Introduction

Efforts to strengthen surveillance of financial systems have led the IMF and a number of central banks to develop Financial Soundness Indicators (FSIs). These indicators are compiled by aggregating data from individual institutions to produce measures that can be used to assess the financial soundness and vulnerabilities of the financial system as a whole. FSIs can also be compiled in this way for key non-financial sectors, such as the corporate sector, that are important sources of risk to the financial sector. The development of FSIs as a surveillance tool occurred largely in the context of the development of the Financial Sector Assessment Program (FSAP) as a vehicle for strengthening financial systems in member countries. FSIs are used in parallel with other FSAP tools for assessing the other dimensions of financial stability. In contrast to these other tools, however, FSIs are also intended for use for ongoing surveillance outside the FSAP.

This paper outlines the role of FSIs in macroprudential surveillance and how that role can be strengthened. It analyzes the linkages among FSIs, including use with other surveillance tools such as stress testing.¹ FSIs can be derived from financial sector balance sheet data and, thus, can contribute to the analysis of country debt sustainability using the balance sheet approach. It also describes how information derived from the other two key dimensions of financial stability—effective financial sector supervision and a robust financial system infrastructure—can be used to strengthen macroprudential surveillance using FSIs. This

¹This paper does not provide detailed descriptions of individual FSIs; however, that analysis can be found in Sundararajan and others (2002).
information can be drawn, in part, from the assessment of a country’s observance of core principles and codes and standards governing effective supervision and a robust financial infrastructure.

The paper draws on the analytic work on the relationship between banking and corporate sector FSIs. It also identifies information in the core principles and codes and standards assessment relevant to the interpretation of FSIs. This analytic work aims to improve our capacity to identify shocks that pose a risk to the financial sector at an earlier stage. The work on using information on the supervisory regime and financial system infrastructure enhances our capacity to interpret FSIs. The analysis of FSIs helps to focus on specific weaknesses in supervision and financial infrastructure that pose significant risks to financial stability.

The second section provides an overview of the role of FSIs and how they need to be analyzed in combination to assess risks to financial stability. The third section outlines how FSIs can be integrated with stress testing in surveillance. The fourth section considers the use of information derived from core principle assessments of the supervisory regime in combination with FSIs. The fifth section examines how information on the financial system infrastructure can enhance surveillance using FSIs. The final section concludes.

**Using FSIs to Assess the Condition of the Financial Sector**

Most FSIs are compiled by aggregating data for individual institutions to produce a measure for the financial sector as a whole and for key peer groups of financial institutions where relevant. As a result, surveillance of the financial sector as a whole—macroprudential analysis—complements that for individual financial institutions by supervisors—microprudential analysis. Macroprudential analysis derives from the need to identify risks to the stability of the system as a whole resulting from the collective impact of the activities of many institutions that are hard to detect through the monitoring of individual institutions alone.

Individual FSIs monitor different vulnerabilities of the financial sector and its soundness. They cover capital adequacy, asset quality, earnings and profitability, liquidity and sensitivity to market risk of banks and nonbank financial institutions, as well as indicators of market liquidity and soundness of nonfinancial sectors (Table 14.1). These FSIs can be compiled for different peer groups within a sector where this can provide insights into the sources of financial sector vulnerabilities.
### Table 14.1. Financial Soundness Indicators: The Core and Encouraged Sets

<table>
<thead>
<tr>
<th>Core set</th>
<th>Encouraged set</th>
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</thead>
<tbody>
<tr>
<td><strong>Deposit-taking institutions</strong></td>
<td><strong>Deposit-taking institutions</strong></td>
</tr>
<tr>
<td>Capital adequacy</td>
<td>Capital to assets</td>
</tr>
<tr>
<td>Regulatory capital to risk-weighted assets</td>
<td>Geographical distribution of loans to total loans</td>
</tr>
<tr>
<td>Regulatory Tier I capital to risk-weighted assets</td>
<td>Gross asset position in financial derivatives to capital</td>
</tr>
<tr>
<td>Asset quality</td>
<td>Gross liability position in financial derivatives to capital</td>
</tr>
<tr>
<td>Nonperforming loans to total gross loans</td>
<td>Trading income to total income</td>
</tr>
<tr>
<td>Nonperforming loans net of provisions to capital</td>
<td>Personnel expenses to noninterest expenses</td>
</tr>
<tr>
<td>Sectoral distribution of loans to total loans</td>
<td>Spread between reference lending and deposit rates</td>
</tr>
<tr>
<td>Large exposures to capital</td>
<td>Spread between highest and lowest interbank rate</td>
</tr>
<tr>
<td>Earnings and profitability</td>
<td>Customer deposits to total (non-interbank) loans</td>
</tr>
<tr>
<td>Return on assets</td>
<td>Foreign currency-denominated loans to total loans</td>
</tr>
<tr>
<td>Return on equity</td>
<td>Foreign currency-denominated liabilities to total liabilities</td>
</tr>
<tr>
<td>Interest margin to gross income</td>
<td>Net open position in foreign exchange to capital</td>
</tr>
<tr>
<td>Noninterest expenses to gross income</td>
<td></td>
</tr>
<tr>
<td>Liquidity</td>
<td></td>
</tr>
<tr>
<td>Liquid assets to total assets (liquid asset ratio)</td>
<td>Average bid-ask spread in the securities market¹</td>
</tr>
<tr>
<td>Liquid assets to short-term liabilities</td>
<td>Average daily turnover ratio in the securities market¹</td>
</tr>
<tr>
<td>Sensitivity to market risk</td>
<td></td>
</tr>
<tr>
<td>Duration of assets</td>
<td></td>
</tr>
<tr>
<td>Duration of liabilities</td>
<td></td>
</tr>
<tr>
<td>Net open position in foreign exchange to capital</td>
<td></td>
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</tbody>
</table>

¹Or in other markets most relevant to bank liquidity, such as foreign exchange markets.
FSIs are divided into two categories—a core and an encouraged set.\(^2\) The core set comprises those FSIs necessary for surveillance in all financial systems. It includes FSIs only for banks, reflecting their central role in all financial systems. The encouraged set comprises FSIs that are likely to be important in some but not all financial systems, such as FSIs for nonbank financial institutions. FSIs for the nonfinancial sector (corporate, household, and real estate sectors) that are a source of risk to the financial sector are also included in this set because of the analytic evidence on the component linkages between the indicators of financial and nonfinancial sectors.

The analysis of FSIs in combination involves distinguishing between FSIs for the nonfinancial and financial sectors and, within the latter, between FSIs monitoring a financial sector’s capacity to absorb losses and those monitoring vulnerabilities. These three types of FSIs play distinct roles in financial surveillance, but they are also linked through financial and accounting relationships. Specifically, FSIs that monitor the condition of the nonfinancial sector, such as the leverage ratio, can provide an early warning of deteriorations and assess quality due to the extensive credit relationships between the financial and nonfinancial sectors. Accounting relationships link FSIs assessing vulnerabilities and soundness and, hence, can be used to assess the impact of shocks on soundness. For example, an increase in nonperforming loans (NPLs) should trigger a rise in provisions, reducing capital. The analysis of these interrelationships plays a central role in macroprudential surveillance.

**Financial Sector FSIs**

The choice of FSIs to monitor the financial sector depends to some extent on the structure of the financial system. Key considerations include the extent to which the system is bank-dominated or whether insurance companies and securities firms are systemically important. In systems where complex financial groups are important, it is also desirable to monitor FSIs for the peer group of these conglomerates in which banking, insurance, and securities activities are consolidated.\(^3\) An analysis of financial structure is also necessary to identify key peer groups that may need to be monitored using FSIs for each group.

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\(^2\)The core and encouraged sets of FSIs may be adjusted based on analytic work and experiences using FSIs that change perceptions about the relative usefulness of specific FSIs.

\(^3\)This consolidation can help detect cross-subsidization or pooling of capital within such groups that can increase the vulnerability of the financial system as a whole. To interpret these FSIs, it is important to take into account the regulatory rules governing consolidation. If, for example, there are strict rules against double-gearing, it would be less critical to monitor FSIs for this peer group.
FSIs measuring financial soundness

Financial soundness of the financial sector is monitored by FSIs that indicate the capacity of the sector to absorb adverse shocks.\(^4\) In using these capital adequacy FSIs, attention needs to be paid to the “quality” of the capital—the extent to which different types of capital will be available to cover losses in the event of insolvency. The key distinction is between capital that can be used to compensate creditors—shareholder equity, retained earnings, and realized reserves—used in the Tier I capital ratio, and capital that may not be available for this purpose—subordinated debt (as it is a junior claim on a bank), tax arrears, and unrealized capital gains (which may prove to be illusory if asset prices fall)—used in Tier II capital and added to Tier I capital to form the regulator capital ratio. The capital to asset ratio can be compiled for both banks and nonbank financial institutions from audited financial statements based on standard accounting concepts (e.g., International Accounting Standards) rather than regulatory data.

To correctly interpret these FSIs, attention must be paid to the specific concepts and definitions underlying the data used to compile them. Account needs to be taken of valuation methods for assets and liabilities and the accounting and regulatory rules on which the underlying measure of capital is based, especially the accounting treatment of provisioning and consolidation rules. These features vary significantly across financial systems and so must be taken into account when international comparisons are made. Core principles and codes and standards assessments are valuable sources of such information on the measurement and accounting treatment of capital, as discussed below.

FSIs measuring the profitability and interest burden of the banking sector also serve as indicators of financial soundness. The FSIs \textit{return on equity} and \textit{return on assets} indicate the extent to which earnings are available to absorb losses. FSIs of the \textit{interest margin} and \textit{noninterest income relative to gross income} also serve as indicators of financial soundness by providing additional information on the availability of resources to help absorb losses.

FSIs of financial sector vulnerability

The role of FSIs of financial sector vulnerabilities in macroprudential surveillance is to assess a sector’s vulnerability to shocks. These FSIs monitor asset quality, liquidity, and sensitivity to market risk. FSIs of asset quality provide an indication of credit risk. NPLs relative to total

\(^{4}\)When the soundness of the financial sector is found to be weak, it is generally necessary to dig deeper to determine whether the weakness can be attributed to specific peer groups or even to individual, large systemically significant institutions.
loans provide information on the quality of the loan portfolio and NPLs net of provisions relative to capital indicates the potential scale of additional provisions (which reduce capital) that may need to be taken relative to the capital available to absorb them. The interpretation of these FSIs requires knowledge of provisioning policies and recovery rates on loans, that is, loss-given-default.\(^5\)

A potential limitation of FSIs that rely on NPL data is that they tend to be lagging indicators of asset quality. The reason is that NPLs are reported only when banks decide to recognize assets as impaired, which typically occurs after a significant lag from the time when banks suspect they are impaired. The lag derives from the criterion for impairment, which is that a loan must be in arrears on interest payments for a period of time before being declared nonperforming (most commonly 90 days), but varies widely across countries. Another source of reporting delay is the incentives of banks to delay or avoid reporting NPLs by, for example, evergreening loans. These shortcomings mean that FSIs for nonfinancial sectors can play a valuable complementary role to NPL-based FSIs by providing an early indication of asset quality problems.

FSIs of the sectoral distribution of loans relative to total loans also serve as indicators of asset quality. However, they monitor a different aspect of credit risk that arises from a lack of diversification in individual banks’ lending portfolios owing to exposure concentrations in particular sectors or countries. They are intended to detect exposure concentrations of the banking sector, or a key peer group, to particular shocks. The systemic risk arising from such collective exposures typically cannot be detected through the separate supervision of individual banks.

One sector-exposure measure that is useful for assessing systemic risk is the gross value of interbank loans—that is, the banking sector’s exposure to itself. This FSI provides an indication of the scale of interbank lending and, thus, of the potential for contagion in a systemic banking crisis. However, it can provide at best only a rough indication of this source of systemic risk, because the distribution of bilateral interbank exposures within the sector is a key determinant of this risk. As discussed below, an interbank stress test serves as a complementary surveillance tool that can provide a more accurate assessment of this risk.

FSIs of banking sector liquidity monitor liquid assets available to banks in the event of a loss of market funding or of deposits in a bank run. Such a loss of access to funding sources could be triggered by shocks such as large credit or market losses that reduce the confidence

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\(^5\)It should be recognized that NPLs do not represent banks’ actual assessment of the quality of their loan portfolio, which is usually based on a private internal rating system, but rather the loans that they choose to declare as impaired and against which they make specific provisions.
in the soundness of the sector or some large banks. These FSIs help assess the risk that such shocks could result in a more extensive banking crisis because solvent banks that lose access to funding are forced to sell assets at a loss to obtain liquidity, which could drive them into insolvency. If their liquidity ratio is low, they are more likely to have to sell illiquid assets at fire-sale prices.

The FSIs liquid assets to total assets and liquid assets to short-term liabilities are compiled by aggregating liquid assets on a cross-border consolidated basis to capture those assets held abroad. The former, also termed the liquidity ratio, indicates how much balance sheet shrinkage could be tolerated owing to loss of access to funding or bank run before it would become necessary to sell illiquid assets at a loss. The latter FSI measures liquid assets relative to the market-funded liabilities that would have to be covered by asset sales if access to funding is lost (where, implicitly, deposits are viewed as a more stable funding source). These FSIs are primarily relevant to the banking sector because banks are inherently illiquid institutions because of their maturity transformation role, where illiquid assets are funded by short-term liabilities. In contrast, securities and insurance firms typically have highly liquid asset portfolios and long-term liabilities, making them less vulnerable to such liquidity risk.

Another factor relevant to the liquidity of banks’ balance sheets is market liquidity, which determines the amount of liquidity banks can raise by selling assets in securities markets. It influences the size of the discount, or market loss, that could result if many institutions are forced to liquidate financial assets in a crisis. This source of vulnerability is measured by two FSIs of market liquidity—the bid-ask spread and market turnover. These FSIs, however, measure liquidity under normal conditions, so they may not provide a particularly accurate indication of how market liquidity will hold up in a systemic crisis. The concern is that while a bank’s holdings of liquid assets may be sufficient in normal times, these assets could cease to be liquid in a crisis when many banks try to sell simultaneously. Information on the market infrastructure relevant to the robustness of market liquidity, derived from core principles and codes and standards assessments, can help assess how liquidity would hold up in a crisis, as described below.

FSIs of sensitivity to market risk monitor the vulnerability of the financial sector to exchange rate, interest rate, and equity market risk. FSIs of the net open position in foreign exchange and in equities to capital and duration of assets and liabilities serve as an indicator of potential for loss attributable to exchange rate, interest rate, or equity price changes, depending on their size. These measures, however, often do not capture accurately the risk associated with off-balance-sheet
instruments, which can be an important source of market risk in more sophisticated financial systems. Especially in such countries, stress tests are often used in place of these FSIs to monitor market risk. Market risk stress tests are now a standard part of their banks’ risk management, so authorities in many countries have access to them on a regular basis. Results of these stress tests can be aggregated for standardized shocks, giving an estimate of loss for the banking sector and key peer groups and, thus, can be used as an indicator with, or in place of, the FSIs.

**FSIs for the nonfinancial sector**

FSIs for the nonfinancial sector allow monitoring of a key channel through which shocks affect the banking sector. They are included in the encouraged set because of the additional analysis required to assess the impact of developments in these sectors on the banking sector. The importance of the corporate, household, and real estate sectors as sources of credit risk to the banking sector can be assessed using FSIs measuring the exposure concentration of the banking sector to these sectors. Because negative shocks to these sectors typically affect bank asset quality with a lag, they can help policymakers detect emerging asset quality problems in the banking sector at an early stage and respond more proactively. FSIs covering the household sector are household debt to GDP, which serves as a measure of leverage, and household debt service payments to income, which monitor debt repayment capacity. The FSIs for the real estate sector include the real estate price index, which can help detect a real estate price bubble or price decline that could adversely affect asset quality.

Corporate sector FSIs monitor the financial condition of the sector and its vulnerability to shocks. They can be compiled by aggregating data from corporate financial statements and, thus, complement microprudential indicators used by shareholders and market participants to monitor the financial condition of individual corporations. Their role is to help assess the potential for corporate sector distress that contributes to a worsening of asset quality. The leverage ratio, defined as the ratio of corporate sector debt to equity, indicates vulnerability to shocks that may impair loan or debt repayment capacity. Similarly, return on equity, return on assets, and earnings relative to interest and principal payments indicate the extent to which earnings are available to cushion losses and maintain loan repayment. The net open position in foreign exchange to capital indicates the sector’s vulnerability to exchange rate movements. Finally, the number of bankruptcy applications serves as an index of financial distress.
Analysis of the Relationship Among FSIs

An analysis of the key relationships among FSIs is necessary to assess the impact of shocks on financial soundness. The first involves the linkage between financial sector vulnerabilities and soundness. This is the channel through which shocks affect capital and, therefore, the financial sector’s capacity to provide financial intermediation to the real economy. The second key relationship gives the impact of changes in FSIs for the nonfinancial sector on the financial sector and is reflected in FSIs monitoring financial sector vulnerabilities. It arises from the credit linkages with the corporate, real estate, and household sectors that represent a key channel through which shocks affect asset quality.

This relationship between FSIs monitoring financial sector vulnerabilities and the capital ratio FSIs derives from accounting linkages. These are given by loan classification and provisioning rules; they make it possible to assess how shocks detected through the monitoring of FSIs of asset quality, market risk, and liquidity will affect financial sector soundness. The accounting rules can vary significantly across countries and so they must be analyzed drawing on information for each country from a range of sources, including Basel Core Principles (BCP) assessments and FSAPs. This is especially important when banks have significant discretion in classifying loans or where forbearance may provide greater scope for underestimating the actual deterioration in credit quality—for example, by evergreening loans. Similarly, inadequate provisioning rules enable banks to delay addressing credit problems, which are likely to become more serious over time as a result.6

The analysis should focus on the linkage between corporate sector FSIs and asset quality in the first instance because this sector is the most important user of bank credit in many countries. There are a number of approaches that can be and have been used to estimate the relationship using data on asset quality and corporate sector FSIs for individual countries. When these data are lacking for a country—perhaps because existing time series are too short—cross-country statistical analysis based on panel data can be used, yielding a single “average” estimate for a large sample of countries. This estimate can

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6It would be optimal to use banks’ own internal rating of their loan portfolios as the measure of asset quality; but since they typically do not report them, NPLs must be used as a substitute. Since NPLs are the assets that these banks choose to declare as impaired, usually because they intend to make provisions against them, information on how well NPLs actually represent banks’ true assessment of asset quality can be useful.
serve as a benchmark measure, or rule of thumb, of the impact of changes in corporate sector FSIs on asset quality, which can be used for macroprudential surveillance in such countries.

This analysis was undertaken using a panel of FSIs for the banking and corporate sectors covering 47 countries and up to 10 years of time series data. Such panels can be compiled from large private databases such as Worldscope and Bankscope that collect data from the audited financial statements of a large number of corporations and banks for many countries. The coverage varies across countries but is quite good for many countries in the sample. For example, the corporate leverage FSI for the United States was compiled using data from 9,000 nonfinancial corporations. Scatterplots of pairs of FSIs from this panel are shown in Figures 14.1 through 14.8. In these charts, each point corresponds to a country. The vertical axis measures the banking sector FSI, while the horizontal axis gives the corporate FSI. The charts also show preliminary statistical analysis of the relationship between these FSIs in the form of a regression line estimated for each pair of FSIs. The charts only show data for 2000 and 2001, as data for the whole sample yield similar results (they are not plotted because outliers make the graphs less revealing). The regression lines in the charts show that the FSIs “NPLs/loans” and “(NPLs-provisions)/capital” are positively correlated with FSIs of corporate leverage but negatively correlated with corporate earnings (Figures 14.1, 14.2, 14.4–14.6, and 14.8), consistent with economic theory. These relationships proved robust to the removal of outliers from the sample. There is also evidence of a statistical relationship between the FSI of financial soundness, the banking sector capital to assets ratio, and corporate leverage; although when outliers were removed, the correlation was much weaker.

While these relationships are consistent with the economic theory, they need to be estimated using an econometric model to control for cross-country differences in macroeconomic performance, financial structure, and data definitions. The emphasis on the relationship between FSIs of asset quality and corporate leverage, shown in Figure 14.1, reflects the usefulness of the latter FSI as an indicator of financial vulnerability in the corporate sector. Estimation of equation (1) of the model outlined in “Modeling the Relationship Between Corporate and Banking Sector FSIs” (Appendix I) yielded a statistically significant estimate for $\alpha_1$ of 0.16 on the $lev$ variable lagged one period, implying that a 10 percentage point increase in the corporate

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7 These data, prepared for research purposes, are less likely to be reliable. They should not be regarded as a substitute for those computed by country authorities.
leverage is on average associated with a 1.6 percentage point rise in NPLs relative to loans after a one period lag. 8

**Using Stress Testing with FSIs in Surveillance**

Stress testing is another surveillance tool that can be used in combination with FSIs to enhance their usefulness. Aggregate stress test results can be obtained by applying shocks to aggregated banking sector balance sheets, or by aggregating individual banks’ stress test results for standardized shocks, to obtain the impact of the shocks on the sector as a whole. Stress testing can support surveillance using FSIs. First, it provides information on the linkages between different FSIs. Second, it helps to “benchmark” FSIs by giving an indication of the impact of a change in an FSI. And third, it provides a complementary (but more direct) way to assess certain types of risks that are hard to measure precisely using FSIs, such as the potential for contagion due to interbank exposures.

The relationship between FSIs and stress testing derives from the fact that changes in FSIs are typically an output of stress tests and, in some cases, an “intermediate” input also. For example, the impact of a macroeconomic shock is usually measured as the impact on the capital ratio FSIs. Moreover, in some stress tests, the shock is fed through NPLs, providing a direct measure of the linkage between changes in the NPL-based FSIs and the capital ratio for the banking sector. In this way, stress testing provides a benchmark for the NPL-based FSIs by providing an indication of how large a change would pose a significant risk to financial stability. 9

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8The estimation results of the model are reported in “Estimating the Relationship Between Corporate Leverage and Asset Quality,” Chapter 5 in *Financial Soundness Indicators*, (International Monetary Fund, 2003). The final empirical specification had a number of notable features. First, equation (1) is estimated with instrumental variables to control for possible simultaneous equation bias noted in Appendix I. Second, estimation of the other equations in the appendix did not yield statistically significant estimates using the panel data, so results are not reported. Third, a general-to-specific estimation strategy was used to develop the final empirical specification and lag structure, where variables with statistically insignificant coefficients were dropped one at a time. In this process, the contemporaneous value of leverage was dropped as it was no longer significant once one lag of the variable was added. Fourth, of the set of control variables, only economic growth was significant and it is the only one included in the final empirical specification. Finally, the fixed-effect term that helps control for cross-country differences in economic structure was highly significant.

9It thus complements the benchmarking of the relationship based on accounting relationships, as described above.
Figure 14.1. Correlation Between NPLs/Loans and the Corporate Leverage Ratio, 2000–01

Figure 14.2. Correlation Between NPLs Less Provision Over Capital and the Corporate Leverage Ratio, 2000–01

Source: Bankscope, Worldscope; calculations by authors.
Figure 14.3. Correlation Between Bank Capital/Asset Ratio and Corporate Leverage Ratio, 2000–01

Source: Bankscope, Worldscope; calculations by authors.

Figure 14.4. Correlation Between NPLs/Loans and Corporate Earnings (EBITA)$^1$/Capital

Source: Bankscope, Worldscope; calculations by authors.

$^1$Earnings before interest and taxes and amortization.
Figure 14.5. Correlation Between NPLs/Loans and Corporate Earnings (EBIT\(^1\))/Interest Expense, 2000–01

![Graph showing the correlation between NPLs/Loans and Corporate Earnings (EBIT\(^1\))/Interest Expense, 2000–01.]

Source: Bankscope, Worldscope; calculations by authors.

\(^1\)Earnings before interest and taxes.

Figure 14.6. Correlation Between NPLs Less Provision Over Capital and Corporate Earnings (EBITA\(^1\))/Capital, 2000–01

![Graph showing the correlation between NPLs Less Provision Over Capital and Corporate Earnings (EBITA\(^1\))/Capital, 2000–01.]

Source: Bankscope, Worldscope; calculations by authors.

\(^1\)Earnings before interest and taxes and amortization.
Figure 14.7. Correlation Between Capital to Assets and Corporate Earnings (EBITA)/Capital, 2000–01

Figure 14.8. Correlation Between NPLs Less Provision Over Capital and Corporate Earnings (EBIT)/Interest, 2000–01

Source: Bankscope, Worldscope; calculations by authors.

1Earnings before interest and taxes and amortization.
Stress testing and FSIs are complementary approaches to assessing financial soundness and vulnerabilities. FSIs can be used for more continuous monitoring of specific vulnerabilities, while the stress tests give an estimate of the losses associated with a vulnerability (typically reported as a change in the capital ratio FSI) resulting from a single, plausible (though exceptional) shock to the relevant macroeconomic risk factor. In addition, when repeated at periodic intervals, this measure of loss from stress events can itself be used as a soundness indicator along with, or even in place of, an FSI. This use of stress tests is most common in the case of market risk where the shock takes the form of a change in an asset price, such as an exchange rate or interest rate, because they are relatively easy to implement. For example, the FSI of the net open foreign exchange position measures exchange rate exposure while the stress test estimates the loss that results from an exchange rate change given the exposure. As the exposure changes, so will the loss associated with periodic stress tests.

Another example where stress tests can play a complementary role to FSIs is the assessment of systemic risk arising from interbank exposures. The FSI measuring this vulnerability provides an indication of the scale of interbank exposures relative to those of other banks. In contrast, stress testing can use information on the distribution of interbank exposures within the banking sector to more precisely assess the risk of a systemic crisis. It reveals to what extent a shock to the banking sector causing the failure of individual banks could precipitate the failure of other banks via their interbank exposures (Box 14.1).

Role of Core Principles Assessments in Financial Stability Analysis

The BCP assessments are another tool contributing to the soundness of financial systems that can be used in combination with FSIs to strengthen the interpretation of FSIs. While different core principles may apply to the banking, insurance, and securities market sectors, it is desirable to focus on the BCPs because financial systems in most countries are dominated by the banking sector. Also, the similarities in core principles for banks, and insurance and securities firms make adoption of the BCP analysis relatively straightforward for the other sectors.

10 At the level of the individual financial institution, there is a close complementarity between the use of frequent stress testing and value-at-risk (VaR) in risk management, since both provide estimates of loss. For surveillance of risks to the sector as a whole, however, this is not the case because VaR results cannot be aggregated except under very restrictive conditions.
**Box 14.1. Using Interbank Stress Testing to Assess Contagion Risk**

Stress testing can be used to assess the systemic risk deriving from the potential for the shocks (monitored using FSIs) to trigger contagion among banks through interbank market exposures. It estimates the potential for the failure of one, or a few, banks triggered by a shock, to cause other banks to fail. There are two dimensions to this stress test. First, a standard stress test applied to (or by) individual banks is used to identify the bank (or banks) that are at the greatest risk of failure. Second, an interbank stress test based on data on bilateral interbank exposures is used to assess whether the failure of this bank (or banks) could trigger the failure of other banks in the system (that would have already been weakened by the shock) due to the interbank exposures between them. The interbank stress test then identifies those banks (if any) with large enough exposure to the failed bank(s) so that they also would be forced into insolvency. The interbank exposure data take the form of a matrix with the cells containing the net bilateral interbank exposures between banks. This is illustrated in the figure below, where each row in the matrix gives the interbank exposures of a bank to every other bank in the matrix. These exposures can be compared to the bank’s capital, where if the losses incurred by a bank due to a default on an interbank loan (or several loans in a crisis) reduce its capital sufficiently it also would fail that, in turn, could have repercussions for other banks in a chain reaction.

**Illustrative Matrix of Net Bilateral Interbank Exposures**

<table>
<thead>
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<th>Bank 1</th>
<th>Bank 2</th>
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<tr>
<td>Bank 1</td>
<td>— —</td>
<td>Interbank exposure of bank 1 to bank 2</td>
<td>• • •</td>
<td>Interbank exposure of bank 1 to bank n</td>
</tr>
<tr>
<td>Bank 2</td>
<td>Interbank exposure of bank 2 to bank 1</td>
<td>— —</td>
<td>• • •</td>
<td>Interbank exposure of bank 2 to bank n</td>
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<td>— —</td>
<td>• • •</td>
</tr>
<tr>
<td>Bank n</td>
<td>Interbank exposure of bank n to bank 1</td>
<td>Interbank exposure of bank n to bank 2</td>
<td>• • •</td>
<td>— —</td>
</tr>
</tbody>
</table>
The BCP assessments contribute to the three core dimensions of financial stability: a robust financial infrastructure, effective supervision, and adequate macroprudential surveillance (Table 14.2).\footnote{Table 14.2 summarizes a much more detailed mapping between FSIs and BCPs in “Using Supervisory Information to Interpret FSIs” (International Monetary Fund, 2003, Chapter IV).} While their purpose is to strengthen individual banks, they also contribute to the stability of the financial system as a whole, both directly by improving supervision (through the BCPs in Section II of Table 14.2), and indirectly by strengthening the financial infrastructure (BCPs in Section I) and the quality of surveillance based on FSIs (BCPs in Section III). The relevance of specific core principles to macroprudential surveillance based on FSIs differs substantially, so it is desirable to focus the analysis on them.

There are three types of BCPs that contribute to the conditions for effective supervision: first, BCPs defining the necessary preconditions for a robust financial system, such as an adequate legal system; second, BCPs insuring that the supervisory authority can operate effectively; and third, BCPs that apply to banks to ensure that they operate in a safe and sound manner (formulated as requirements for supervisors to enforce and verify). The latter two types are the most relevant and contain the subset of BCPs identified in Table 14.2 from which information can be drawn to help to interpret FSIs. (See “Using Stress Testing with FSIs in Surveillance,” above.)

The information provided by the BCP assessments can be used to help interpret FSIs in a number of ways.\footnote{The BCP assessments consist of both descriptive information on the extent and means by which specific criteria are met and a rating of the degree of compliance with each core principle. The analysis of FSIs relies on the former, since the latter has not proved to be a reliable predictor of banking sector weakness (Sundararajan, Marston, and Basu, 2001).} First, it can clarify the definition of data provided by institutions that is being used to compute FSIs, thereby contributing to a more precise understanding of what is being measured. Second, information is provided on risks that cannot be captured adequately using FSIs, such as operational and legal risk. Third, the assessments indicate the responsiveness of the supervisory system to emerging financial sector problems. Finally, they provide information on the effectiveness of bank risk management. These latter two indicate how quickly vulnerabilities identified by FSIs are likely to be corrected, which helps define the level above which there should be cause for concern.

The mapping between FSIs and BCPs (summarized in Table 14.2) helps use the BCP assessments to support macroprudential surveillance.
Table 14.2. BCPs Containing Information Relevant to the Interpretation of FSIs

<table>
<thead>
<tr>
<th>Information relevant to macroprudential surveillance</th>
<th>BCPs providing relevant information to macroprudential surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BCP number</td>
</tr>
<tr>
<td>I. Robust Financial Infrastructure</td>
<td></td>
</tr>
<tr>
<td>Sound and stable macroeconomic policies</td>
<td>Precondition 1</td>
</tr>
<tr>
<td>Well-developed public infrastructure</td>
<td>Precondition 2</td>
</tr>
<tr>
<td>Efficient bank resolution procedures</td>
<td>Precondition 4</td>
</tr>
<tr>
<td>Appropriate public safety nets</td>
<td>Precondition 5</td>
</tr>
<tr>
<td>II. Effective Supervision</td>
<td>BCP 1(2)</td>
</tr>
<tr>
<td>Autonomy, power, and resources of supervisory authority</td>
<td>BCP 1(4)</td>
</tr>
<tr>
<td></td>
<td>BCP 1(5)</td>
</tr>
<tr>
<td>Capacity to take prompt remedial actions in response to identified weaknesses</td>
<td>BCP 22</td>
</tr>
<tr>
<td>Capacity to collect necessary information</td>
<td>BCPs 16–19</td>
</tr>
<tr>
<td>Capacity to verify data provided by banks</td>
<td>BCP 21</td>
</tr>
<tr>
<td>Capacity to collect and verify information on cross-border activities</td>
<td>BCP 1(6)</td>
</tr>
<tr>
<td></td>
<td>BCP 23–25</td>
</tr>
<tr>
<td>III. Macroprudential Surveillance</td>
<td>BCP number</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Surveillance of FSIs of capital adequacy</td>
<td>BCP 6</td>
</tr>
<tr>
<td></td>
<td>BCP 8</td>
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<tr>
<td></td>
<td>BCP 20</td>
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<tr>
<td></td>
<td>BCP 23</td>
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<tr>
<td>Surveillance of FSIs of asset quality</td>
<td>BCP 7</td>
</tr>
<tr>
<td></td>
<td>BCP 8</td>
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<tr>
<td></td>
<td>BCP 9</td>
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<tr>
<td></td>
<td>BCP 10</td>
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<tr>
<td></td>
<td>BCP 20</td>
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<tr>
<td></td>
<td>BCP 23</td>
</tr>
<tr>
<td>Surveillance of FSIs of earnings and profitability</td>
<td>—</td>
</tr>
<tr>
<td>Surveillance of FSIs of liquidity</td>
<td>BCP 11</td>
</tr>
<tr>
<td></td>
<td>BCP 13</td>
</tr>
<tr>
<td>Surveillance of FSIs of sensitivity to market risk</td>
<td>BCP 12</td>
</tr>
</tbody>
</table>

Source: Authors.
Specifically, a lack of compliance with particular BCPs affects banking sector soundness and vulnerabilities and, thus, can help assess the degree of risk associated with a specific value of the FSI. Conversely, this analysis can also indicate how a strengthening of the supervisory system to bring specific BCPs closer to full compliance would reduce specific vulnerabilities being monitored by FSIs and the risks to financial stability. Finally, this analysis of the relationship between FSIs and BCPs can enhance the contribution of BCP assessments to financial stability by helping focus BCP assessments on sources of risk to financial stability.

**BCPs on the effectiveness of supervision**\(^\text{13}\)

BCPs covering the effectiveness of supervision support macroprudential surveillance by helping assess whether supervisors respond effectively to vulnerabilities detected using FSIs. They indicate, first, that they have the independence to be able to respond effectively (BCP 1).

Second, they reveal whether supervisors have access to the necessary information to identify problems in individual banks. This depends on the adequacy of their systems for collecting and analyzing information (BCPs 16–19 on on- and off-site examination procedures). The BCPs also indicate whether supervisors are able to verify the accuracy of their data on the condition of the bank (BCP 21). Finally, supervisors need to be able to collect information on their banks’ activities abroad, and in other financial sectors, through information exchanges with other supervisors (BCPs 1(6), 23, and 24, covering different aspects of consolidated supervision).

Third, BCPs indicate whether supervisory tools are adequate to implement remedial measures once problems have been identified. This requires information on the extent to which supervisors can respond to the specific weaknesses identified by an FSI. This includes whether procedures are in place to prevent forbearance, such as firm criteria for taking remedial action as soon as problems have been identified (BCP 22). It can help distinguish cases in which a deterioration in an FSI reflects the effects of remedial action to correct weaknesses from a case in which it signals an increased risk to financial stability—for example, whether a decline in the capital ratio is due to rapid growth of assets or the recognition of losses in response to remedial actions by supervisors to force a change in policies.

\(^{13}\)This and the following section draw on a note by Goran Lind, “The Basel Core Principles as an Instrument to Identify Financial Sector Vulnerabilities” (2001), prepared for a Financial Sector Assessment Program (FSAP) training course.
BCPs covering the safety and soundness of bank operations

A number of BCPs focus on whether supervisors can ensure that banks operate in a safe and sound manner (rather than on supervisory procedures). They address bank capital adequacy and the effectiveness of risk management procedures, as shown in Table 14.2. They provide information that can support interpretation of FSIs monitoring financial soundness, asset quality, market risk, and liquidity. For FSIs measuring capital adequacy, for example, information on the types of instruments that supervisors allow banks to include in capital can clarify the definition of capital (BCP 6). Moreover, accounting and provisioning rules can have a significant effect on capital ratios reported by banks (BCP 8).

The interpretation of FSIs measuring credit risk can be enhanced using information on the soundness of banks’ credit policies. It can be obtained from BCP 7 covering supervisory oversight of the framework for credit approval and risk management. Complementary information on country risk management reveals how effectively banks can identify and manage this aspect of credit risk (BCP 11). These BCPs provide an indication of how quickly the banking sector as a whole is likely to react to weaknesses identified using FSIs of asset quality. Similarly, the interpretation of FSIs on the sectoral distribution of loans and loan concentrations can be enhanced by information covering restrictions on large exposures and portfolio concentrations set by supervisors (BCP 9). For example, if such limits force banks to diversify their portfolios, these FSIs are likely to be less relevant for surveillance.

FSIs of sensitivity to market risk also need to be interpreted in light of the supervisory treatment of market risk exposures, particularly with respect to the exposure limits and capital charges for market exposures set by supervisors (BCP 12). This reveals whether the banks have the discretion to build up market exposures large enough to pose a risk to the soundness of the system. Information on the overall effectiveness of bank management of market risk is also useful. Finally, interpretation of FSIs measuring funding liquidity risk is improved by information on supervisory requirements relating to banks’ liquidity management policies (BCP 13).

Role of Information on the Financial Infrastructure

The robustness of the financial system infrastructure influences the risks posed by the vulnerabilities monitored by FSIs. Several features of the financial infrastructure are relevant to financial stability: the liquidity infrastructure, including central bank operating procedures; the
insolvency regime; and the accounting, disclosure, and corporate governance regime. However, the analysis will focus on the liquidity infrastructure because of its importance to the vulnerability of the banking sector, as monitored using FSIs and because much relevant information can be derived from codes and standards and assessments.

**The Liquidity Infrastructure of the Financial System**

The liquidity infrastructure consists of structural features of the financial system that affect financial institutions’ capacity to access liquidity, especially under stressful market conditions. It is relevant to both banks’ capacity to access funding on the liabilities side of their balance sheet and their capacity to liquidate positions on the asset side. Information on the financial infrastructure can enhance the effectiveness of the FSIs that assess liquidity risk in surveillance. It can also help assess the robustness of market liquidity under conditions of stress, since this is not captured well by these FSIs, which only measure current liquidity conditions.

The financial infrastructure is made up of payment and settlement systems and a broad range of markets that banks rely on for funding sources and for trading. The relevance of markets in this latter role derives from the need to adjust the composition of its asset portfolio and, in particular, its capacity to liquidate assets to obtain liquidity. These markets have operational, institutional, or structural features that influence the robustness of market liquidity. In addition, the efficiency and risk mitigation features of the payment and settlement system contribute to the robustness of liquidity in interbank and money markets. Finally, the involvement of central banks and national treasuries in markets also influences market liquidity.

**Banking sector access to liquidity**

Information on the structure of the markets that banks rely on for funding should help to assess their vulnerability to a loss of access to market funding.\(^{14}\) This depends on the degree of diversification among the banks’ funding sources and on structural features of the different markets. The interbank, repo, and securities markets are typically the most important market funding sources for banks. The interbank market is generally the lowest-cost source of funding, but it is an unsecured market in which access is particularly sensitive to a deterioration in

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\(^{14}\)This form of financial crisis is more common than that triggered by a depositor bank run, which has received the most attention in the theoretical literature on banking crises.
bank credit quality from macroeconomic shocks. This is reflected by the fact that banks will only lend to highly rated bank counterparties through this market. In contrast, repo market lending is conducted on a secured basis, so liquidity is more robust to such shocks. Similarly, securities markets are effective at pricing credit risk so that a reduction in credit quality is likely to be reflected in a wider borrowing spread rather than in a loss of access to funding relative to the interbank market. In sum, information on the microstructure of these markets and on diversification of funding sources can help assess banks’ capacity to maintain access to funding in a crisis.\footnote{It is worth noting the greater operational risk in these latter two markets, making them more vulnerable to other types of shocks. For example, the terrorist attack on September 11, 2001, impaired the repo and securities markets to a greater extent than the interbank market, providing yet another reason to diversify funding sources.}

Structural features of the payment system also can affect bank access to liquidity. Some payment systems give rise to large, very-short-term (intra-day) credit exposures that make banks less willing to lend to one another if there is uncertainty about the creditworthiness of key counterparties. This effect has been reduced in some markets through reductions in the settlement lag in large-value payment systems, through loss-sharing arrangements, and through greater reliance on collateral. The move in many countries to Real Time Gross Settlement systems in money markets has eliminated credit exposures arising from the settlement lag entirely. These features can be assessed using information from Committee for Payment Settlement Systems core principles assessments. Thus, FSIs of market liquidity can be complemented by indicators of payment system functioning, such as on intra-day interbank exposures and daylight overdrafts.

The framework through which central banks provide liquidity and the safety net influence the extent to which banks can continue to access market liquidity in a crisis. An extensive safety net contributes to the perception that the authorities will prop up weak banks through lender-of-last-resort and other forms of support. This should help maintain access to liquidity by encouraging other banks to continue lending to weak banks as their credit quality deteriorates. Also, central bank operating procedures that provide broad access to liquidity make it easier for weak banks to continue to obtain liquidity. This further maintains access to liquidity by reducing concerns that a loss of access to liquidity could trigger a crisis. Another facet is the quality of the collateral central banks are willing to accept; for example, when a relatively broad range of securities is accepted as collateral, this allows weaker banks that may have already committed their higher-quality collateral to continue to obtain
funding from the central bank. Information on these features of a financial system can be obtained from Financial Sector Stability Assessment reports and other sources.

**Market liquidity**

Information on the market infrastructure can help assess the robustness of market liquidity under conditions of market stress. It complements FSIs of market liquidity measuring current liquidity conditions by providing insights into how rapidly and at what discount banks can liquidate assets in a crisis. The market microstructure that determines the robustness of market liquidity vary, depending on whether they are over the counter or exchanges, and whether an electronic trading system is used. For over-the-counter markets, the capacity and incentives of market makers to make markets play an essential role in ensuring liquidity. Thus, indicators such as the number of market makers and the size of net open positions relative to turnover or market size will help assess the robustness of market liquidity. For exchanges, factors that influence the efficiency and robustness of trading systems (such as price transparency, margining rules, and capital available to support liquidity) could be a useful indicator. When electronic trading systems are used, information on transaction size or the extent and size of “gapping” (that is, the difference between closing and opening prices) can serve as an indicator. Finally, the robustness of liquidity can be enhanced when closely related assets are traded on different types of markets—for example, foreign exchange is traded on over-the-counter markets, exchanges, and electronic trading systems—so the extent to which different types of markets can substitute for one another must be considered.

**The Insolvency, Disclosure, and Corporate Governance Regimes**

Information on the insolvency regime is relevant to the interpretation of FSIs because it influences the capacity of the banking system to limit losses in the event of counterparty default by seizing assets or collateral. In a regime favoring creditors, for example, losses in the event of default should, in principle, be smaller than in a debtor-friendly regime. In particular, information on loss-given-default (LGD) could help interpret FSIs. For example, the impact on capital of a deterioration of NPLs would be less than in a debtor-friendly regime because LGD would be lower. This suggests that the FSIs of asset quality could be complemented by indicators of LGD derived from supervisory data.
Conclusion

This paper outlines how the surveillance role of FSIs can be strengthened by taking into account the relationships among FSIs and by using them in combination with tools such as stress testing, BCP assessments, and codes and standards assessments. Accounting relationships and statistical analysis of the linkages between FSIs can help evaluate the extent to which increases in FSIs monitoring vulnerabilities will eventually be reflected in a deterioration in financial soundness. This enhances our capacity to judge the extent to which these increases endanger financial stability. Other surveillance tools can compensate for some limitations of FSIs. Stress testing complements the ongoing surveillance using FSIs by providing estimates of the potential loss associated with changes in FSIs, thereby helping to benchmark them. They also provide more precise estimates of sources of risk such as that arising from interbank exposures.

The BCP assessments provide information that enhances our capacity to assess the risk to financial stability using FSIs. They help interpret FSIs by providing information on their definition. They also indicate how rapidly and effectively supervisors and financial institutions are likely to address vulnerabilities identified by FSIs, helping to judge at what level an FSI should be regarded as a cause for concern. Information on the financial system infrastructure from codes and standards assessments is relevant to the analysis of FSIs monitoring banking sector liquidity by providing insights into the robustness of bank access to liquidity under conditions of stress. It also complements FSIs of market liquidity by indicating the difficulty for banks of liquidating their asset portfolios to raise liquidity in a crisis.
Appendix I: Modeling the Relationship Between Corporate and Banking Sector FSIs

The modeling and estimation of the relationship between corporate leverage and asset quality are made more complex by the possibility that the two are simultaneously determined in conjunction with the cost of capital. Specifically, the following relationships need to be incorporated in the model:

• A more highly leveraged corporate sector implies that corporates are more vulnerable to macroeconomic shocks that could precipitate defaults, which would increase NPLs.

• As the corporate sector becomes more leveraged, the risk premium in lending rate rises, reducing the incentive to take on more leverage.

• The amount of leverage depends on the capacity of the banking system to extend credit, which is reduced by the deterioration in asset quality due to increased corporate sector defaults when leverage is high.

These interrelationships suggest that the equation representing the effect of leverage on asset quality may also need to be estimated together with two other equations, thus capturing the indirect effect of leverage on lending rates and the effect of financial sector weakness on leverage. This is shown in equations (1), (2), and (3), respectively.

\[
\text{npls} = \alpha_0 + \alpha_1 \text{lev} + \alpha_2 \text{rcc} + \alpha_3 \text{reer} + \alpha_4 \hat{\gamma} + \alpha_4 \hat{p} + \alpha_5 \hat{m} \\
\text{(1)}
\]

\[
\text{lev} = \beta_0 + \beta_1 \text{npl} + \beta_2 \text{rcc} + \beta_3 \hat{\gamma} + \beta_4 \hat{p} + \beta_5 \hat{d} + \beta_6 \text{roe} \\
\text{(2)}
\]

\[
\text{rcc} = \gamma_0 + \gamma_1 \text{lev} + \gamma_2 \hat{\gamma} + \gamma_3 \hat{m} \\
\text{(3)}
\]

These are the variable definitions:

\text{npls}: Ratio of nonperforming loans to total loans
\text{lev}: Corporate sector leverage ratio (ratio debt to equity plus retained earnings)
\text{rcc}: Real cost of capital (weighted average of real lending rate and cost of equity)
\text{reer}: Real effective exchange rate
\text{y-hat}: Real GDP growth rate
\text{p-hat}: Inflation rate
\text{m-hat}: Growth rate of M1
\text{d-hat}: Growth rate of domestic credit
\text{roe}: Return on equity
The economics underlying equation (1) implies that the ratio of NPLs to total loans \((npl)\) should increase with a rise in corporate leverage \((lev)\), which makes default more likely, though possibly with a lag. The effect of the real cost of capital \((rcc)\) is more complex because it has offsetting effects on the numerator and denominator of \(npls\). A rise in the real cost of capital encourages banks to lend more, which reduces the ratio by raising the denominator. However, it also increases borrowing costs, which should contribute to a rise in NPLs (in the numerator), although probably with a lag. This is because equation (1) has a ratio as the dependent variable; it incorporates both credit quality and loan supply effects. The ratio \(npls\) increases with an appreciation of the real effective exchange rate \((reer)\), because defaults should rise as the corporate sector loses competitiveness, increasing NPLs. The ratio should decrease with economic growth \((y-hat)\), which makes default less likely because it is usually associated with a rise in profitability. It should decrease with higher inflation \((p-hat)\) because it becomes easier to repay loans contracted at a fixed nominal value, and it should fall with a rise in money growth \((m-hat)\), which is associated with increased lending and, therefore, with an increase in the denominator of \(npls\).

The economics underlying equation (2) implies that the leverage ratio \((lev)\) should be negatively related to the \(npls\), as a higher level of NPLs contributes to banking sector weakness, which is likely to cause banks to scale back lending. It should decline with a rise in the real cost of capital \((rcc)\), as borrowing costs rise reflecting the interpretation of equation (2) as the corporate sector’s demand for credit. It should increase with economic growth \((y-hat)\), as firms borrow more to invest. It should increase in inflation \((p-hat)\), which creates an incentive to take on more debt because it reduces the real value of existing debt. It declines with an appreciation in the real effective exchange rate \((reer)\) because the loss of competitiveness reduces profits and, hence, the incentive to borrow. It increases with domestic credit growth \((d-hat)\), which is associated with the financing of the increase in leverage. Finally, it should be positively related to the return on equity \((roe)\), as a higher return encourages firms to take on more debt to fund the more profitable investment. Note that this variable contributes to the identification of equations (1) and (2) because return on equity \((roe)\) affects leverage but not \(npls\).

In equation (3), the real cost of capital (a proxy for firms’ financing costs, which is a weighted average of the cost of debt and equity) should be a function of leverage, because a rise in leverage contributes to a higher risk premium in the lending rate and rate of return on equity. It should also be positively related to economic growth, as this contributes

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to increased demand for credit, pushing up borrowing costs. But it should be negatively related to money growth, because an easing of monetary conditions should be associated with lower real interest rates and cost of capital (at least temporarily). This cost of capital measure provides another channel through which shocks affecting financial soundness can influence macroeconomic conditions, because a rise in the cost of capital associated with the widening of the risk premium influences the savings-investment balance and balance of payments.

References


