid assets	X					
Marketable collateral	X		X		X	X
Asset prices	X		X	X	X	X
Current cash flow	X		X			
Dividends			X			
Banking indicators 1/						
Availability of credit	X					X
Cost of credit	X					

1/ Some studies look specifically at bank vulnerabilities (capital adequacy and liquidity), which would feed into corporate vulnerability through the channels of availability (rationing) and cost of bank credit.

Legend: BG: Bernanke and Gertler; K: Krugman; KS: Kim and Stone; KM: Kiyotaki and Moore; CK: Caballero and Krishnamurthy; CGN: Gertler, Gilchrist and Natalucci.

60.   Prolonged distress in the corporate sector negatively affects firms' repayment capacity and creditworthiness, and results in a worsening of bank asset quality and ultimately higher NPLs. Gray (1999) examines how NPLs directly link corporate sector vulnerability to financial sector vulnerability. In his model, reduced corporate equity as a result of

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[44]Céspedes, Chang, and Velasco (2000).

macroeconomic shocks results in an increase in NPLs, the size of the increase depending on the composition of corporate debt (i.e., the importance of nonbank-financed debt). Nonpayments may be triggered by illiquidity, insolvency or a collapse in credit culture in situations of systemic distress—a behavior known as "strategic defaulting." Since banks only book NPLs *after* a period (often three months) of nonpayment, direct indicators of corporate health such as cash flow adequacy can be more timely indicators of banking problems than NPL figures.

61.   More recent Fund efforts in this area points to a strong link between macroeconomic developments and corporate leverage, and between corporate leverage and the probability and intensity of financial crises. Stone and Weeks (2001) analyze the financial crises of the 1990s by dividing them into two stages: pre- and post-crisis equilibria. The first stage is a long buildup of balance sheet stress rooted in poor corporate governance, financial deepening, accelerated capital inflows and, in many cases, overheating of the economy. These tensions leave the economy susceptible to financial shocks. A shock—usually external—triggers a sudden crisis, or a shift from a stable equilibrium into a new contractionary equilibrium. Empirical results show that both corporate leverage and aggressive bank lending can be significant indicators of the *probability* of a crisis. Corporate leverage, the availability of nonbank financing, and the legal environment are key elements in determining the *intensity* of crises. This has clear policy implications—the need to pay attention to corporate sector balances as well as the breadth and quality of the domestic financial system.

62.   Begum and Schumacher (2001) note the relationship between the corporate capital structure and volatility in financial markets. They argue that firms that operate in highly volatile environments will tend to have lower leverage in order to reduce the possibility of financial distress.[45] The paper suggests that the degree of corporate leverage together with the volatility of the environment in which corporations operate could be important indicators of the probability of corporate financial distress. High leverage could make corporate bankruptcy more likely during times of low growth or recession and high volatility could further increase the probability of distress.

Corporate indicators

63.   The literature reviewed above points to the importance of specific balance sheet and cash flow information—notably data on leverage, interest cover, liquidity and profitability— as indicators of corporate sector soundness. More recent studies have examined specific measures of corporate vulnerability, as summarized in Table 4. The table also includes indicators from a review of corporate rating methodologies.[46]

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[45]There is a vast literature on the determinants of corporate leverage and its relevance to probability of financial distress and corporate credit ratings. See Rajan and Zingales (1995).

[46]See Fitch IBCA (1998), and Standard & Poor's (2000).

64.   Excessive corporate leverage increases the vulnerability of corporate entities in the event of a shock and may impair their repayment capacity. A known indicator is total debt to equity, also called the gearing (or leverage) ratio. In general, indicators of corporate leverage can have total debt, total liabilities or total long-term debt as the numerator; and equity, capital (defined as debt plus equity), or assets as the denominator.

Table 4. Indicators for the Corporate Sector

	BS (01)	BPS (00)	SW (01)	Fitch	S&P
Leverage					
Total liabilities to equity				X	
Total debt to total assets	X		X		
Total debt to equity	X			X	
Total debt to capital	X				X
Long-term debt to equity	X				
Total debt to market value of equity		X			X
Total debt plus off-balance sheet liabilities to capital plus off-balance sheet liabilities					X
Profitability					
Return on equity					X
Return on assets				X	
Operating income to sales				X	X
Cash flow adequacy					
EBIT to interest expenses	X			X	X
EBITDA to interest expenses					X
Debt payback period				X	
Liquidity					
Current ratio	X			X	
Quick ratio	X				

Legend: BS: Begum and Schumacher; BPS: Barnhill, Papapanagiotou and Schumacher; SW: Stone and Weeks; Fitch: Fitch IBCA; S&P: Standard & Poor's.

65.   Standard and Poor's (2000) discusses the limitations of some of these indicators. First, traditional measures focusing on long-term debt have lost much of their significance since companies rely increasingly on short-term borrowing. Second, the ratios suffer from difficulties in estimating the true economic value of assets.[47] Third, off-balance sheet items

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[47]Methods to mark asset values to market can be used, although they have shortcomings even at the individual firm level, and are hardly feasible at the aggregate level. Similarly, market values of equity are sometimes used, but these also have shortcomings as stock prices have a short-term bias, are correlated to alternative investment opportunities and are highly volatile, and may ultimately not reflect a company's ability to service its debt.

should be factored into the analysis of leverage, such as operating leases, guarantees, contingent liabilities and securitization (e.g. of accounts receivable). Fourth, the type of equity matters. For instance, many preferred stock issues have characteristics that make them quasi-debt in nature—such as fixed redemption dates, fixed dividend requirements, and on occasion higher redemption values. Fifth, as Begum and Schumacher (2001) point out, broad indicators such as the ratio of total liabilities to total assets do not provide a good measure of risk of default, but are rather a proxy of what is left for the shareholders in case of liquidation. Sixth, corporate debt-equity ratios depend on countries' legal and accounting definitions of debt and equity, and are not easily comparable across countries.

66.   Profitability is a critical determinant of corporate strength, affecting capital growth, attraction of equity, operating capacity, ability to withstand adverse events and, ultimately, repayment capacity and survival. Sharp declines in corporate sector profitability, for example as a result of economic deceleration, may serve as a leading indicator of financial system distress. The most significant measures of profitability include (1) return on equity (earnings before interest and tax (EBIT) to average equity); (2) return on assets (EBIT to average assets); and (3) operating income to sales (EBIT to sales).[48] While the absolute levels of these ratios are important, it is equally important to focus on trends. Moreover, profitability information is particularly affected by market structure—that is, industry characteristics, competitive environment and pricing flexibility—implying that the analysis of these indicators would be best performed at the subsectoral level.

67.   Earnings are also viewed in relation to a company's burden of fixed charges. Cash flow adequacy is often measured by the coverage ratio—earnings to interest expenses (interest payable less interest capitalized).[49] Earnings can be measured before interest and taxes (EBIT); or before interest, taxes, depreciation and amortization (EBITDA).[50] This ratio measures the risk that a firm may not be able to make the promised fixed payments on its debts, and can reflect the closeness to corporate financial distress better than corporate leverage. In addition to the interest coverage, other measures are often considered important, such as the debt payback period (total debt to discretionary cash flow). All these ratios are

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[48]Care should be taken to identify cyclical movements in corporate sector profitability.

[49]Interest expenses should be calculated to include leasing costs. Also, ideally earnings should be adjusted to arrive at cash flow available for operations (e.g., by amending for noncash provisions and contingency reserves, asset write-downs which do not affect cash, and blocked funds overseas). See Moody's (1998).

[50]A recent study by Moody's (2000) concludes that the use of EBITDA interest coverage ratios can be misleading, notably as they (1) overstate cash flow in periods of working capital growth; (2) can be manipulated through aggressive accounting policies; (3) do not consider the amount of required reinvestment; and (4) say nothing about the quality of earnings. EBITDA, however, remains a legitimate tool for analyzing poorly performing corporations.

particularly critical in the analysis of corporate financial strength in distress situations.[51] A description of the main cash flow items is contained in Table 5.

68.   Corporate liquidity determines the sector's ability to carry out business without endangering credit quality. Liquidity ratios include: (1) the current ratio—current assets (cash and accounts receivables) to current liabilities (debt and other liabilities coming due within a year); and (2) the quick ratio or acid test—current assets minus inventories to current liabilities. It should be noted that the current ratio is influenced by inventory valuation methods, which make international comparison particularly problematic.

Table 5. Cash Flow Summary

Funds flow from operations
        + (–) decrease (increase) in noncash current assets
        – (+) decrease (increase) in nondebt current liabilities
= Operating cash flow
        – capital expenditure
= Free operating cash flow
        – cash dividends
= Discretionary cash flow
        – acquisitions
        + asset disposals
        + (–) other sources (uses) of cash
= Prefinancing cash flow

Source: Standard & Poor's (2000).

69.   Assessments of corporate sector vulnerability should also measure the ratio of corporate foreign currency debt to total debt, since significant currency depreciation could put severe pressure on those banks whose clients have large foreign exchange debt-servicing burdens. This applies to both firms borrowing domestically in foreign currency, and firms turning to foreign forms of financing.[52] Similarly, the ratio of foreign liabilities to foreign assets of the corporate sector may also be useful as foreign currency debt that is not matched with foreign currency earnings also increases the vulnerability of the corporate sector.[53]

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[51]Ratios such as funds flow from operations to total debt (and other off-balance sheet liabilities) are more meaningful in assessing long-term profitability trends of corporate entities and sectors.

[52]In some cases, strengthened financial sector supervision may create relative incentives for firms to borrow abroad, thereby shifting foreign exchange exposure-related vulnerabilities to the corporate sector.

[53]In the case of foreign exchange (as well as interest rate) exposures, swaps, caps and hedges are tools that can significantly affect corporate financial positions.

70.   Despite the growing theoretical and empirical literature on the subject, aggregate corporate sector balance sheet and income data remain limited at best, in quantity and timeliness—a fact that in itself limits the scope of research. As regards quantity, the data is usually available—at the disaggregated level—for listed companies only. This may bias the sample significantly, although the direction of this bias is theoretically ambiguous, and empirically it is likely to differ from market to market. As regards data quality, accounting quality determines to what extent the picture determined by corporations' accounts, individually or at the aggregate level, can be relied upon as an accurate and comparable indicator of corporate strengths and weaknesses. Accounting quality can be assessed by looking at a country's accounting policies, including consolidation principles, income recognition rules, valuation (including inventory pricing) and depreciation methods, and goodwill treatment.

⇒   *A number of key indicators of corporate soundness emerge from this section. They include total debt to equity as a measure of leverage; EBIT to average equity as a measure of return to equity; EBIT to interest and principal payments as a measure of debt service coverage; and corporate foreign currency debt to foreign current assets as a measure of vulnerability to foreign exchange risk. Measures of liquidity, such as the current and quick ratios, can also be useful in assessing the corporate vulnerabilities.*

C. The Household Sector

71.   While banks are often more exposed to companies than to households, the size of the exposure to the latter can be substantial, particularly in the most advanced economies. Furthermore, household consumption behavior has a strong effect on banks' main credit customers—the corporate sector—and household asset allocation decisions can impact bank liabilities and asset prices. This section reviews the literature on linkages between the household sector and financial intermediaries and markets, and discusses recent approaches to monitoring household developments that are relevant for financial system soundness.

Household behavior and vulnerability

72.   Two types of models are most relevant for explaining the linkages between households and the financial system—those that analyze household saving and borrowing decisions and those that explain their asset allocation.[54]

73.   Household consumption and saving decisions are influenced by the availability of bank credit. There is an extensive empirical literature on the importance of current disposable income and household debt to future consumption. A recent study by Murphy (1998) finds

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[54]Household consumption patterns can also be a leading indicator of corporate and financial sector distress. For example, there is some evidence that consumers react at an early stage to macroeconomic shocks such as higher interest rates, notably in their demand for housing and consumer durables. See Bernanke and Gertler (1995).

that in the United States the ratio of debt service to income is a statistically significant predictor of future consumer spending and income growth: a high debt service ratio sustained over several quarters precedes reductions in the rate of growth of consumption and income (although with an elasticity of significantly less than one). He argues that this can be explained by a reduction in bank lending in response to a rise in household debt burden that directly affects consumption (especially of durables goods) and indirectly affects income growth. Empirical evidence on this point, however, is not conclusive.[55]

74.   Financial institutions typically react to changes in macro and household financial variables (such as earnings, collateral, debt levels) by restricting access to credit if these variables signal changes in the borrowers' capacity to repay their obligations. Liquidity constraints may affect the composition of household balance sheets, especially the leveraged purchases of consumer durables and residential housing, and the preference for liquid assets. This in turn may affect the corporate sector—as household consumption has a large impact on domestic output and household participation in the equity market may affect the ability of firms to raise funds for investment. Thus, banks are exposed to households directly, through their repayment capacity on consumer and mortgage loans, as well as indirectly through the effect that household consumption decisions have on corporate sector financial strength.

75.   Banks are also exposed to households through the liabilities side of their portfolios. The decision to deposit savings in financial institutions is part of the portfolio allocation behavior of households, which is a function of the supply and demand of assets based on current wealth, and of households' risk propensity.[56] Household deposits typically provide banks with the most stable and low-cost source of funding. Since in principle these funds may be withdrawn rapidly, the stability of household deposits is very important given the often-substantial maturity gap that arises from banks' intermediation function (i.e., channeling short-term savings into longer-term investment). Stability is a function of the confidence households have in the individual institutions and the financial system as a whole. While direct measures of consumer confidence in the financial sector are difficult to identify, indirect measures that focus on bank liquidity are available, such as changes in the level or volatility of savings deposits or changes in the interest rates paid.[57]

Household indicators

76.   The vulnerability of households may be assessed through the use of sectoral balance sheets, flow of funds, and other macro and microeconomic data. Table 6 presents indicators

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[55]For instance, a recent paper by De Ruiter and Smant (1999) finds that in the Netherlands high debt ratios do not slow durables consumption.

[56]In particular, portfolio diversification reduces risks to household income. This underscores the need to monitor the composition of household balance sheet, not just net wealth, to better gauge vulnerabilities.

[57]For a discussion of bank liquidity indicators, see Chapter II.B.

Table 6. Household Indicators used in Norway, Sweden, and the United Kingdom

NORWAY

National accounts and financial market data
    Wage income and disposable income trends
    Savings trends
    Interest expenses to cash income
    Interest expenses to interest income excluding interest on insurance claims
    Gross loan debt to disposable income
    Gross loan debt to gross claims excluding insurance claims
    Gross loan debt to value of housing wealth
    Composition of financial assets (deposits, securities, equities)
    Composition of interest bearing debt
    Net investment in financial assets to disposable income trends

Micro data
    Interest and debt burdens classified by age, socio-economic conditions (e.g., employment status), and income categories

SWEDEN

Risk build-up indicators
    Lending to households by categories of financial institutions
    Lending by type of credit
    Lending by income deciles
    Housing prices
    Employment and income
    Stock prices

Repayment ability indicators
    Wages, real disposable income, and wealth
    Interest cost after tax to disposable income
    Household debt to disposable income

UNITED KINGDOM

Leverage indicators
    Total and mortgage interest payments as a proportion of personal disposable income
    Total lending (debt stock) to the household sector as a proportion of residential and financial wealth.
    Secured and unsecured debt as a proportion of residential and financial wealth
    Net financial wealth
    Real household income

Financial distress indicators
    Personal bankruptcies
    Mortgages in arrears to total mortgages

Potential threat indicators
    Housing prices, including asset bubbles as measured by the ratio of housing prices to earnings
    Interest rate changes
    Unemployment

Source: Begum, Khamis, and Wajid (2001).

used and approaches taken by three central banks in monitoring developments in the household sector. These indicators tend to follow from the variables highlighted by the literature as important: wealth, current income, debt, and asset prices. Indicators include debt to GDP or to assets, and debt burden (principal and interest payments) to disposable income. Some of the other indicators used follow from credit risk analysis (see Chapter IV.A), such as the ratio of debt to collateral value (important for mortgage loans).

77.   Most of the analysis of the vulnerability of the household sector is primarily focused on direct bank exposure and thus relies heavily on debt-servicing capacity. However, the other indicators on asset composition highlight the concern that households may be significantly exposed to equity and real estate price movements.

78.   One potentially useful approach to look at the linkages between households, firms, financial institutions and the macroeconomy at the empirical level is that of using national sectoral balance sheets (see Chapter IV.C). Sectoral balance sheets permit the examination of a comprehensive set of linkages between households, firms, financial institutions, the public sector and the rest of the world, and can potentially help to better understand the complex interactions among these sectors. This approach, however, is limited by data availability.

⇒   *Due to the direct and indirect exposure of financial institutions to the household sectors, indicators of household financial strengths and vulnerabilities are important in assessing financial institutions' soundness and resilience to shocks. Key indicators of financial strength of the household sector include household indebtedness to GDP and household debt burden to income. These indicators should be complemented with detailed data on financial institutions' credit outstanding to the household sector.*

D. Real Estate Markets

79.   In many countries, unbalanced real estate developments have contributed to financial sector distress. Notwithstanding their importance from a macroprudential standpoint, analyses of developments in the real estate markets are rarely undertaken on a systematic basis. This section presents some evidence on the link between macroeconomic developments and real estate prices and between the real estate sectors and financial sector soundness.

Macro-financial linkages

80.   Rapid increases in real estate prices—often fueled by expansionary monetary policies or by large capital inflows—followed by a sharp economic downturn, can have a detrimental impact on financial sector profitability and health, by affecting credit quality and the value of collateral. The literature on real estate market developments can be categorized into three groups: papers that explain how real estate markets function in normal circumstances, those that focus on the emergence of price bubbles, and those that study the (over)exposure of the financial system to risky real estate loans.

81.   In well-functioning markets, the price formation process should equilibrate supply and demand and the fundamental equilibrium price would be the price at which the existing stock of real estate equals replacement costs.[58] If the price of real estate is above (below) the replacement cost, construction will increase (decrease) until the market regains equilibrium—i.e., the adjustment of stock of real estate takes place in the construction sector. An increase in the number of investors, the existence of optimistic investors, an increase in the number of office workers or other similar events can trigger an outward shift of the demand curve, and the new equilibrium will move to a higher level. In well-functioning markets, real estate cycles will be driven by normal economic cycles, due to the changes in expected growth in income, real interest rates, taxes, future demographic profile, etc.[59]

82.   Growth in construction in excess of income growth and other fundamentals may be related to price bubbles that develop from credit booms. A number of mechanisms can trigger or amplify the appearance of cycles and bubbles in real estate markets, some due to nonfinancial characteristics of real estate markets, others to the lending behavior of banks.[60] These include: (1) fixed supply and the behavior of investors willing to purchase property in periods of rising prices; (2) construction time lags in the adjustment of property supply to increasing demand; (3) the impact of rising real estate prices on loan collateral values; (4) moral hazard in the form of over-guaranteed and under-regulated financial institutions, leading to risky behavior and high investment and asset prices; (5) increased competition for financing risky real estate projects subsequent to financial liberalization; (6) rising real estate prices resulting in greater lending to the real estate sector, as a bank's own holdings of real estate—hence its capital—increase in value.

83.   The arguments above suggest that the higher the exposure of banks to real estate, the more amplified the cycles in real estate markets. Still, banks seem to underestimate the risks associated with high exposure to this sector due to the following factors:

- *Disaster myopia or low frequency of shocks*: Real estate cycles are often long and a whole generation may have passed since the last severe downturn in prices. During a boom period, profitability in terms of (expected) returns is high and the risks are underestimated.

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[58]Di Pasquale and Wheaton (1996).

[59]International Monetary Fund (2000a), in particular Chapter III on "Asset Prices and the Business Cycle."

[60]Real estate markets are characterized by heterogeneity, consisting of a series of geographical and sectoral submarkets that lack a central trading market. No two properties are identical and information on market transactions is often limited and not generally available. Also, real estate markets are typically characterized by infrequent trades, a negotiated pricing process, large transaction costs, and very rigid supply. In contrast to stock markets and other financial markets there is, therefore, no clear market price.

- *Inadequate data and weak analysis*: Even under the best circumstances, it may be difficult to estimate the present value of a real estate project. It will depend, among other things, on projected rents, discount rates, anticipated inflation, loss in value due to depreciation and vacancies due to the development of competing projects. In many countries data on building permits, new construction contracts, rents, market prices and vacancy rates are not readily available or difficult to obtain and verify.

- *Perverse incentives or moral hazard* resulting from a combination of highly leveraged real estate developers and asymmetric information may lead to bank financing of real estate projects that are riskier than if they were financed largely through equity—as developers will initiate riskier projects when they can shift most of the downside risk to banks. This is more likely to occur in economies with highly leveraged banks, poorly designed financial safety nets and weak supervision, and/or weak corporate governance.

84.   Empirical analysis so far on the link between real estate market developments and banking distress has been limited. A recent Fund study reviews the experience of 13 cases of extreme price swings in the real estate market associated with increased banking sector vulnerability.[61] The authors find a strong correlation between real estate price developments and credit growth—real estate booms are generally preceded or accompanied by a boom in banking credit to the private sector, and busts by a strong contraction of credit growth. This supports the notion that the availability of financial resources is one of the driving forces of prices in this market.

85.   The empirical results also show that in most of the cases studied, real estate prices surged sharply and began falling prior to the beginning of financial distress.[62] On average, residential real estate prices corrected for inflation rose more than 20 percent from seven to two years before the beginning of financial distress and then fell by more than 15 percent two years prior to the beginning of financial distress and then continued to fall at least until the peak of the crisis. A similar pattern can be observed for commercial property prices in most countries for which there is data. For the few cases where data on stock prices of real estate companies are available, there is a tendency for these prices to fall drastically before a banking crisis and to bottom out or stabilize by the onset of crisis. A logit-probit analysis of episodes of banking distress and real estate price developments finds that a downturn in residential real estate prices adds about 6–7 percent to the probability of banking distress.[63]

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[61]Hilbers, Lei, and Zacho (2000).

[62]Cross-country comparisons of real estate developments, however, are complicated by differences among countries in financing structure, tax structure and the use of real estate as collateral.

[63]Commercial real estate prices were not analyzed due to the scarcity of data.

86.   Case studies highlight the role that shocks to output and monetary conditions, combined with weak capital positions of banks, can play in increasing the vulnerability of the financial system to real estate market price swings. However, the lack of high frequency data on real estate markets and poor data on credit exposure (and NPLs) to the real estate sector for most of the countries prevents more thorough analyses.

Real estate indicators

87.   Ideally, a range of indicators should be analyzed to get a sense of real estate market developments (demand, supply, prices and links to the business cycle) and to assess financial sector exposure to the real estate sector (Table 7).

88.   To determine the exposure of the banking sector to the real estate sector, it is important to have information on the size of the credit exposure and the riskiness of the exposure. To accomplish the latter, it may be necessary to distinguish between different types of real estate-related loans, which may have very different risk characteristics. For example, it would be useful to distinguish between lending: (1) for the purpose of investment in (purchase of) commercial real estate; (2) for the purpose of investment in residential real estate, including mortgages; (3) for the purpose of real estate construction, or more generally, to construction companies; and (4) collateralized by real estate. The degree of risk involved could be estimated by the average probability of default as well as the default recovery rate for the different types of debt, as in Barnhill, Papapanagiotou and Schumacher (2000).[64] A critical aspect of this analysis is the ratio of loan to value (where value is equal to market value of equity for firms, and to housing value for mortgages and collateralized loans). Default is likely to occur when the loan to value ratio exceeds a threshold that can be estimated from historical series. An alternative would be to use the NPL ratio as the expected default rate for the different types of loans.

89.   A major obstacle to in-depth analyses of real estate markets is the availability of data, in particular for emerging markets. No major international database provides data on real estate prices or other indicators of developments in real estate markets. The Bank for International Settlements (BIS) maintains a small database with annual residential and commercial property prices for 17 industrialized countries, but only part of the data is publicly available. In some advanced and emerging markets, real estate indicators are available from commercial sources, generally focusing on the largest cities and covering prices (sales and rentals) as well as current and forecasted supply, demand and vacancy rates. Sectoral breakdowns cover industrial, commercial, retail and residential space. These data are heterogeneous: differences exist with respect to timeliness, assets considered, quality and coverage.[65] Finally, financial sector data on the exposure of the financial system to real estate

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[64]See Chapter II.C for details.

[65]In particular, some commercial property indices cover only offices, others include retail property as well as property used for production and storage. There are also technical differences, such as the weights used to combine different localities and qualities of property, as well as whether the mean or the median price in the sample is chosen.

markets is also difficult to obtain, and the quality and definition of such indicators varies significantly.

Table 7. Real Estate Indicators

Indicator	Definition and measurement issues
Prices	
Real estate price index	In equilibrium, price would equal cost, thus this price index can be compared to the construction cost index to assess the incentive to build. Subindices that reflect developments in subsectors (commercial, industrial and residential) or geographical areas are also useful in assessing exposure to real estate.
Construction cost index	Could proxy for fundamental prices under certain conditions; however, market imperfections and inclusion of other non-construction costs in the index often drive replacement costs away from fundamental prices.
Rents	In principle, the present discounted value of future rents should equal the price of the property. However, the path of rents may be difficult to predict and rents may include other services, such as utilities, which drive the discounted value of today's rents away from fundamental prices.
Land prices	Since land is in fixed supply, speculation will be reflected in rapidly rising land prices at rates higher than construction costs. Thus, land prices could be indicators of the development of bubbles.
Supply and demand	
Property stock available	Current supply of property
Vacancy or occupancy rates	Gap between demand and supply
Number/value of new buildings	Additions to current supply
Number/value of sales	Indication of current demand. In particular, the number and value of sales in a given period divided by the stock of supply at the beginning of the period provides an indicator of the tightness of the market.
Stock price indices	The stock price of real estate firms should equal the present discounted value of profits; changes in the index could signal changing perceptions on sector profitability.
Exposure to the real estate sector	
Loans outstanding	While this may give a broad indicator of exposure, different types of real estates loans (e.g., residential mortgages, commercial mortgages, loans to construction companies, other loans collateralized by real estate) may have different characteristics.
Loan-to-value	This ratio is an important indicator of the probability of default.
NPLs	This indicator could act as a proxy for the expected default rate.

⇒   *A number of key indicators of financial institutions' exposure to real estate markets emerge from this section. They include the loans outstanding to the real estate sector to total loans, possibly supplemented by data on nonperforming loans to the sector (as a share of total real estate loans). The usefulness of these data, however, is often limited by the fact that different types of real estate-related loans have very different risk characteristics. Moreover, it is important to monitor developments in real estate markets, particularly prices, for both residential and commercial real estate.*

IV. ANALYTICAL METHODS

90.   Having discussed specific FSIs, the next step is to look at methods to analyze these indicators. Much attention has been devoted recently to this issue. The methods described in this section include stress testing, Value-at-Risk (VaR) models, and sectoral balance sheet analysis. Particular attention is paid to data requirements for, and information obtained through, the different analytical methods.

A. Stress Testing Financial Systems[66]

91.   Stress testing is a key element of macroprudential analysis that helps to monitor and anticipate potential vulnerabilities in the financial system. It adds a dynamic element to the analysis of FSIs—that is, the sensitivity, or probability distribution, of FSI outcomes in response to a variety of (macroeconomic) shocks and scenarios.[67] By anticipating the potential impact of specified events on selected FSIs, stress tests also help to focus on financial system vulnerabilities arising from particular banking system, macroeconomic, and sectoral shocks.

92.   The type and range of FSIs used in stress tests depend on model specification. In simple models, the impact of changes in a macroeconomic variable (such as a slowdown in GDP, which increases credit risk) is measured in terms of resulting changes in the FSI capturing banks' exposure to that risk (such as nonperforming loan ratios). In more sophisticated models, the impact of shocks is measured in terms of changes in capital adequacy ratios. The channels through which shocks ultimately affect capital adequacy would usually involve indicators of bank sensitivity to market risks, asset quality and

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[66]This section is based on Blaschke, Jones, Majnoni, and Martinez Peria (2001). For details on stress testing by large financial institutions, see Committee on the Global Financial System (2000, 2001).

[67]Commonly tested shocks include a slowdown in economic growth, balance of payments shocks, and changes in inflation, interest and exchange rates. Equity and security price shocks may also be important, particularly in the most advanced countries were banks and bank borrowers have significant capital market exposures. It is important to identify shocks that are representative of past country experiences, or that are justified by observed volatilities and correlations in the data.

provisioning, liquidity, and profitability. The results of stress tests provide information on the elasticity of a given FSI to macroeconomic shocks, and such elasticity can itself be used as an indicator of bank vulnerability to individual risks or a combination of risk factors.

Exogenous shocks

93.   There are important macro-financial linkages and co-movements between real and financial variables. While these are obviously two-way linkages—shocks can have a negative impact on the health of debtors and creditors, which in turn can have an adverse impact on macroeconomic performance—stress tests focus on the former linkage: the impact of macroeconomic shocks on the health and stability of the financial system, and of the banking sector in particular.

94.   Several studies have analyzed the types of shocks or changes to the macroeconomic environment that may be important in increasing the vulnerability of financial systems. In the aftermath of the Asian crisis, a wave of financial sector studies confirmed that macroeconomic shocks to output, exports, prices and the terms of trade, asset price booms, and inappropriate monetary and exchange rate policies, all resulted in financial pressures and contributed to crises in financial systems that are inherently fragile.[68] More recently, Johnston, Chai and Schumacher (2000) and Blaschke, Jones, Majnoni and Martinez Peria (2001) identify a number of shocks that are typically considered when assessing financial systems' resilience using stress tests. These include higher interest rates, foreign exchange devaluation, higher inflation, lower growth rates, and unfavorable changes in the terms of trade. Blaschke, Jones, Majnoni and Martinez-Peria (2001) review the experience of conducting stress tests in the context of the joint Bank-Fund Financial Sector Assessment Program (FSAP), and conclude that the impact of these types of macroeconomic shocks on the banking system can be significant.

- *Credit shocks.* Macroeconomic factors that have been found to help to explain the behavior of the NPL ratio include the real interest rate, the terms of trade, the exchange rate, GDP growth and real estate prices. This evidence is based on a limited number of countries, however, and should be considered as a starting point in the analysis, rather than a definitive relationship.

- *Liquidity shocks.* Withdrawal of deposits or credit lines may cause a liquidity shock to financial institutions. Liquidity shocks may also be correlated to other shocks and indirectly affect bank liquidity. For example, during currency attacks, banks may face a liquidity crisis as depositors withdraw their funds from the banking system to purchase foreign currency. Hence, financial institutions may lose access to both domestic and foreign exchange funding during a currency crisis.

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[68]For a complete review of this literature, see Evans, Leone, Gill, and Hilbers (2000).

- *Interest rate shocks*. For interest rate risk, shocks may take the form of a parallel shift in the yield curve, a change in the slope of the yield curve, and a change in the spread between different interest rates with the same time horizon. These shocks typically affect the level of interest rates, but may also increase their volatility and correlation. Larger shocks may take place particularly in countries with illiquid money and capital markets as well as those that are vulnerable to currency crises.

- *Exchange rate shocks*. Shocks to one or more exchange rates can affect financial institutions' soundness, depending on their type of exposure. Switches in currency regimes, capital account liberalization, increasing use of derivatives, changes in regulation and supervision, and the entry of foreign banks are all factors that can make a difference in how a financial system reacts to a foreign exchange shocks. In countries where domestic lending in foreign currency is allowed, exchange rate fluctuations can have direct as well as indirect impacts, as some borrowers may be exposed to currency risk that translates into credit risk for the lender (see Chapter II).

- *Equity price shocks*. Particularly in the more advanced countries, banks have significant direct and indirect exposures to capital markets as a result of their own investment and trading portfolios and those of their borrowers. In addition, adverse developments in these markets can result in a marked general economic slowdown and, consequently, lead to deterioration in the credit quality of the loan book. Shocks related to adverse capital market developments can be measured by market-based indicators such as stock market prices and credit spreads.[69]

Designing stress tests

95.   Individual portfolio stress tests aim at assisting in managing risks within a financial institution and ensuring the optimal allocation of capital across risk-taking activities.[70] A good stress test needs to be relevant to the current portfolio, include all relevant market rates, encompass potential regime shifts and market illiquidity, and consider the interaction of different risks. Specification issues include: (1) the type of risk or risks to be considered and appropriate models to be used; (2) the range of factors to be considered—a single factor sensitivity test or the simultaneous movement in a group of risk factors as in scenario analysis; (3) the specification of the type of shock (i.e., whether the shock affects the level, volatilities and/or correlation of prices), the size of the shock, and the time horizon; (4) the assets to be included; (5) whether to use historical prices, hypothetical prices or Monte Carlo-

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[69]For examples of market-based indicators for the United States, see Nelson and Passmore (2001).

[70]The Committee on the Global Financial System (CGFS) has recently undertaken a global census of stress tests in use at major financial institutions. See CGFS (2001).

simulated prices;[71] and (6) the aggregation (across business units and/or product lines) of the portfolio. Figure 2 provides a summary of these specification issues.

96.   Aggregate stress tests are measures of the risk exposure of a group of institutions to a specified stress scenario. Their aim is to help to identify structural vulnerabilities and overall risk exposures in a financial system that could lead to the disruption of financial markets. The emphasis is on potential externalities and market failures. Aggregation of stress testing scenarios has the potential to expose the vulnerability of a system to simultaneous attempts by firms to reduce exposures—a cumulative effect on market liquidity usually not captured by individual portfolio stress tests.

97.   Stress testing of financial systems presents various methodological challenges. It is difficult to decide the scope of the test and to clearly delineate aggregate portfolios that are systemically important. In practice, (1) complex interlocking claims among financial institutions make it difficult to take aggregate net positions at face value (i.e., interbank claims may represent a small net aggregate position, but the gross positions may be systemically significant); (2) a narrow focus on "systemically important" institutions (e.g., banks, if nonbanks do not present a systemic threat) may be more manageable, but may overlook potential vulnerabilities; and (3) inclusion of foreign-owned banks requires knowledge on the stability of the parent group.

98.   Other challenges include aggregation issues and the choice of models. Aggregation of stress tests may be accomplished either by compiling the results of stress tests of individual portfolios—which may not be comparable if the tests were conducted using different methodologies—or by applying a common stress test to a aggregated portfolio—which may suffer from less detailed knowledge of the individual institutions. Finally, while the aim of an aggregate stress test is to identify structural vulnerabilities (i.e., externalities and market failures), the tools for quantifying these effects in a simple measure are not yet well developed.[72] Bearing in mind these limitations, approaches do exist that can be used in conducting assessments of financial system soundness.[73] Data availability and the sophistication of the financial system largely determine the approach to be used in each country with respect of each relevant risk.
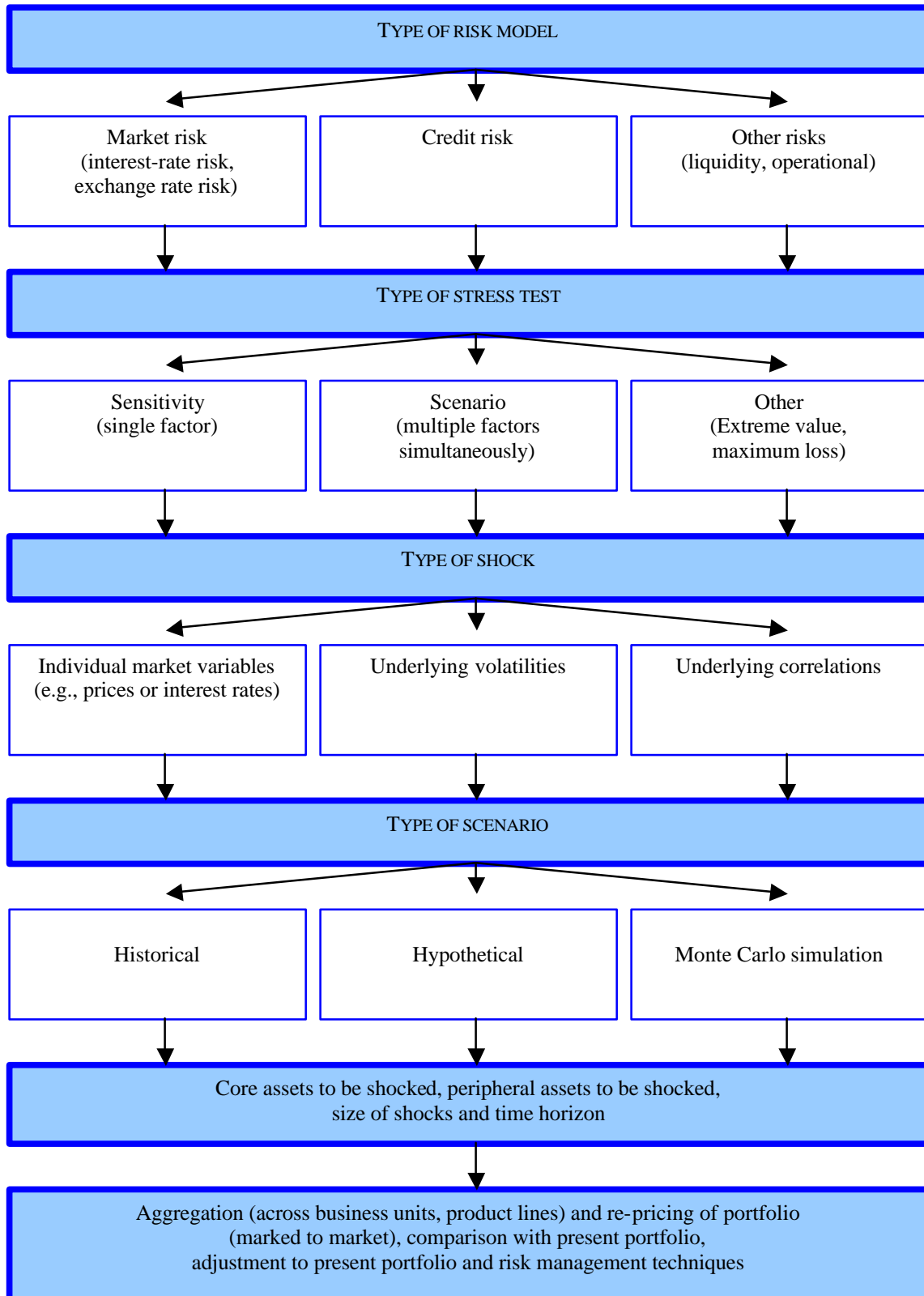
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[71]The Monte Carlo method is a stochastic technique that generates prices by performing repeated statistical sampling experiments from random numbers. It approximates the market's price-generating process.

[72]For instance, results from the most complex simulation techniques may be strongly model-dependent and sensitive to the parameter used.

[73]For a detailed discussion of these approaches, see Blaschke, Jones, Majnoni and Martinez Peria (2001).

Figure 2. Decision Sequence for Stress Testing

TYPE OF RISK MODEL

Market risk (interest-rate risk, exchange rate risk)	Credit risk	Other risks (liquidity, operational)

TYPE OF STRESS TEST

Sensitivity (single factor)	Scenario (multiple factors simultaneously)	Other (Extreme value, maximum loss)

TYPE OF SHOCK

Individual market variables (e.g., prices or interest rates)	Underlying volatilities	Underlying correlations

TYPE OF SCENARIO

Historical	Hypothetical	Monte Carlo simulation

Core assets to be shocked, peripheral assets to be shocked, size of shocks and time horizon

Aggregation (across business units, product lines) and re-pricing of portfolio (marked to market), comparison with present portfolio, adjustment to present portfolio and risk management techniques

Individual risk factor assessments

99.   Financial institutions face a number of risks—related to changes in credit quality, liquidity, interest rates, exchange rates, and equity and commodity prices. Stress tests typically consider these risks separately. The basic method in assessing the impact of each risk factor is to determine the exposure of the portfolio to each risk and then to estimate the change in the market value of portfolio that may result from a change in the risk factor (i.e., the risk sensitivity of the net exposure). This may be relatively straightforward in the case of spot foreign exchange holdings, but more complex for holdings that are expected to deliver cash flows over time (e.g., bonds and loans). The following sections briefly describe the different techniques that can be useful in assessing individual risk factors.

Credit risk

100.   Credit risk is the risk of default of a counterparty or obligor on its contractual obligations (i.e., the risk that principal or interest on an asset may not be paid in full according to contractual agreements). Measuring the credit risk of a portfolio of instruments involves the estimation of the likelihood of default on each instrument,[74] the extent of losses in the event of default, and the likelihood that other obligors will default at the same time (i.e., the joint distribution or correlation of defaults).

101.   Several estimation methods are available, including from commercial sources.[75] Most of these approaches, however, are microeconomic, and have limitations in estimating the impact on the financial system of a common external shock, and in detecting elements of systemic risk. A proper specification of the impact of macroeconomic factors on financial institutions would enable an analysis of different sources of credit risk in countries at different levels of economic development, of different sizes, and with different financial structures.

102.   One approach that helps to assess the systemic impact of macroeconomic shocks is the *nonperforming loan (NPL) approach*.[76] It uses time series of NPLs for homogenous groups of banks or borrowers as the dependent variable in a regression using macroeconomic factors as independent variables—such as nominal interest rates, inflation, GDP growth, and terms of trade. The coefficients of the regression provide an estimate of the sensitivity of bank borrowers to the relevant macroeconomic and financial risk factors. This approach also permits dynamic analyses of short-run and long-run (equilibrium) effects, for instance by using an error correction model. Assuming a linear risk exposure to the macroeconomic

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[74]For instance, the default mode approach uses an average default probability; and the mark-to-market approach uses a default transition matrix based on the borrower's credit rating.

[75]Theses include JP Morgan's *Creditmetrics*, Credit Suisse's *CreditRisk+*, and KMV's *Credit Monitor Model.*

[76]For details see Blaschke, Jones, Majnoni and Martinez Peria (2001).

variable, an expression of the volatility of NPLs can be derived as a function of the volatilities of the macroeconomic variables and the unexplained volatility. A major shortcoming of this approach is the lack of long and reliable time series for NPLs, in particular for transition and developing countries that are experiencing structural changes.

Liquidity risk

103.   There are two types of liquidity risk: asset liquidity risk and funding liquidity risk. The former refers to the inability to sell assets at current market prices because of the size of the assets and the short amount of time available for liquidation (a situation commonly referred to as "fire sales"). The latter refers to the inability to access sufficient funds to meet payment obligations in a timely manner. Two main methods are available to assess liquidity risk: the sources and uses of funds approach and the structure of funds approach.

- *The sources and uses of funds approach* defines as liquidity gap the difference between the sources and uses of funds: a deficit occurs when uses of funds exceed sources. This method requires forecasting of uses and sources of funds in any given liquidity planning period.

- *The structure of funds approach* looks at the structure of the sources and uses of funds. Future liquidity requirements are forecast by dividing bank deposits and other sources of funds into categories based on their probability of being withdrawn, and identifying the sources of funds that can become illiquid in certain situations.

Interest rate and other market risks

104.   *Interest rate risk* is the risk of loss by a financial institution when the interest rate sensitivity of its assets and liabilities are mismatched. Simple methods such as *gap analysis*—including the repricing model, the maturity-gap model, and the duration model—can be used to assess this risk (see also Chapter II.B). Gap analysis requires the compilation of a maturity (or repricing) schedule for all assets and liabilities.[77] The "gap" is the difference in interest flows on the holdings of assets and liabilities in each time bucket, measured in terms of net assets for the repricing model. In the maturity gap and duration models, the "gap" is the difference in the maturity of assets and liabilities, measured in terms of weighted maturity for the maturity-gap model and average life for the duration model. In the simple repricing model, the value of assets and liabilities does not change with a change in interest rates, while in the more complex duration model the value of assets and liabilities change according to the interest elasticity of each asset or liability. The duration model provides

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[77]For the simple repricing model, this requires the sorting of assets and liabilities according to their time to repricing for floating rate instruments, and remaining time to maturity for fixed rate instruments; net assets are then classified in a limited number of time categories or "buckets." For the duration model, it is necessary to know the timing of future cash flows, which may also be grouped into different buckets.

more accurate estimates of the change in the market value of a portfolio due to changes in interest rates.[78] However, its additional data requirements (i.e., the cash flow profile and expected change in the interest rate term structure) make it difficult to use in countries with less sophisticated statistical systems.

105.   Exchange rate and equity price risks can be assessed by calculating net open positions (see Chapter II.B). *Exchange rate risk* is the risk that exchange rate changes will affect the value of an institution's assets and liabilities (both on- and off-balance sheet), capital position and income. *Equity price risk* is the risk that stock price changes will affect the value of an institution's portfolio. It has a specific and a general component. A risk is specific when it is associated with movements in the price of an individual stock. It is general when it is related to movements of the stock market as a whole. *Commodity price risk* refers to the potential losses that may result directly from changes in the market price of bank assets, liabilities, and off-balance sheet instruments, as well as indirectly through the loan portfolio, due to commodity price changes. Even if financial institutions do not take positions in commodities or commodity-linked instruments directly, they may be subject to commodity price risk indirectly via the impact on their loan portfolio. This occurs if the borrowers' ability to repay their debt is affected by shocks to commodity prices. This indirect source of commodity risk can be particularly important for many banks in developing countries that lend to exporters and/or importers of commodities.

B. Value-at-Risk Techniques

106.   The Value at Risk (VaR) framework is a multivariate approach to risk assessment that is used to capture multiple risks arising under normal market circumstances. The VaR is an estimate of the maximum loss on a portfolio with a given probability over a preset horizon.[79] It is used in financial institutions as a risk management tool to set limits to the amount of risk that is undertaken, typically, in the trading book. VaR techniques can complement stress tests in that the latter are used to measure risks arising at the tail-end of the distribution of market circumstances under which financial systems operate.

107.   There are two broad approaches to estimating a VaR. The local valuation method uses an estimate of the sensitivity of the portfolio multiplied by the estimated price change to arrive at the estimated change in value of the portfolio. The full valuation approach recalculates the value of the portfolio using historical or Monte Carlo simulations of prices. The correlations and volatilities used for a VaR calculation can be based on historical or on implied observations.

108.   VaR techniques are usually applied to the measurement of market risk, but they have also been used to assess credit risk. Barnhill, Papapanagiotou and Schumacher (2000) attempt to measure banks' integrated market and credit risks using a full-valuation VaR in

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[78]See, for instance, Saunders (2000).

[79]The estimate of maximum loss is dependent on the correct specification and estimate of the underlying statistical model of returns.

which the two types of risks are correlated. In their model, corporate credit risk is a function of leverage and the volatility of the firm's equity value. The paper simulates the financial environment as a probability distribution of 8000 scenarios, where under each scenario, each bank client has a different debt to equity ratio. These simulated debt to equity ratios are then mapped into credit risk categories and the value of each client loan is discounted by the (simulated) interest rate that corresponds to the credit risk category under each scenario (Table 8). Their methodology provides a base for evaluating potential changes in a bank's asset/liability portfolio composition (e.g., credit quality, sectoral and geographic concentration, maturity structure, currency composition) as well as its capital ratio.

Table 8. Data Requirements for an Integrated VaR Analysis

Financial Environment

- Time series of short-term interest rates or the credit spreads on the various quality loans to undertake volatility   and correlation analyses.
- Specific estimates of the term structure of interest rates for each currency, and credit risk level at the date of the risk   assessment.
- Prices for a set of interest rate options for each currency.

Portfolio Structure

- Asset/liability maturity mismatches that create interest rate risk.
- Asset/liability currency mismatches that create foreign exchange risk.
- Credit quality of governments, companies and individuals to which the institution has loaned money that affect the risk of adverse rating changes and default.
- The level of geographic and economic sector concentration (diversification) in the asset portfolio that   greatly affects portfolio credit risk.
- The level of seniority and security for the loans in the portfolio that substantially affects the recovery rates on loans   that may default.
- Off-balance sheet transactions that either reduce (i.e., hedge) or increase the institution's risk level.

Business Loans

- Each bank's business loan broken down, for each currency, by sector, credit quality, maturity, and yield.
- Estimates of typical debt to value ratios for loans of various credit quality broken down by sector.
- Balance sheets, income statements and credit classification for all large exposures.
- Time series of default rates on business loans by credit quality one (up to five) year prior to default.
- Estimates of loan default recovery rates by sector and seniority of loan.

Mortgage Loans

- Number and amounts of real estate loans broken down by loan-to-value ratios.
- Typical loan-to-value ratio at which mortgage loans default.

Other Securities and Money Market Deposits

- Amounts of government securities, equity securities, etc., broken down for each currency by type, credit quality, maturity, and yield.

Source: Barnhill, Papapanagiotou and Schumacher (2000).

109.   VaR techniques have several limitations, however.[80] The VaR measure is not the maximum amount that a portfolio could lose, rather it is a loss threshold that will be exceeded with only a small probability. VaR techniques can provide useful information to decision makers about the likely pattern of events that will influence the value of a portfolio, but they are less useful in providing information about unlikely events. In addition, the analysis is sensitive to the assumed distribution and underlying estimation techniques.[81] Data requirements for conducting VaR analyses are substantial, and the degree of detail required on individual positions makes it practical to apply this method to individual institutions only. In view of the variety of VaR techniques used in financial institutions, aggregating individual VaR results in a meaningful manner can be very difficult. For these reasons, the VaR framework is rarely used in conducting aggregate stability assessments.

C. Sectoral Balance Sheet Analysis[82]

110.   Sectoral balance sheet analysis is potentially useful in assessing vulnerabilities in the financial system from stresses elsewhere in the economy. Balance sheet analysis uses sectoral breakdowns in the national accounts for the following sectors: households, nonfinancial corporations, nonbank financial institutions, banking institutions, the government and the rest of the world. In addition to identifying the specific asset/liability components that may be particularly vulnerable to fluctuations in asset prices, interest rates and income flows, the balance sheets of all sectors taken together can help to clarify the linkages among sectors that could transmit financial disturbances. A useful, albeit partial, framework for such analysis is provided by the flow of funds accounts.[83]

111.   A number of countries have started to utilize sectoral balance sheet data in their assessments of financial stability. The approach used combines macro, micro and sometimes a market view of the sectors, focusing on the risk posed to the banking sector by the enterprise and household sectors. The macro approach uses sectoral balance sheet and flow of funds data including loan growth to enterprises, enterprise debt and interest rate burdens,

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[80]Blaschke, Jones, Majnoni, and Martinez Peria (2001).

[81]For example, the normal distribution is typically used, but if the true distribution has fatter tails, the VaR may underestimate possible losses. Also, linear approximations are commonly used to estimate changes in the value of the portfolio, but this may underestimate the VaR if movements in asset prices are large and the portfolio includes many assets with nonlinear payoffs (e.g., options).

[82]This section is based on Begum, Khamis and Wajid (2000).

[83]Flow of funds accounts link savings and investment in the national accounts with their associated lending and borrowing activities. Because they provide information on changes in assets and liabilities, these accounts are an important complement to balance sheet data.

sectoral trends in enterprise profits, profit margins and dividend payments, debt and interest burdens of households, financial wealth of households, and real income of households.

112.   While there is some merit in using sectoral balance sheets to form judgments about buildup of financial stress in some sectors and their implications for other sectors, there are also important limitations. Specifically, transactions based on balance sheet data are unlikely to provide an accurate picture of asset price movements and would not capture off-balance sheet items. A more robust analysis should be grounded in a comprehensive macro model specifying the behavioral features of assets markets and deriving sectoral balance sheets consistent with the flows and prices determined by the model.

113.   More generally, the usefulness of this approach is constrained by the very limited availability of data. In their recent review, Begum, Khamis and Wajid (2001) find that in the UN system of national accounts, sectoral balance sheet data are available only for two industrialized countries. Flow data on capital finance accounts by sector exist for only 15 countries (of which 12 industrialized), either from UN or OECD sources. Information on sectoral balance sheets from national sources is limited, and generally focused on banks and other financial institutions.

V. QUALITATIVE ASPECTS

114.   In carrying out financial sector assessments, it is important to evaluate how risk is managed by risk-taking units and how risk management is governed by regulatory authorities.[84] Different financial institutions have different risk appetites. Moreover, the level of risk-taking is strongly influenced by the particular institutional and regulatory framework of the financial system.

115.   As absolute risk levels may not by themselves indicate fully financial institutions' or a system's vulnerabilities, an implicit concept of "net risk" is often applied to the assessment of financial institutions' or system vulnerabilities.[85] This concept allows combining the quantitative and qualitative aspects of financial vulnerability.[86] The "net risk" approach

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[84]The linkages between the development of a sound banking system and well-functioning banking regulation and supervision are discussed in Sundararajan (1999). See also Sundararajan, Marston, and Basu (2001).

[85]For a description of a "net risk" approach to risk assessment in the context of dynamic banking supervisory practices, see Office of the Superintendent of Financial Institutions (1999).

[86]The importance of a healthy balance of quantitative and qualitative information in order to provide a meaningful picture of the extent and nature of financial risks has been recently highlighted by the Multidisciplinary Working Group on Enhanced Disclosure of the Financial Stability Forum (2001).

involves quantitatively evaluating all risks faced by financial institutions (including the direction of the risk assumed) and qualitatively adjusting for institutional characteristics to assess the extent to which the risks are adequately managed through market discipline and internal governance in an institution, and through regulatory and supervisory frameworks in the system as a whole. Such analyses can be synthesized into an overall risk assessment for individual institutions, and an overall stability assessment for the financial system, which evaluate the quantity of all risks against the quality of the institutions and institutional arrangements.[87] However, by definition, combining qualitative and quantitative aspects of risk is not an exact method and requires judgment.

A. Incentives

116.   There are many institutional characteristics of a financial system that need to be considered for qualitative adjustments to gross risk. The nature of government subsidies and taxes, payment culture and insolvency regime, credit and deposit guarantees, the quality of supervision and regulation, moral hazard, corporate governance, and management quality all affect the overall incentive structure of a financial system and need to be taken into account in qualitative adjustments.[88]

117.   An important aspect of the incentives structure is the legal framework. As all financial instruments are legal contracts, enforceability, recourse, and net expected returns are highly dependent upon a financial system's legal framework. If a country has a well-established commercial law with a court system well versed in financial litigation, legal risk is minimal. If it is not, qualitative adjustments to gross risk for these factors are essential.

118.   Even well-functioning legal systems require qualitative adjustments of risk. There are underlying differences of financial contract enforceability among common and codified legal systems. Such differences also affect the accounting systems used, and from which macroprudential indicators are derived. Differences in accounting information for common versus codified legal systems are derived in part from differences in stakeholders in economies with the two legal foundations. Under a common law system, the principal stakeholder is the corporate shareholder. Under a codified legal system, creditors, labor, government, and other interested parties may be the relevant stakeholders. Different stakeholders require different information, which affects construction of financial ratios.

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[87]It should be noted, however, that regulatory factors could influence the size and movement of FSIs, notably through the establishment of minimum regulatory ratios.

[88]The incentive audit approach, outlined by Johnston and Chai (2001), looks at three factors that affect the risk-taking and monitoring behavior of participants (investors, borrowers and intermediaries) at the core of the financial system: (1) market structure and the availability of financial instruments that affect market discipline; (2) government safety nets, including implicit and explicit exchange rate and deposit/investor guarantees; and (3) the legal and regulatory framework, including high quality enforcement.

119.   Assessing the incentive structure should also take into account the objectives of managers, owners, and directors of financial institutions. Such objectives may differ and profit maximization may not always be the main objective. An example of where differences can affect financial institutions' vulnerability is in the area of lending. Bank managers interested in expanding business may reward employees by a percentage of loan volume contracted. Since loan quality is typically determined much later in the process, such behavior can lead to strong loan growth and income in the short-run, with deterioration in loan quality and shareholder capital later on.

B.   Observance of Standards and Codes

120.   Assessments of observance and implementation of relevant financial sector codes, good practices and standards help to capture key qualitative aspects of financial system stability, and are needed to supplement quantitative assessments carried out in macroprudential analysis. Such assessments, in particular, capture how financial system risk is managed through regulatory and supervisory frameworks by analyzing the extent to which observance of existing standards helps to address the identified vulnerabilities and risks. Such analyses are routinely carried out as part of the FSAP/FSSA process.[89] In this context, they have helped countries to focus on key operational and supervisory risks and to identify needed corrective actions and institutional strengthening plans. They can also help to reveal the quality of FSIs—for instance, of capital adequacy ratios through the assessment of compliance with the Basel Core Principles for Effective Banking Supervision.

121.   The standards that have been assessed to date in the context of the FSAP/FSSA process—with country specific prioritization of which standards were most relevant for assessment in each case—have been: the Code of Good Practices on Transparency in Monetary and Financial Policies, the Basel Core Principles for Effective Banking Supervision, the Core Principles for Systemically Important Payment Systems, the International Organization of Securities Commissions (IOSCO) Objectives and Principles of

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[89]While FSAP reports provide detailed assessments of strengths and vulnerabilities, observance of standards, institutional structures, and overall stability and developmental needs, the focus of FSSAs is on financial system stability issues of significance for macroeconomic performance and policies. FSSAs are prepared by Fund staff in the context of Article IV consultations, by drawing on the FSAP findings, for discussion in the IMF Executive Board. In the World Bank, the FSAP reports provide the basis for producing Financial Sector Assessments (FSAs) and formulating financial sector development strategies. For details, see *Financial Sector Assessment Program (FSAP)—A Review: Lessons from the Pilot and Issues Going Forward* (www.imf.org/external/np/fsap/2001/review.htm). Summary assessments of financial sector standards and codes from the FSAP/FSSA process are also issued as Reports on Observance of Standards and Codes (ROSCs). See *Standards and Codes—The IMF's Role* (www.imf.org/external/np/exr/ib/2001/042701.htm).

Securities Regulation, and the International Association of Insurance Supervisors (IAIS) Insurance Core Principles. Recently, Corporate Governance standards have been assessed in the context of the FSAP as well.

122.   Monitoring information on implementation of standards can be a useful component of financial system vulnerability analysis. A high degree of observance of relevant standards contributes to the stability of financial systems that are integrated into global financial markets and face a variety of financial innovations and shocks. Standards assessments are also helpful in identifying and implementing regulatory and operational reforms needed for the development of countries' financial systems over time and their integration into global markets.

VI. CONCLUSIONS

123.   This paper reviews a wide range of FSIs that the literature supports in terms of their relevance for assessing the health and stability of financial systems. While a broad variety of FSIs need to be analyzed in order to complete a thorough financial stability assessment—also depending on country-specific circumstances—a smaller and more manageable subset of FSIs is useful, notably for the purpose of periodic monitoring of financial systems. A possible set of analytically relevant FSIs—in terms of their information content in assessing financial soundness—is reported in Table 9.

124.   The review contained in this paper emphasizes that work on measuring and analyzing FSIs has advanced substantially in recent years. At the same time, it points to specific areas where more work is still needed.

- Definitional guidelines and uniform accounting conventions for the compilation of FSIs for the banking sector are necessary to arrive at clear definitions of the indicators, thereby advancing international comparability and convergence toward best practice.

- Indicators of nonbank financial institutions need to be developed that reflect the specificities of each segment of the sector—finance companies, securities firms, collective investment schemes, insurance companies, and others.

- Market liquidity indicators are also important and need to be uniformly defined and regularly collected.

- On the corporate sector, while it is possible to identify a set of useful indicators, data availability remains a key obstacle, both at the aggregated and disaggregated level, and particularly for nonlisted companies, which are a significant share of the sector in many countries.

Table 9. A Selection of Analytically Relevant FSIs

Banks	
Capital adequacy	Regulatory capital (total and Tier I) to risk-weighted assets
	Assets to capital
Asset quality	NPLs to total gross loans
	NPLs net of provisions to capital
	Sectoral distribution of loans to total loans
	Geographical distribution of loans (credit) to total loans (credit)
	Large exposures and connected lending to capital
	Foreign currency-denominated loans to total loans
	Gross asset position in financial derivatives to capital
	Gross liability position in financial derivatives to capital
Earnings and profitability	ROA (net income to average total assets)
	ROE (net income to average equity)
	Interest margin to gross income
	Noninterest expenses to gross income
	Trading and foreign exchange gains (losses) to total income
Liquidity	Liquid assets to total assets (liquid asset ratio)
	Liquid assets to liquid liabilities
	Customer deposits to total (noninterbank) loans
	Spread between highest and lowest interbank rate (market segmentation)
	Central bank lending to deposit-taking institutions
Sensitivity to market risk	Duration of assets
	Duration of liabilities
	Net open position in foreign exchange to capital
	Net open position in equities to capital
Market liquidity	Average bid-ask spread in the securities market 1/
	Average daily turnover ratio in the securities market 1/
Nonbank financial institutions	NBFI assets to total financial system assets
	NBFI assets to GDP
Corporate sector	Total debt to equity
	Return on equity (earnings before interest and taxes to average equity)
	Earnings before interest and taxes to interest and principal expenses
	Corporate foreign currency debt to foreign currency assets
Households	Household debt to GDP
	Household debt burden to income
Real estate markets	Real estate prices
	Loans outstanding to the real estate sector to total loans

1/ Or in other markets that are most relevant to the liquidity of bank assets, such as domestic foreign exchange markets.

- Efforts to develop better indicators of financial institutions' exposure to the household and real estate sector should be stepped up, notably in the direction of more transparent information on credit outstanding to these sectors.

- Stress testing is a key element of macroprudential analysis. The analytical basis for stress testing should be further developed, including in the area of aggregation and model specification.

- Overall, increased efforts are needed on data accuracy and timeliness. Where possible, this should be achieved without creating an additional reporting burden on financial institutions.

- The development of benchmarks for the level of FSIs would help to monitor and interpret developments in the financial system. In particular, guidelines are needed to help to determine the relevant threshold that makes an indicator a source for concern. A high degree of flexibility is required in the use of benchmarks, however, as they are most often country-specific and can change over time.

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AGGREGATION ISSUES

Simple aggregation of balance sheets and income statements of individual institutions can disguise important structural information, and it is often necessary to supplement the aggregate data with information on dispersion. For example, the capital to asset ratio of a system is calculated by dividing the total capital by total assets, which is essentially the average (or mean) capital to asset ratio of the system. If capital asset ratios where symmetrically distributed, this statistic would also convey information about the middle capital asset ratio (the median) as well as the most frequently observed capital asset ratio (the mode). However, typically the distribution is not symmetric, hence focusing on the mean values only may be misleading as the mean can be affected by value of outliers—e.g., one very strongly capitalized bank could be more than offsetting many other undercapitalized banks.

Descriptive statistics on data dispersion provide ways to supplement mean values with additional information. Data skewness can be particularly useful, as it provides a measure of the size and direction of asymmetry in the distribution of the observations. Positive skewness indicates that aggregation biases the results upwards (a substantial number of institutions are actually below the average), and the opposite is true for negative skewness. Skewness is zero when the distribution is symmetrical, i.e., mean, median and mode are equal. To get a sense of the proportional affect of the outliers, or the thickness of the tails, the kurtosis can also be calculated. Ways to calculate the direction and degree of skewness and the degree of kurtosis are discussed below.

Descriptive statistics and data dispersion

Summary measures for a data set are often referred to as descriptive statistics. Descriptive statistics fall into four main categories: (1) measures of position, (2) measures of variability, (3) measures of skewness, and (4) measures of kurtosis. They can be useful for beginning data analysis, for comparing multiple data sets, and for reporting final results of a survey.

Measures of position (or central tendency) describe where the data are concentrated:

- *Mean* (first moment of the distribution, or $\bar{x}$) is the mathematical average of the data, and is a common measure of central tendency.

- *Median* (Med) is the middle observation in a data set. It is often used when a data set is not symmetrical, or when there are outlying observations.

- *Mode* is the value around which the greatest number of observation are concentrated, or the most common observation.

Measures of variability describe the dispersion (or spread) of the data set:

- *Range* is the difference between the largest and the smallest observations in the data set. It has limitations because it depends on only two numbers in the data set.

- *Variance* (second moment of the distribution, or s^2) measures the dispersion of the distribution around the mean, taking into account all data points.

- *Standard Deviation* (or s) is the positive square root of the variance, and is the most common measure of variability. Standard deviation indicates how close to the mean the observations are.

Measures of skewness indicate whether the data are symmetrically distributed:

- *Skewness* (third moment of the distribution, or m_3) measures the degree of asymmetry of the data set. Positive skewness indicates a longer right hand-side (tail) of the distribution; negative skewness a longer left tail. Distributions that are symmetric have identical tails and thus no skewness. One easy way of determining skewness is to compare the values of mean and the median relative to the standard deviation:

$$g = \frac{\bar{x} - Med}{s_x}$$

A more precise method to calculate skewness is the Pearson coefficient:

$$\frac{m_3}{s^3} = \frac{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^3 \cdot n_i}{N}}{s_x^3}$$

Measures of kurtosis indicate whether the data are more or less concentrated toward the center:

- *Kurtosis* (fourth moment of the distribution, or m_4) measures the degree of flatness of the distribution near its center, or equivalently the degree of thickness of the tails. It is large if the distribution has sizeable tails that extend much further from the mean than $\pm s$; zero if the distribution is normal. A normalized measure is:

$$K = \frac{m_4}{s^4} = \frac{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^4 \cdot n_i}{N}}{s_x^4} - 3$$