IV SPECIAL FEATURES

A MEASUREMENT CHALLENGES IN ASSESSING FINANCIAL STABILITY[1]

Financial stability assessment as currently practised by central banks and international organisations probably compares with the way monetary policy assessment was practised by central banks three or four decades ago – before there was a widely accepted, rigorous framework. The measurement challenges that lie ahead for financial stability assessment are formidable. However, it is important to acknowledge that significant progress has been made in recent years. Even though there is no obvious framework for summarising developments in financial stability in a single quantitative measure, a growing number of central banks around the world are making financial stability assessments and publishing financial stability reports, many of them based on a broad and forward-looking conception of financial stability.

INTRODUCTION

Financial stability is a difficult concept to define. Although it is often seen only from the perspective of avoiding financial crises, it also has a positive dimension. It is a condition where the financial system is capable of performing well all of its normal tasks and where it is expected to do so for the foreseeable future. From this viewpoint, financial system stability requires the principal components of the system – including financial institutions, markets and infrastructures – to be jointly capable of absorbing adverse disturbances. It also requires that the financial system is facilitating a smooth and efficient allocation of financial resources from savers to investors, that financial risk is being assessed and priced reasonably accurately and that risks are being efficiently managed. Financial stability also has an important forward-looking dimension: inefficiencies in the reallocation of capital or material shortcomings in the pricing of risk can, by laying the foundations for future vulnerabilities, compromise future financial system stability and, therefore, economic stability.

There are three important aspects to producing a comprehensive assessment of financial stability. The first entails forming a judgement about the individual and collective strength and robustness of the constituent parts of the financial system – institutions, markets and infrastructures. The second involves systematically identifying the plausible and (systemically) important sources of risks and vulnerabilities that could pose challenges to financial stability in the future. The third is an appraisal of the potential costs – that is, the ability of the financial system to cope – should some combination of these identified risks and vulnerabilities materialise. In practice, this requires an ability to measure (and model) strength and robustness, or to calibrate the plausibility and importance of the various risks, or to appraise quantitatively the potential costs should risks materialise. However, each of these areas entails formidable measurement and modelling challenges, so much so that in practice many shortcuts and qualitative judgements must be made to produce an overall assessment. This Special Feature is the companion to a Special Feature in the last issue of this Review, and discusses some of the main measurement challenges involved in practical financial stability assessment.[2]

The rest of this Special Feature is organised as follows. Section 2 discusses some of the practical challenges involved in implementing a framework for financial stability assessment. It outlines criteria for disciplining the process of information gathering, monitoring and assessing, and it highlights the formidable measurement challenges faced. Section 3 briefly outlines some of the immediate and difficult challenges that lie ahead in both assessing and safeguarding financial stability. Finally, Section 4 briefly draws some conclusions.

1 This special feature draws heavily on J. Fell and G. Schinasi (2005), "Assessing Financial Stability: Exploring the Boundaries of Analysis", *National Institute Economic Review*, No 192, April, pp. 102-117.

2 See ECB (2005), "Assessing financial stability: Conceptual boundaries and challenges". *Financial Stability Review*, June, pp. 117-125.

PRACTICAL CHALLENGES IN IMPLEMENTING A FRAMEWORK FOR FINANCIAL STABILITY ASSESSMENT

DISCIPLINING THE PROCESS OF ASSESSMENT

One of the objectives of any financial stability assessment should be to determine whether the financial system can be judged to be either in a zone or corridor of financial stability, as approaching a boundary of stability/instability, or outside a zone or corridor of stability. Within the third category, the financial system could be further judged to be in a position in which self-corrective processes and mechanisms are assessed as being likely to move the system back towards the corridor of stability or, alternatively, need prompt remedial and even emergency measures to reverse the instability.

While categories of possible assessments may be straightforward to discuss in principle, they are difficult to identify in practice. How should the boundary of stability be defined and measured, for example? When does an isolated small problem threaten to become a systemic one? There would also seem to be a bias towards being prudent and overreaching in identifying potential sources of risks and vulnerability and therefore towards overestimating their likelihood and importance. Thus, it would be useful to establish some ground rules or guidelines which could discipline the continuous process of information gathering, analysis, and monitoring; and, most importantly, to identify sources of risks and vulnerabilities. A checklist of disciplining principles for identifying risks and vulnerabilities and for assessing where along the stability spectrum the financial system might be could include the following:

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

In practice, the process of assessing financial stability entails a *systematic* identification and analysis of the sources of risk and vulnerability that could impinge on stability in the circumstances in which the assessment is being made. For example, consider the comprehensive list of sources of risk in Table A.1 below.[3]

An operationally significant distinction is made between endogenous sources of risk that

3 See A. Houben, J. Kakes and G. Schinasi (2004), "Framework for Safeguarding Financial Stability", *IMF Working Paper* 04/101.

Table A.1 Sources of risk to financial stability

Endogenous	Exogenous
Institutions-based:	*Macroeconomic disturbances:*
Financial risks	Economic environment risk
Credit	Policy imbalances
Market	*Event risk:*
Liquidity	Natural disaster
Interest rate	Policy events
Currency	Large business failures
Operational risk	
Information technology weaknesses	
Legal/integrity risk	
Reputation risk	
Business strategy risk	
Concentration risk	
Capital adequacy risk	
Market-based:	
Counterparty risk	
Asset price misalignments	
Run on markets	
Credit	
Liquidity	
Contagion	
Infrastructure-based:	
Clearance, payment and settlements system risk	
Infrastructure fragilities	
Legal	
Regulatory	
Accounting	
Supervisory	
Collapse of confidence leading to runs	
Domino effects	

Source: Houben, Kakes and Schinasi (2004).

are present within the financial system, and exogenous sources of risk. Defining the financial system broadly, endogenous sources of risk can arise either in financial institutions, or in financial markets, or in the infrastructures, or in any combination of these.[4] For instance, credit, market or liquidity risks may be present in financial institutions which, if they materialise, could hamper the process of reallocating financial resources between savers and investors. Financial markets can be a source of endogenous risk not only because they offer alternative sources of finance to non-financial sectors, but also because they entail systemic linkages between financial institutions, and more directly between savers and investors. Financial infrastructures are also an important endogenous source of risk, in part because they entail linkages between market participants as well, but also because they provide the institutional framework in which financial institutions and markets operate. Outside the financial system, the macroeconomic environment can be an exogenous source of risk for financial stability because it directly influences the ability of economic and financial actors (households, companies, and even the government) to honour their financial obligations. Financial stability assessments should entail a systematic and periodic process of monitoring of each of these sources of risk, both individually and collectively, taking into account cross-sector and also cross-border linkages.

Calling attention to the main sources of risk and vulnerability to financial stability does not necessarily aim at identifying the most likely future scenarios. Instead, it entails the identification of potential sources of risk and negative events, even if these are remote and unlikely. In order to preserve discipline in an exercise that essentially involves determining what could go wrong, a key consideration is the *plausibility* of the risks identified.

For example, an analysis of conditions in the household and corporate sectors might reveal that a sizeable drop in the rate of output growth could, by significantly lowering income and profits, cause a notable rise in household and corporate loan default rates, and thereby threaten the smooth functioning of the financial system. However, if the constellation of economic fundamentals underpinning the pace of economic activity suggests that the likelihood of recession is very low, then such an assessment would carry limited value. Ideally, if the probability of a disruptive event occurring can be estimated reasonably, then the plausibility of a source of risk can be rigorously determined. In current practice, given data, measurement and methodological limitations (which will be discussed later), in most cases a ranking of the plausibility of the various risks identified must be based on qualitative judgements based on very limited information.

While it is desirable to consider seriously all plausible sources of risk to financial stability, it would also be desirable to distinguish sources that could prove to be *systemically relevant* from sources that are unlikely to prove costly. For example, the plausible risk of an asset market correction would be seen as relatively benign if, given the current conjuncture, it was judged to entail only a minor threat to the financial condition of the household, corporate and financial sectors. However, if the risk was judged to threaten the solvency of a significant portion of any one of these sectors, it could prove more costly from a systemic perspective. The challenge is to distinguish between those threats to financial stability that, should they crystallise, carry a high probability of a significant disruption to real economic activity, and those that are likely to prove self-correcting without having a material impact either on the level of activity or the process of resource allocation. As implied by the examples, the systemic relevance of a particular set of risks can be determined if a reasonable judgement – if not quantitative assessment – can be made about

4 See G. J. Schinasi (2004), "Defining Financial Stability", *IMF Working Paper*, No 04/187; and G. J. Schinasi (2005), *Safeguarding Financial Stability: Theory and Practice*, IMF, December.

the likely real economic costs, given the materialisation of the risks. Ideally, the expected losses (for example, ones resulting from the product of the probability of the event and the cost, given materialisation) could lead to a ranking of the importance of the various plausible risks identified. More realistically, formidable practical challenges remain in assessing and estimating the likelihoods of what are, typically, low probability events and in measuring the associated costs. As discussed later, costs are also difficult to estimate, but at least there is a history of financial events that could, in principle, allow potential costs to be calibrated.

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

With regard to *cross-checking*, since the process of identifying sources of risk and vulnerabilities is to some extent contrarian, in the sense that it identifies what could go wrong, the burden of proof should arguably be higher than that required for predicting the most likely outcome. Hence, financial stability analysis should involve sufficient cross-checking of the assessment by considering a sufficiently wide range of alternative analytical tools, models, and data sources – and importantly, should include a continuous dialogue with market participants.

Concerning *time consistency*, further discipline on the process of identifying risks and vulnerabilities can be achieved if the horizon over which a given risk is most likely to crystallise can be assessed. The empirical literature has shown that it can be a challenging, if not impossible, task to predict the timing of crises. This should not stand in the way of judging whether a given plausible source of risk has a near, medium or long-term likelihood of materialising. Doing this systematically and periodically for the same sets of risks can improve accountability in the process of financial stability assessment. Some risks may ultimately prove to be self-correcting without posing any systemic threat, and in such cases, it is important to understand the reasons why. If a "false signal" was sent because of a more orderly than predicted unwinding of an imbalance or because of a structural change, such as better risk management that strengthened the financial system and thereby mitigated the risk, then this information can serve to improve future assessment.

MEASUREMENT AND MODELLING ISSUES

For most macroeconomic or monetary policy objectives (unemployment, economic growth, external or budgetary equilibrium, price stability, etc.) there is a widely accepted measurable (set of) indicator(s) that define, and measure deviations from, the objective, even if these indicators are still subject to methodological and analytical debate and even controversy. In the case of macroeconomics and monetary economics, it took both disciplines some several decades of practice, trial and error, measurement and modelling development, and fundamental research to accomplish this. Financial stability analysis is still in its infancy and thus, by contrast, there is

as yet no widely accepted set of measurable indicators of financial stability that can be monitored and assessed over time. In part, this reflects the multifaceted nature of financial stability, as it relates to both the stability and resilience of financial institutions, and to the smooth functioning of financial markets and settlement systems over time.[5] Moreover, these diverse factors need to be weighed in terms of their potential ultimate influence on real economic activity. However, this situation also reflects the fact that the discipline of assessing financial stability is relatively new. Because measurement is not yet highly developed, the current practice of making financial stability assessments could be best described more as an art form rather than as a rigorous discipline or science.

Each of the three main conceptual aspects of the notion of financial stability outlined in Schinasi (2004) – resource allocation, risk pricing and management, and absorptive capacity – poses challenges for measurement. Take the simple example of measures of solvency for judging the potential resilience and absorptive capacity of an individual financial institution. Even if balance sheet capital (that is, the difference between assets and liabilities) provides a good indication of near-term shock absorption capacity, bank solvency may still not adequately capture the forward-looking dimensions of financial stability. If a bank's high levels of solvency reflect missed lending opportunities in a highly competitive industry, then the foundations may be laid for future weaknesses in the bank through future profit erosion and loss of market share. To take a financial market example, while measures of low asset price volatility could be indicative of stable conditions in a financial market, they may alternatively signal a failure in the price discovery process. Should this lead to a misallocation of financial resources, it may sow the seeds of vulnerabilities that could threaten financial stability in the future.

The challenge of measuring financial system stability extends well beyond the challenge of measuring the degree of stability in each individual sub-component of the financial system. Financial stability requires the constituent components of the system – financial institutions, markets and infrastructures – to be jointly stable. Weaknesses and vulnerabilities in one component may or may not compromise the stability of the system as a whole, depending on size and linkages – including the degree and effectiveness of risk-sharing between different components. Moreover, as different parts of the system perform different tasks, aggregating information across the system represents a challenge. For example, in diversified financial systems – where both financial institutions and markets are important providers of finance – there is no commonly accepted way of aggregating information on the degree of stability in both the banking system and financial markets in order to form an overall assessment of system stability. If the banking system is functioning well but, at the same time, there are signs of strains in financial markets, the overall assessment of financial system stability is likely to be ex ante ambiguous, particularly if the respective shares of the two components as providers of finance are similar. The more complex and sophisticated a financial system is, the more complex the task of measuring overall stability in a precise way is likely to be.

Measurement challenges in identifying the risks and boundaries to financial stability can be illustrated by examining aspects of the Minsky (1977) financial instability hypothesis.[6] In this hypothesis, as an economy

5 Sets of indicators have been developed – and are widely used – for assessing the soundness of banking institutions. See, for example, IMF (2003), *Analytical Tools of the Financial Sector Assessment Program*; IMF (2004), *Compilation Guide on Financial Soundness Indicators*; and L. Mörttinen, P. Poloni, P. Sandars and J. Vesala (2005), "Analysing Banking Sector Conditions – How to Use Macro-prudential Indicators", *ECB Occasional Paper* No 26, April.

6 See H. M. Minsky (1977), "The Financial Stability Hypothesis: An Interpretation of Keynes and an Alternative to "Standard" Theory", *Nebraska Journal of Economics and Business*, 16 (1), pp. 5-16.

enters into an upswing, risk premia are gradually eroded as managers of firms and banks discover that the majority of conservatively financed projects are succeeding. Gradually, two characteristics emerge: "Existing debts are easily validated and units that were heavily in debt prospered: it pays to lever". As a result, prevailing risk premia begin to be considered as excessive. Lenders and borrowers begin to take on greater risks and, fuelled by credit and optimism about future profits, this sets off both growth in investment and exponential increases in asset prices. At some point, however, excesses occur, and the conditions that underpinned the boom eventually trigger its collapse. Overinvestment begins to reduce the return on capital, bankruptcy rates begin to rise, firms scale back on investment, and consumers reassess their capacity to repay debt. As optimism gives way to pessimism, aggregate demand in the economy falls sharply and asset prices plummet, possibly inducing a financial crisis.

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

Analytical frameworks are required to help in guiding measurement, for example by identifying and suggesting the sets of variables and conditions that could underpin threats to financial stability. Presently, there is a dearth of general equilibrium models and comprehensive system-wide approaches for identifying measures of, and risks to, financial stability.[7] Alternatively, some practitioners employ partial approaches, relying on the analysis of individual indicators of financial imbalances. Sometimes this entails basing assessments on "rule of thumb" thresholds derived from longer-term historical averages or from cross-country comparisons. Here, too, important measurement (and modelling) issues can arise. Many, if not most, imbalance indicators can be interpreted in one of two ways, with each one, which may be cycle-dependent, having different implications for financial stability assessments. As discussed, high levels of bank solvency, while possibly indicating a stable bank, could equally be the harbinger of emerging vulnerabilities. Narrow spreads across a wide range of fixed income markets could indicate perceptions of low credit risk in these markets, but also may reflect a mispricing of risks – as proved to be the case prior to, and following, the near-collapse of Long-Term Capital Management (LTCM) in 1998. High price-earnings ratios in equity markets might indicate a stock price bubble but could alternatively represent an accurate expectation of a future strengthening of corporate sector profitability. Similarly, while high non-financial sector debt ratios might be indicative of heightened credit risks facing banks, they could also be a reflection of a welfare-enhancing relaxation of liquidity constraints, together with a favourable assessment of long-term economic prospects by private economic agents. These examples serve to illustrate that in the absence of relying on a broad range of indicators and an understanding of the broader economic and financial environment in which indicators are being measured, excessive reliance on single indicator analyses can lead to unsound financial stability assessments.

7 A rare exception can be found in A. Haldane (2004), "Defining Monetary and Financial Stability", Bank of England mimeo. Here a general equilibrium model is used to derive a simple financial stability "indicator" that is related to monetary stability.

In identifying risks and vulnerabilities, there are ways of dealing with the ambiguities that can arise in single indicator analyses. While identifying financial imbalances ex ante can be challenging, progress can be made by combining the information contained in individual indicators such as credit growth and asset prices (see Hargraves and Schinasi (1993), and more recently and rigorously, Borio and Lowe (2002)).[8] Other cross-checking approaches can involve looking beneath the surface of aggregate data by examining micro data. For instance, the question whether or not abnormally high aggregate household debt ratios pose acute credit risks for banks may easily be settled if micro data on households reveal that the most indebted households also have sufficient financial buffers to protect them against sharp changes in interest costs and/or employment income.[9] Overall, it would appear that the best assurance of a robust financial stability assessment is to base it on eclectic inputs – including a wide range of data sources.

An important component of any financial stability assessment is to assess the ability of the financial system to cope with problems, should plausible risks materialise. One of the most common ways to perform such assessments is stress testing, based on a range of techniques – including sensitivity and scenario analyses. These approaches, which are increasingly used by individual financial institutions[10], are also being used at an aggregated macro level for assessing systemic stability. The IMF has formalised this through the introduction of macroeconomic stress testing as a key element in its Financial Sector Assessment Program (FSAP).[11] Sensitivity tests are ordinarily designed to isolate the likely impact of selected risk factors such as changes in interest or exchange rates. Scenario analyses tend to be richer, involving simultaneous moves in a number of risk factors. The scenarios can be based on historical episodes of financial stress or on hypothetical events that are considered to be plausible, or on sets of events. As such approaches often have a high degree of internal consistency, they can make an important contribution to the understanding of the systemic relevance of financial risks.

While methodological advances have been made, as currently practised, macro stress-testing techniques have several limitations. The impacts of scenarios can be gauged both through bottom-up approaches – aggregating information on how a range of institutions would weather a plausible but "challenging" scenario – or at an aggregate level, perhaps employing a macroeconometric model. Combining the two approaches can facilitate cross-checking and more reliable assessment. However, a limitation of both approaches is that potential second-round effects of scenarios tend to be ignored because the underlying models pay insufficient attention to macro-financial interaction (as discussed in Hoggarth and Whitley (2003)).[12] This means that the overall impacts of adverse disturbances could well be underestimated. For instance, in the case of a decline in the pace of economic activity that is sufficiently large to challenge the robustness of the banking system, weakened banks might face an increase in funding costs and/or a withdrawal of deposits that puts further downward pressure on profits. At the same time, faced with deterioration in the creditworthiness of their customers, banks might be inclined to tighten lending terms and conditions. This would most likely have second-round effects on aggregate

8 See M. Hargraves and G. Schinasi (1993), "Boom and Bust" in Asset Markets in the 1980s: Causes and Consequences", in *Staff Studies for the World Economic Outlook*, IMF, December; and C. Borio and P. Lowe (2002), "Asset Prices, Financial and Monetary Stability: Exploring the Nexus", *BIS Working Papers*, 114.

9 See, for instance, Sveriges Riksbank (2004), *Financial Stability Report*, 1; and the Special Feature in this Review entitled "Assessing the financial vulnerability of euro area households using micro-level data".

10 See Committee on the Global Financial System (CGFS) (2005), "Stress Testing at Major Financial Institutions: Survey Results and Practice", available at http://www.bis.org/.

11 See IMF (2003), "Analytical Tools of the Financial Sector Assessment Program"; and W. Blaschke, M. Jones, G. Majnoni and S. Peria (2001), "Stress Testing of Financial Systems: A Review of the Issues, Methodologies, and FSAP Experiences", *IMF Working Paper*, WP/01/88.

12 See G. Hoggarth and J. Whitley (2003), "Assessing the Strength of UK banks through Macroeconomic Stress Tests", *Bank of England Financial Stability Review*, 14.

demand and output, potentially leading to further losses in the banking system. Moreover, for a disturbance that was sufficiently large to cause the failure of a large financial institution, this might have a direct impact on the capital, or even solvency, of other (counterparty) banks. Macro stress testing, as currently practised, is generally not capable of assessing the importance or gauging the magnitude of these effects.

Financial stability assessments carry a higher degree of uncertainty than ordinarily associated with forecasts based on macroeconometric models. This is because there can be formidable practical challenges to measuring, modelling and assessing the consequences of rare events. A first practical challenge is that if past crises had been prevented or tackled by policy actions, assessments of the likely costs of a selected scenario, based on simulations drawn from historical datasets, would likely prove to be biased unless sufficient account is taken of policy reaction functions. It is doubtful that past policy responses to episodes of financial stress could be summarised by a mechanical reaction function, particularly if the authorities were mindful of avoiding the moral hazards that typically follow from predictable behaviour. Moreover, even in cases that did not prompt policy responses, the frequency of crises in historical datasets may be too low to facilitate precision in estimating the likely policy-neutral consequences of a stylised scenario.

Second, confidence intervals around the expected output losses associated with the materialisation of a specified scenario may be not well-defined statistically, or even not defined at all. For instance, simulations based on historical episodes tend to be founded on statistical relationships that reflect the central tendency of, rather than the tails of, probability distributions. Moreover, in purely hypothetical scenarios, it might not be possible to compute a confidence interval around the simulation because the events themselves may be subject to so-called Knightian uncertainty – or unquantifiable risk.[13]

Third, most macroeconometric models used for stress testing tend to be built on the basis of log-linear relationships. For simulations, this means that a doubling of the size of a shock will result in a proportionate change in the effect. However, in reality, it can never be excluded that in situations of financial stress, unpredictable non-linearities may surface, for instance due to threshold effects.

Fourth, as witnessed during the near collapse of LTCM in 1998, unexpected links may surface during crises, such as correlations between financial markets that do not ordinarily tend to be correlated. Given such uncertainties, the real economic costs associated with a particular scenario could well prove to be larger than those predicted by an empirical model. Such considerations would suggest that the output of any stress-testing exercise should only be viewed as indicative of how, or if, the financial system would endure such adverse disturbances. To avoid complacency, this calls for a high degree of caution and judgement in forming financial assessments.

Fifth, concerning measurement of the costs of financial instability, the literature is just in its infancy and has tended to focus on the increasing incidence of bank crises (see Bordo et al. (2001); Garcia-Herrero and Del Rio (2003)) and their considerable costs (see Lindgren, Garcia, and Saal (1996); Hoggarth and Sapporta (2001); and Barrell, Davis and Pomerantz (2005)).[14] Even defining a systemic financial crisis is not straightforward and, once defined, there are several elements to take into

13 See F. H. Knight (1921), *Risk, Uncertainty, and Profit*, Cambridge, Riverside Press.

14 See M. Bordo, B. Eichengreen, D. Klingebiel and M. Martinez-Peria (2001), "Is the Crisis Problem Growing More Severe?", *Economic Policy*, 32, pp. 51-82; A. García-Herrero and P. del Rio (2003), "Financial Stability and the Design of Monetary Policy", *Documento de Trabajo*, 0315, Banco de España; C.-J. Lindgren, G. Garcia and M. Saal (1996), "Bank Soundness and Macroeconomic Policy", *IMF Occasional Papers*, 135; G. Hoggarth and V. Sapporta (2001), "Costs of Banking System Instability: Some Empirical Evidence", *Bank of England Financial Stability Review*, 10; R. Barrell, E. P. Davis and O. Pomerantz (2005), "Costs of Financial Instability, Household-sector Balance Sheets and Consumption", NIESR, mimeo.

account in assessing the costs (as Hoggarth and Sapporta demonstrate). In measuring the costs, it is particularly important to be mindful of feedback: banking crises can be caused by sluggishness in the pace of economic activity, but they can also be the cause of an economic slowdown or recession. A challenge for measurement is to disentangle the feedback effects and isolate the quantitative impact of the crisis on the economy. The costs associated with banking crises can include losses faced by stakeholders in the banks which have failed, including shareholders, depositors and other creditors. Taxpayers may face costs if there is a public sector resolution of the crisis. If, because of rising risk aversion or the rationing of credit, borrowers lose access to funds or face difficulties in accessing other sources of finance, economic activity may be adversely affected. The incomes of depositors may also be adversely affected if banks seek to widen spreads by lowering deposit interest rates in order to recoup loan losses. Finally, if the functioning of the payment system is impaired because consumers become reluctant to make deposits with banks, the overall adverse impact on economic activity may be magnified. For measurement, it is not clear-cut whether the overall costs should be gauged by losses in GDP, fiscal costs or some combination of the two. The impact on the broader macroeconomy of some crises may have been avoided because of early resolution, resulting in the incurrence of fiscal costs. For others there may have been no direct fiscal implication, but instead a significant impact on economic activity.

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

SOME REMAINING CHALLENGES IN DESIGN AND IMPLEMENTATION

In order to advance the practice of financial stability assessment from an art towards a science, progress is necessary on at least three fronts: data, models and the understanding of linkages. Regarding data, several areas can be identified which contain shortcomings. A priority for data gathering must be micro balance sheet data covering financial institutions, households and firms. While a picture of the aggregate risks borne within each of these sectors can be useful for financial stability analysis, far more important is an understanding of the way in which the risks are distributed across sectors, and especially whether or not concentrations or pockets of vulnerabilities can be pinpointed. In mature economies, the availability and comprehensiveness of such data are rather mixed, particularly for the household sector.

It has become fashionable to employ indicators based on the prices of securities for financial stability assessment. In principle, if markets are efficient, then indicators derived from securities prices – such as credit spreads, distances-to default, volatilities implied by options prices, etc. – should contain invaluable information for financial stability. This is because securities prices should contain the collective expectations of the multitude of market participants with regard to the underlying fundamentals governing valuations. If those market participants also have an eye on the possible impacts of the same risks and vulnerabilities as the public authorities then, in principle, market indicators could reveal information on the ability of the financial system to weather plausible adverse disturbances. For instance, via risk-neutral densities, options prices can even facilitate the extraction of market-based probabilities of the occurrence of pre-specified asset price movements over pre-specified horizons.

However, there can be risks of circularity in this analysis: a comprehensive financial stability assessment should attempt to gauge whether there are plausible risks of market dislocations resulting from mispricing, whereas inferences on market expectations are built on the assumption that prices are always "correct". More and better data on quantity indicators – such as indicators of liquidity, leverage, market positioning, etc. – would help in shedding light not only on the indicator properties of securities prices for financial stability assessment, but also on the vulnerabilities prevailing within financial markets.

Two areas where more and better analytical research on financial stability modelling appears necessary include models for identifying risks and vulnerabilities, and models for assessing the consequences of adverse disturbances.[15] Concerning the identification of risks, the literature suggests that it is doubtful that models will ever be capable of predicting crises, particularly when it comes to their precise timing. Nevertheless, this should not stand in the way of developing models for assessing vulnerabilities. Even simple single indicator approaches can be useful for gauging risks to financial stability (see Campbell and Shiller (2001))[16], and ongoing work holds out some hope for the development of more comprehensive frameworks that could pinpoint the sets of variables (see IMF (2004)), as well as the conditions that increase the likelihood of financial stress (see, for example, Borio and Lowe (2002)). As for the prediction of crises, it cannot be excluded that, by borrowing from advances made in other disciplines in the modelling of discontinuous processes (such as the prediction of earthquakes), insights may be gained that can benefit financial stability assessment.

Ideally, to ensure an accurate assessment of the likely impact of adverse disturbances, it would be necessary to have dynamic general equilibrium modelling frameworks capable of measuring (possibly non-linear) interaction within and between financial and non-financial sectors of the economy, including at the global level. Although current practices are far from achieving this, the implementation of macroeconomic stress-testing frameworks, such as those increasingly applied in the context of the IMF's FSAPs, have undoubtedly advanced the development of internally consistent frameworks for assessing the resilience of financial systems to adverse disturbances.[17] Sources of risk and vulnerability can be quantitatively mapped into their impact on banks' balance sheets, both individually and on a system-wide basis. However, reflecting the limitations of underlying models, current practices tend to ignore the second-round effects of financial crises. They also tend to focus exclusively on the functioning of the banking system, whereas a broader definition of the financial system requires an understanding of the likely impacts on other financial institutions and on the functioning of financial markets and infrastructures. This calls for further work to be conducted not only on the modelling of real-financial interaction, the complexity of which exhibits a tendency to increase over time, but also on interactions within the financial system itself.

Finally, a good understanding of linkages is crucial for financial stability analysis. To ensure that important linkages are not missed in a financial stability assessment, both the financial system and the sources of potential risk and vulnerability should be defined in

15 See R. Sahajwala and P. van den Berg (2000), "Supervisory Risk Assessment and Early Warning Systems", *Basel Committee on Banking Supervision Working Paper*, 4, for an overview of early warning systems used by some G10 authorities, and M. Persson and M. Blåvarg (2003), "The Use of Market Indicators in Financial Stability Analysis", *Economic Review*, Sveriges Riksbank, pp. 5-28, on the use of financial market indicators.

16 See J. Campbell and R. Shiller (2001), "Valuation Ratios and the Long run Stock Market Outlook: An Update", *NBER Working Paper* No 8221, April.

17 See Blaschke et al. (2001), who review issues of measurement and methodology in stress testing, as well as the IMF's experience with FSAP.

sufficiently broad terms. For instance, although alertness grew among market participants and public authorities in the late 1990s and in 2000 of the vulnerability of the US stock market to an abrupt correction, general awareness of the possible impact on the European insurance industry – one of the places where the subsequent market tumble hurt the most – was rather limited. This was mainly because little macro-prudential surveillance of the industry was being undertaken at the time. Micro balance sheet data, especially on exposures, can be helpful when seeking to identify the relevance of linkages both between real and financial sectors and within the financial system itself. As financial institutions strengthen their disclosure policies, data availability in this area has the potential to improve over time. In order to make inferences on the linkages and channels of contagion, cross-correlation analysis of securities prices can also be helpful, although sight should not be lost of the fact that during crisis periods, correlations may differ markedly to those prevailing when markets are operating smoothly.

CONCLUDING REMARKS

Current practice in financial stability assessment can probably be compared to the way monetary policy assessment was practised by central banks three or four decades ago – before there was a widely accepted, rigorous framework. The measurement challenges that lie ahead for financial stability assessment are formidable, in part because financial stability assessments must not only take stock of disturbances as they emerge, but also need to identify and examine the vulnerabilities that could lead to such disturbances occurring in the future. A forward-looking approach is required to identify the potential build-up of financial imbalances and to account for the transmission lags in policy instruments. The real difficulty is that financial crises are inherently difficult – if not impossible – to predict, in part because of contagion effects and likely non-linearities in both the build-up of imbalances and their transmission to the real economy. In addition, financial stability risks often reflect the far-reaching consequences of unlikely events. This implies that the focus of attention is not the mean, median or mode of possible outcomes, but the entire distribution of outcomes, in particular the left tail.

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

While many conceptual and methodological challenges lie ahead, it is important to acknowledge that significant progress has been made in recent years. Even though there is no obvious framework for summarising developments in financial stability in a single quantitative measure, a growing number of central banks around the world are making financial stability assessments and publishing financial stability reports, many of them based on a broad and forward-looking conception of financial stability.