Basel Committee
on Banking Supervision

Peer review of supervisory authorities' implementation of stress testing principles

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E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

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Executive summary

This report summarises the Basel Committee's peer review on how supervisory authorities have implemented the Committee's 2009 *Principles for sound stress testing practices and supervision*[1].

The global financial crisis and the 2009 stress testing principles

Stress testing is an important tool for banks to identify unexpected adverse outcomes across a range of risks. It plays a particularly important role in:

- providing forward-looking assessments of risk;
- overcoming limitations of models and historical data;
- supporting internal and external communication;
- feeding into capital and liquidity planning procedures;
- informing the setting of banks' risk tolerance; and
- facilitating the development of risk mitigation or contingency plans across a range of stressed conditions.

In 2009, the Committee reviewed the performance of stress testing practices during the crisis and found weaknesses in various areas. Based on the findings, and as part of its efforts to incorporate lessons from the crisis in supervisory practices, the Committee published recommendations for banks and supervisors entitled *Principles for sound stress testing practices and supervision*.

The guidance sets out a comprehensive set of principles for the sound governance, design and implementation of stress testing programmes at banks. The principles also established high-level expectations for the role and responsibilities of supervisors in evaluating stress testing practices.

Scope of the review

As part of its mandate to assess the implementation of standards across countries, during 2011 the Committee's Standards Implementation Group undertook a peer review of supervisory authorities' implementation of the principles.

The review was conducted via an off-site survey of supervisory authorities. All Committee member countries and one non-member country participated in the review.[2] The review focused primarily on progress in supervisory processes used to implement the principles. It

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1 Available at www.bis.org/publ/bcbs155.htm.

2 The Basel Committee on Banking Supervision consists of senior representatives of bank supervisory authorities and central banks from Argentina, Australia, Belgium, Brazil, Canada, China, France, Germany, Hong Kong SAR, India, Indonesia, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. In addition, Thailand participated in this exercise.

was not designed to provide a detailed country-by-country assessment or to assess the adequacy of banks' stress testing programmes.

Increasingly, supervisory stress tests are being used to set minimum capital requirements, determine explicit capital buffers or to limit capital distributions by banks. This recent development was not extensively considered in the principles and as a result was not a key focus of the review.

Key findings

Progress overview

In the period since the principles were issued, stress testing has become a key component of the supervisory assessment process as well as a tool for contingency planning and communication. Many of the countries participating in this peer review have been working to implement and refine stress testing frameworks and methodologies at the same time as their economies and banking systems have been affected by a high degree of global economic and financial uncertainty. Although many supervisory authorities and banks had operational stress testing frameworks in place, existing guidance and rules had to be revised and new expectations put in place to broaden and deepen stress testing capabilities at both banks and supervisory authorities.

The review found that countries are at varying stages of maturity in their implementation of the principles. Nearly half of the countries were considered to be at an early stage. These countries showed some progress toward implementing the principles, but they may not have issued or finalised prudential requirements on enterprise-wide stress testing since the principles were published. They generally had not conducted regular on-site or off-site reviews other than in the context of risk-specific modelling requirements such as for market risk, and had conducted industry-wide stress tests infrequently, or only as part of International Monetary Fund Financial Sector Assessment Program (FSAP) reviews.

In contrast, a few countries were considered to be advanced. For these countries, the survey responses provided evidence of a rigorous regular review process that included a combination of on-site and off-site assessments, some review and feedback on detailed stress testing models used by banks, evidence of follow-up actions and a well-embedded supervisory stress testing programme that was not limited to externally imposed scenarios.

The remainder of countries were found to fall between the above two groups. These countries have issued some formal requirements or guidance consistent with the principles, are generally performing regular supervisory stress tests on large banks in their jurisdictions and are reviewing stress testing in the context of annual internal capital adequacy assessment process (ICAAP) reviews and specific risk reviews. These countries have more to do in deepening their stress testing programmes, including issuing updated requirements and conducting more detailed on-site and off-site reviews of banks' stress testing capabilities.

Remaining challenges and examples of good practices

The most common overall supervisory approach was to conduct some review of banks' stress testing as part of regular ICAAP assessments and in the context of specific risks where ongoing supervisory review of exposure modelling is now routine, notably market and liquidity risks. Conducting more detailed, comprehensive reviews of banks' enterprise-wide stress testing governance and modelling as envisioned in the principles requires expert skills and resourcing at both banks and supervisors, and as a result has not yet become standard practice in many countries.

A significant development in the last several years has been the increased use of supervisory stress tests. A majority of countries now regularly conduct mandated stress tests with prescribed scenarios across the large banks in their jurisdictions, although for some countries, this is limited to the FSAP stress tests.

A number of countries noted the resource-intensive nature of industry-wide stress tests. In particular, the more advanced countries note that resourcing at both supervisory authorities and banks to support stress testing is challenging, with a trend towards establishing specially staffed units or internal task forces for stress testing. Many, however, found that these exercises have been helpful in terms of enhancing the visibility of stress testing and providing a structured basis for dialogue with banks on their capabilities. It was noted that industry dialogue around mandated stress tests had led to improvements in bank capabilities.

The following types of practices are also associated with relatively more advanced countries:

- plans for, or completed horizontal or thematic reviews of, stress testing either at an enterprise-wide level or for specific portfolios;
- engagement with boards of directors on stress testing scenarios and governance;
- review of detailed evidence of how banks are using stress test outcomes in their decision-making and risk-appetite setting;
- well-articulated plans for improving their stress testing supervision programmes;
- involvement of both generalist and specialist supervision staff; and
- publication of the results and provision of consistent feedback to banks.

While not a primary focus of the peer review, many countries provided views on areas for improvement in stress testing practices at banks. These responses focused fairly consistently on areas such as governance and the use of stress testing in bank decision-making, data and information technology infrastructure, severity of scenarios and firm-wide modelling challenges.

The review found the principles to be generally effective. The Committee, however, will continue to monitor implementation of the principles and determine whether, in the future, additional guidance might be necessary.

1. Introduction

Stress testing is an important tool for banks to identify unexpected adverse outcomes across a range of risks. The financial crisis highlighted significant weaknesses in banks' stress testing programmes that contributed to failures to identify the nature and magnitude of key risks. As a result, the Committee engaged with the industry in examining stress testing practices and, in May 2009, the Committee published recommendations for banks and supervisors entitled *Principles for sound stress testing practices and supervision*.

The guidance set out a comprehensive set of principles for the sound governance, design and implementation of stress testing programmes at banks. The principles established expectations for the role and responsibilities of supervisors in evaluating stress testing practices. Overall, the guidance includes fifteen principles for banks and six principles for supervisors (see Annex 1).

As part of its mandate to assess the implementation of its standards across countries, the Committee's Standards Implementation Group undertook a peer review of supervisory authorities' implementation of the principles. The objectives of this review were to:

- assess the extent to which the principles have been implemented in a rigorous and consistent manner across the Committee's member authorities;
- identify and provide feedback on factors that are most critical to the effective implementation of the principles; and
- assess the effectiveness of the principles themselves.

An important element of the review was the context in which the principles are being implemented. Many of the countries participating in this peer review have been working to implement and refine stress testing frameworks and methodologies at the same time their economies and banking systems have been affected by a high degree of global economic and financial uncertainty. Although many supervisory authorities and banks had operational stress testing frameworks in place, existing guidance and rules had to be revised and new expectations put in place to broaden and deepen stress testing capabilities at both banks and supervisors. This is being done in a stressed environment and is also being conducted at a time when stress testing infrastructure, including the ability to collect appropriate data, develop models and aggregate results, is evolving.

As a result, the current environment has provided a useful early test of how countries are putting the principles into practice. More broadly, it was evident that countries are implementing stress testing regimes and activities in different ways that may reflect their individual situations and not all will follow the same progression or path in implementing the principles. The review was intended to deliver feedback on good supervisory practice to help supervisors implement standards more effectively. Indeed, several countries have reported significant progress subsequent to the completion of the peer review survey, particularly with regard to supervisory stress testing practices.

2. Methodology

The peer review was conducted through a questionnaire which was distributed to Committee member countries in September 2011. Analysis of the responses was conducted by a working group of representatives of supervisory authorities with expertise in stress testing. The questionnaire focused primarily on the implementation activities of supervisors and consisted of both factual multiple choice questions and free-form responses.

The review team used the information provided by each country and, where relevant, source documents demonstrating its implementation of the principles, to assess and compare the progress made across countries. Given the off-site and high-level nature of the review, it was not intended to produce a definitive assessment of individual countries' implementation of the principles, but, rather, to allow an overall view of progress across countries. A detailed report was provided to the Standards Implementation Group and to the Committee.

The review focused primarily on the implementation of principles 16-21 for supervisors, as it was not within the scope of the peer review to assess compliance by banks with principles 1-15 on stress testing practices. However, countries were invited to provide their views on the ease and effectiveness of implementation for each of the principles for banks in their jurisdiction. In their responses, supervisory authorities were asked to focus on supervision of the largest banks in their jurisdiction, although some also addressed their supervisory expectations for stress testing at smaller banks.

3. Assessment of principles for supervisors

3.1 Overall maturity of implementation

For purposes of assessing and comparing implementation of the principles, participating countries were stratified as being in an *early*, *intermediate* or *advanced* state of implementation. These assessments were based on indicators of maturity developed for this purpose by the review team (Annex 2), as well as the quality and thoroughness of the questionnaire responses.

Countries in the *early* category (nearly half of respondents) showed some progress towards implementing the principles; however, they may not have issued or finalised prudential requirements on enterprise-wide stress testing since the principles were published. These countries generally had not conducted regular on-site or off-site reviews other than in the context of risk-specific modelling requirements such as for market risk, and have conducted industry-wide stress tests infrequently, or only as part of FSAP reviews.

In contrast, a few countries were classified as *advanced*. For these countries, the review team saw evidence of a rigorous regular review process that included a combination of:

- on-site and off-site assessments;
- some review and feedback on detailed stress testing models used by banks;
- evidence of follow-up actions; and
- a well-embedded supervisory stress testing programme that was not limited to FSAP or regionally-imposed scenarios.

The remainder of countries (approximately half of respondents) fell into the *intermediate* category. These countries have issued some formal requirements or guidance consistent with the principles, were generally performing regular supervisory stress tests on their large banks and were reviewing stress testing in the context of annual ICAAP reviews and specific risk reviews. These countries have more to do in deepening their programmes, including issuing updated requirements and conducting more detailed on-site and off-site reviews of banks' stress testing capabilities. Notably, several countries have reported significant progress subsequent to the completion of the peer review survey, particularly with regard to supervisory stress testing practices and also in some cases issuance of stress testing requirements or guidance.

Specific areas of supervisory activity in relation to the principles are discussed in more detail below.

3.2 Prudential framework

The review found that all countries have in place prudential requirements relating to stress testing. In many cases these requirements were implemented as a component of Basel II, namely the ICAAP requirements, or otherwise pre-date the principles. In addition, a large majority of the respondents stated that they had issued specific rules or guidance implementing the principles. However, approximately one-third of respondents has not issued any rules or guidance on stress testing post-2009, and thus would not be considered to have implemented the principles explicitly. These countries rely on other rules relating to stress testing, particularly under the Basel II credit or market risk requirements. In terms of future plans, a number of countries across different levels of maturity are in the process of, or are planning to strengthen or finalise guidance or regulations.

In some cases, key elements of the principles have been incorporated into the Pillar 2 requirements and in other cases as (non-mandatory) guidance for banks. Some countries issued informal guidance based generally on the principles or on other regional guidelines. A number of countries are still in the early phases of issuing prudential expectations for enterprise-wide stress testing. At least a few countries have not yet issued requirements relating to Basel II ICAAPs, which was the most common means of implementing the principles.

Other countries have already updated their rules and adapted the principles or other guidelines for their own circumstances. These would be considered to have a more mature supervision framework for stress testing. A few other countries have issued their own good practice guidelines which incorporate the principles as well as key findings from supervisory activities and industry dialogue.

Roughly three-quarters of respondents reported that there have not been any impediments to implementing the principles. However, resourcing and other supervisory priorities were noted as a constraint by a number of other countries.

A number of countries asserted that because their banks or banking systems are not complex, some of the aspects of the principles are not relevant (eg structured products and highly leveraged counterparties). Further, banks in some jurisdictions generally do not have the infrastructure and skills to be able to comply with sophisticated stress testing requirements.

3.3 Supervisory review

Principle 16 recommends that supervisors should make regular and comprehensive assessments of banks' stress testing programmes. The review found that supervisory authorities use a combination of on-site and off-site reviews to assess banks' stress testing practices. Most countries indicated that they have conducted some form of on-site review of stress testing at banks. For specific risk areas (primarily market, liquidity and to some extent credit risk), there are well established supervisory review programmes.

Almost three-quarters of countries indicated that they perform extensive regular review of firm-wide stress testing practices. The most common approach for assessing firm-wide stress testing is through annual ICAAP reviews, which generally cover capital planning as well as other matters. Given the scope of ICAAP reviews, it may be difficult to assess all of the principles during a routine ICAAP review. Indeed, a few countries indicated that they conduct horizontal or thematic reviews specifically on firm-wide stress testing including the principles, which is considered a more advanced practice.

The frequency of on-site reviews of firm-wide stress testing varied across countries. About one-third of countries conducted less-than-annual reviews (every 2-4 years) while roughly half of responding countries reported that they conduct annual or more frequent on-site reviews of stress testing. Some supervisors have conducted a one-time review of the principles through self-assessments, questionnaires, or benchmarking studies across a range of banks.

In terms of the scope of supervisory review, supervisory activities regularly covered stress testing for firm-wide risks, general credit risks, retail mortgages and corporate credit risks, market risk, banking book interest rate risk and liquidity risk. Authorities reported that areas such as operational risk, overseas operations, as well as specific portfolios such as commercial property and sovereign risks, receive less coverage.

Supervisory authorities in most countries reported conducting annual or more frequent review of board and senior management reporting of stress test results. Use of stress testing in loan loss provisioning was reviewed regularly by about half of the countries. The role of stress testing to help set risk appetite and identify risk concentrations were areas that were less commonly reviewed; this is an area where supervisory and bank practice is at a very early stage. Review of contingency plans for operational risk is the surveyed area least likely to have been assessed by supervisors in the context of stress testing.

Some countries noted different requirements or expectations of stress testing across banks, mainly depending on the banks' systemic importance (including size, complexity and relevance to economy) and risk profile. Most emphasised that supervisors have proportionately different expectations when conducting stress testing reviews of smaller banks. Several countries (particularly those at the more advanced stages of implementation of the principles) indicated that they are planning to increase the expectations of smaller institutions with respect to stress testing going forward.

3.4 Supervisory action

Principle 17 indicates that supervisors should take action on deficiencies in banks' stress testing programmes. The review found that the two most common areas for supervisory follow-up were improving governance processes for stress testing and use of additional (in particular, more severe) scenarios. Many countries either regularly or occasionally imposed requirements to improve data or model validation processes. The least common supervisory follow-up action indicated in the responses was to require the bank to review or change limits or exposures (less than half of the countries reported taking this action regularly).

Principle 19 encourages supervisors to consider the results of stress tests in assessing capital adequacy and in setting prudential buffers for capital and liquidity. A large majority of countries indicated that they sometimes or regularly impose capital or liquidity requirements as a result of stress testing deficiencies. In particular, use of stress scenarios for setting liquidity requirements appears to be fairly well established, particularly as countries work toward implementing the Basel III liquidity framework, which is based on stressed cash flows. Nearly all of the countries indicated regular review of liquidity stress testing.

Use of stress tests for setting minimum capital requirements, determining explicit capital buffers or for limiting capital distributions by banks is a more recent development that was not extensively considered in the principles and as a result was not a key focus of the review. A small number of countries indicated that stress testing has become a key tool for setting or assessing capital requirements. Some countries have issued new requirements in the past year or so specifically related to the use of stress tests in assessing capital adequacy. While use of stress tests to set formal minimum capital requirements is not common, use of standard supervisory stress scenarios as a benchmarking tool is increasingly prevalent.

Other countries took the view that stress test results are just one factor in assessing how much capital is needed to offset the risk of unexpected losses. In a number of countries, and even those with fairly advanced stress testing supervision programmes, stress testing was seen as one of several tools in assessing capital adequacy and there was a reluctance to place primary reliance on stress test scenario outcomes. This may reflect the evolving nature of supervisory and bank practices.

3.5 Supervisory resourcing

As stress testing is a fairly new and specialised area of supervision, the review found that resourcing and capabilities for stress testing supervision were key challenges for many supervisory authorities. Only a few countries have established units specifically dedicated to stress testing. Most countries are primarily relying on separate teams of staff to conduct supervisory stress tests and, in many cases, also to review stress testing practices at banks. These teams also perform other tasks in addition to reviewing or conducting stress testing.

Typically, a set of specially trained supervisors is responsible for coordinating with banks with respect to the collection of data for stress testing and reviewing and consolidating the stress test information. Often an inter-departmental team is used to conduct the stress tests. In general, it was noted that staff with a variety of different backgrounds can be useful in stress testing, including macro-surveillance economists, risk specialists and modelling experts, as well as generalist supervisors who are most familiar with individual institutions or accounting experts.

Similarly, most countries utilise both risk specialists and generalist supervisors in reviewing stress testing practices at banks. In most countries, generalist supervisors are involved in the review of stress testing practices; however, they are not generally involved in conducting supervisory stress tests. At the same time, some countries noted that where stress testing is allocated to a separate unit, it can be more difficult to ensure that stress testing is embedded within routine supervision and that stress test outcomes are understood and used by the generalist supervisors. This was seen as an evolving challenge.

The more advanced countries, in particular, noted a general lack of specialised stress testing resources. Indeed, some countries found that prioritisation of supervisory work is a major issue as key individuals involved often have other responsibilities.

Most countries indicated they had established some form of training programme on stress testing for supervisors. In many cases, the training was of a quite general nature and in some cases limited to presentation of the results of supervisory stress tests or high-level discussion in the context of introductory training on Pillar 2 approaches. A few countries provide quite advanced training programmes, including case studies, and some offer training to other countries' supervisors or to banks in their jurisdiction. Not surprisingly, several countries noted that stress testing training is an area of focus in their future plans.

3.6 Supervisory stress testing

Principle 20 recommends that supervisors should consider implementing stress test exercises based on common scenarios. It is clear that there has been a significant increase in the use of supervisory stress tests in recent years. In fact, all countries indicated that they conduct some form of supervisory stress test. As a result, progress in this area can be considered more advanced generally than some other aspects of the principles.

Portfolio-level stress tests were reported by more than half of the countries. In recent years, this has included specific stress tests on, for example, housing loan portfolios, consumer debt, sovereign risks and liquidity risk. Some countries indicated that they conduct very frequent sensitivity testing for specific risks, for example, applying market risk and liquidity shocks on a regular basis.

In terms of firm-wide stress tests based on a common scenario, there was a range of experience. A few countries have performed FSAP stress tests only. While these stress tests provide an important basis and experience for designing supervisory stress tests, in many cases they tended to be led by the FSAP mission team and the national central bank, and did not have a supervisory focus. About one-third of countries were not running stress tests on a firm-wide basis. In a couple of countries, firm-wide stress tests were conducted by the (non-supervisory) central bank, although with some involvement by the supervisory authority.

Many countries conduct both bank-run and supervisor-run stress tests. This can involve the supervisory authority running the same scenario using supervisory or public data in order to benchmark banks' results from the bank-run stress test. Some countries run both regional and country-specific stress tests.

Directing banks to run a stress test using a common scenario is considered to be a more advanced practice for supervisors, as it requires more detailed understanding of bank modelling capabilities and an ability to assess the results. About half of the countries have conducted bank-run, firm-wide stress tests (outside of the FSAP process), of which about half conduct these on an annual basis.

3.7 Supervisory assessment and challenge

The overall assessment and challenge of the reasonableness of banks' stress test scenarios and outputs is a difficult area for supervision. In many countries, the models, assumptions and approaches used are evolving, and banks are at varying degrees of sophistication.

At a general level, the review found a range of supervisory methods for challenging the scope and results of banks' stress tests and scenarios. The most widely used method was to compare outputs with historical experience, such as a past severe recession. However, in countries with little history of financial crisis, this approach may be more difficult.

A number of countries conducted their own parallel stress tests on bank financial data to benchmark results produced by banks or placed high reliance on reasonableness checks based on supervisors' understanding of portfolios. Peer comparisons were very useful in countries where banks subject to stress testing are comparable in size and scope. Some countries facilitate this by requiring banks to report the results of their stress tests in a standardised manner. A number of countries also place moderate to high reliance on banks' own internal model validation reporting.

Independent review by external auditors or consultants can be one element of the assessment and challenge process for some countries. But more than half of countries indicated they do not rely at all on independent review of stress testing results as part of their supervision activities.

Another supervisory trend is that supervisory authorities are more actively reviewing scenarios chosen by the banks in their internal stress testing and, for example, the banks' ICAAPs. Monitoring or keeping a systematic inventory of scenarios used by banks is a more advanced practice as it allows better benchmarking of peer banks' internal view of stressed conditions and possible vulnerabilities.

Several countries maintain a database of scenarios used by their banks, and others have plans to do this. Over half of the countries periodically review the scenarios used by banks in their internal stress testing. A few countries in the earlier stages of maturity were not regularly reviewing scenarios used by banks.

Supervisory authorities in several countries indicated that they have performed reverse stress tests, that is, stress tests designed to be sufficiently severe that they challenge the viability of the bank. However, reverse stress testing has not become a common supervisory practice. In fact, the supervisory stress tests appear to be the vehicle for assessing the impact of more severe scenarios. In terms of the choice of scenario for supervisory stress tests, the most common approach was to look to a previous severe recession or input from the central bank. Also very common was to target the scenario to known vulnerabilities. About half of the countries have used externally prescribed scenarios (for example, from a regional authority or FSAP process).

3.8 Dialogue with public and private sectors

Stress testing is increasingly part of the public debate on the strength and transparency of supervision. Supervisory authorities have regular discussions with banking industry risk officers or hold occasional seminars, workshops or roundtables with banks to exchange experiences on stress testing methodologies and use of results. In some cases, this has resulted in publication of local industry guidance based on the Committee's principles.

Some supervisors also have a formal process for coordinating with other official organisations within their country. In some cases, a formal committee of regulators and other authorities (including the central bank) discusses systemic vulnerabilities and provides input into stress testing programmes and the scenarios to be tested. A number of other supervisors coordinate with their central bank in conducting a quantitative macroeconomic stress test, including consideration of potential systemic issues that may be caused by banks' management reactions to a common stress scenario. Regional-level coordinating bodies have also become increasingly important.

3.9 Effective supervisory approaches

The review highlighted a number of different supervisory approaches that appear to have been more effective and are reflective of more advanced progress. One of the most effective tools in advancing stress testing practices has been the significantly heightened focus on industry-wide supervisory stress tests. Many countries found that this process has helped focus on common expectations, provide a structured approach for dialogue on better stress testing practices, and identify gaps in banks' stress testing infrastructure. By challenging the loss results reported by banks on the prescribed scenarios, supervisors have motivated banks to justify their results and hence improve their internal assessment of key risk areas. In contrast, there was some evidence that countries that have only conducted supervisory stress tests or supervisory review of stress testing practices without leveraging these two aspects together have not made as much progress in implementing the principles.

In addition, countries that address bank stress testing practices through the ICAAP review process have generally found this to be an effective mechanism, although periodic horizontal or thematic reviews that allow detailed comparison of practices across banks is a more advanced approach that is in use or under consideration in some countries. A formal self-assessment process conducted in some countries helped banks identify where their practices are consistent with the principles and where gaps exist in stress testing programmes.

Open dialogue with banks was also seen as a key element of an effective supervisory programme. Annual meetings with banks can include discussions of risk developments and best practices in stress testing that effectively create incentives for banks to strengthen their own practices. Another approach highlighted by some countries was to engage in dialogue on scenario selection, dynamics of models, reporting templates and data capabilities, and overall robustness of the stress test at the highest level of bank management.

Several countries have issued publications describing observed good practices arising from benchmarking or initial implementation reviews of the principles. This type of guidance allows banks to benchmark themselves against their local peers.

Banks, and to some extent regulators, are increasingly using stress testing as a means of communicating their risk profiles to the market. However, disclosure requirements and practices vary considerably by country. Many countries now publish aggregate summaries of stress tests results in their regular financial stability reports, and in some cases outcomes for individual banks. Some banks now routinely provide stress test results as part of their financial results.

3.10 Future plans

Most supervisory authorities described future enhancements to their stress testing supervision programmes. Those countries in the *early* phases of maturity are planning to issue, finalise or update rules on stress testing and to commence review and assessment of stress testing practices. Some are also conducting supervisory stress tests for the first time.

Those supervisory authorities in *intermediate* to *advanced* stages of maturity plan to focus on deepening their current on-site and off-site review programmes, with the aim of better assessing how stress test outcomes are used in bank decision-making and risk appetite setting. Stress testing results are expected to have a greater impact on contingency planning including recovery and resolution.

Additional supervisory work is planned for identifying and assessing how banks are integrating stress tests results in the development of risk appetite and overall risk management. Some supervisors will also use horizontal reviews across multiple banks to assess these areas as well as to benchmark banks' internal stress test scenarios and assumptions. Greater focus on the use of stress test outputs in assessing capital adequacy and liquidity was evident in a few countries, with some also planning more explicit consideration of stress test outcomes in setting capital buffers.

4. Principles for Banks

As the peer review focused on supervisory implementation, an assessment of stress testing practices at banks was not within the scope of this review. Nevertheless, many countries provided high-level comments on progress of banks in their jurisdictions that were reasonably consistent and may be of broader interest.

In particular, all countries reported significant improvements in stress testing capabilities at banks since publication of the principles. Authorities noted an overall improvement in the rigor and quality of stress testing and the quality of information presented in ICAAPs.

Risk-specific stress testing, particularly regarding market and liquidity risk, was found to be reasonably well developed. More recently, banks have focused increasingly on centralised, firm-wide stress testing that encompasses a broader range of risks, but many countries note this area is still evolving. Banks have strengthened their resourcing, with some banks now having set up dedicated stress testing units.

Banks are using a broader range of scenarios, including those that are more severe and complex. However, as noted below, many countries indicated that banks' scenarios continue to be less severe than supervisors might find appropriate.

Banks generally are establishing stronger governance frameworks with clear lines of responsibility for stress testing, and some banks are giving more importance to stress test results in their decision making. Some countries have seen an improvement in data systems and ability to adapt to new vulnerabilities and specific scenarios. The level of documentation has also improved.

Countries' responses to the review survey highlighted the following common areas of future improvement in bank stress testing practices.

- *Integrating results into decision-making*. A number of countries pointed to challenges banks have in incorporating stress test results into business and strategic decisions. Stress testing tools are still immature and some countries felt that in many cases the banks take a compliance-oriented approach in order to meet regulatory requirements.
- *Governance*. There is a sense that banks need to have a better understanding of stress testing limitations, assumptions, and uncertainties by users of stress test results, including senior management and the board of directors.
- *Severity of scenarios*. A number of countries saw a need for firms to deepen the severity of scenarios. Supervisors in these countries remain concerned that banks' internal stress test scenarios do not plausibly reflect potential severe scenarios and outcomes.
- *Data and IT infrastructure*. A number of countries noted that data and IT systems remain a key impediment to implementing effective stress testing programmes. Accumulation of sufficient data for modelling purposes is a challenge for banks in some countries and aggregating information across the bank remains an issue. Generally, some manual intervention is needed to support the banks' current IT and data infrastructure to run regular stress tests.
- *Modelling issues*. Translating and calibrating scenarios into stress outcomes continues to be an area where banks' capabilities are challenged. Multiple risk class impacts generally have not been modelled in a sophisticated manner, although some banks attempt to take into account correlations between risks. Incorporating feedback effects and system-wide interactions remains very difficult. Another technical area cited is the identification and aggregation of correlated risks and integration between credit, market and liquidity risks.

5. Conclusions

The current environment has provided a sound test of how countries are putting into practice the Committee's 2009 principles for stress testing supervision. There is clearly room for further progress among the supervisory community in the supervision of stress testing. Many countries in the *early* to *intermediate* stages of implementation are working to finalise their prudential requirements for stress testing and implement regular review programmes that cover enterprise-wide stress testing governance, capabilities and models. Even those countries considered to be in the *advanced* phase of implementation of the principles felt that there are many remaining challenges with respect to their own stress testing programmes.

Authorities are continuing with their efforts to embed the use of stress testing within their supervisory programmes. In many cases, this requires additional resources and training for both generalist and specialist supervision staff. Stress testing infrastructure, including the ability to collect appropriate data, develop models and aggregate results, continues to evolve.

Explicit consideration of stress test outcomes in assessing liquidity and market risk capital requirements is well established in supervisory frameworks. Stress testing has traditionally not featured as prominently in assessment of overall bank capital adequacy but practices are evolving in this area.

The peer review has highlighted that there are different supervisory approaches and it is difficult to state which is most effective. A combination of supervisory stress tests together with involvement of generalist and specialist supervision staff in reviews of banks' stress testing practices at an enterprise-wide level often characterises the more well developed supervisory programmes. More advanced countries are encouraging development of more rigorous practices at banks by conducting horizontal and thematic reviews, publishing the results and providing feedback to banks. Finally, while the review found the principles themselves to be generally effective in setting high-level expectations, the Committee will continue to monitor implementation of the principles and determine whether, in the future, additional guidance might be necessary.

Annex 1

BCBS Principles for Sound Stress Testing Practices and Supervision

	BCBS Principles
1	Stress testing should form an integral part of the overall governance and risk management culture of the bank. Stress testing should be actionable, with the results from stress testing analyses impacting business decisions of the board and senior management. Board and senior management involvement in the stress testing programme is essential for its effective operation
2	A bank should operate a stress testing programme that promotes risk identification and control; provides a complementary risk perspective to other risk management tools; improves capital and liquidity management; and enhances internal and external communication.
3	Stress testing programmes should take into account of views from across the organisation and should cover a range of perspectives and techniques.
4	A bank should have written policies and procedures governing the stress testing programme. The operation of the programme should be appropriately documented.
5	A bank should have a suitably robust infrastructure in place, which is sufficiently flexible to accommodate different and possibly challenging stress tests at an appropriate level of granularity.
6	A bank should regularly maintain and update its stress testing framework. The effectiveness of the stress testing programme, as well as the robustness of major individual components, should be assessed regularly and independently.
7	Stress tests should cover a range of risks and business areas, including at the firm-wide level. A bank should be able to integrate effectively, in a meaningful fashion, across the range of its stress testing activities to deliver a complete picture of firm-wide risk.
8	Stress testing programmes should cover a range of scenarios, including forward-looking scenarios, and aim to take into account system-wide interactions and feedback effects.
9	Stress tests should feature a range of severities, including events capable of generating the most damage whether through size of loss or through loss of reputation. A stress testing programme should also determine what scenarios could challenge the viability of the bank (reverse stress tests) and thereby uncover hidden risks and interactions among risks.
10	As part of an overall stress testing programme, a bank should aim to take account of simultaneous pressures in funding and asset markets, and the impact of a reduction in market liquidity on exposure valuation.
11	The effectiveness of risk mitigation techniques should be systematically challenged.
12	The stress testing programme should explicitly cover complex and bespoke products such as securitised exposures. Stress tests for securitised assets should consider the underlying assets, their exposure to systematic market factors, relevant contractual arrangements and embedded triggers, and the impact of leverage, particularly as it relates to the subordination level in the issue structure.
13	The stress testing programme should cover pipeline and warehousing risks. A bank should include such exposures in its stress tests regardless of their probability of being securitised.
14	A bank should enhance its stress testing methodologies to capture the effect of reputational risk. The bank should integrate risks arising from off-balance sheet vehicles and other related entities in its stress testing programme.

15	A bank should enhance its stress testing approaches for highly leveraged counterparties in considering its vulnerability to specific asset categories or market movements and in assessing potential wrong-way risk related to risk mitigation techniques.
16	Supervisors should make regular and comprehensive assessments of a bank's stress testing programme.
17	Supervisors should require management to take corrective action if material deficiencies in the stress testing programme are identified or if the results of stress tests are not adequately taken into consideration in the decision-making process.
18	Supervisors should assess and if necessary challenge the scope and severity of firm-wide scenarios. Supervisors may ask banks to perform sensitivity analysis with respect to specific portfolios or parameters, use specific scenarios or to evaluate scenarios under which their viability is threatened (reverse stress testing scenarios).
19	Under Pillar 2 (supervisory review process) of the Basel II framework, supervisors should examine a bank's stress testing results as part of a supervisory review of both the bank's internal capital assessment and its liquidity risk management. In particular, supervisors should consider the results of forward-looking stress testing for assessing the adequacy of capital and liquidity.
20	Supervisors should consider implementing stress test exercises based on common scenarios.
21	Supervisors should engage in a constructive dialogue with other public authorities and the industry to identify systemic vulnerabilities. Supervisors should also ensure that they have the capacity and skills to assess a bank's stress testing programme.

Annex 2

Indicators of maturity of BCBS principles implementation

The following criteria were considered by the review team to be indicative of an *advanced* level of stress testing supervision and implementation of the Committee's principles for sound stress testing:

- Final rules or supervisory guidance in place fully consistent with the Committee's principles as well as local sound practices.
- Regular supervisor-mandated stress tests conducted by banks as well as by supervisors and are not purely externally driven (eg FSAP).
- Supervisory review includes targeted or thematic reviews of firm-wide stress testing practices as well as risk-specific stress testing (eg market, liquidity risks).
- Supervisory review includes regular review of governance, infrastructure, models, outcomes and scenarios.
- Supervisory review programme is well resourced, involves experts as well as generalist supervisors with capability to challenge bank outputs.
- Programme includes both on-site and off-site components.
- Some expectations set for smaller banks.
- Demonstration of stress testing leading to follow-up supervisory actions.
- Detailed commentary in peer review questionnaire supports affirmative responses and provides evidence of depth of expertise.

The following criteria were more indicative of an *intermediate* level of progress in implementing the BCBS principles:

- Rules or guidance may be in draft form or limited to restatement of the Committee's principles or Basel II requirements.
- Review of firm-wide stress testing but primarily through annual ICAAP process rather than targeted or horizontal/thematic reviews.
- Supervisory stress tests conducted including bank-run stress tests.
- Occasional or limited review of stress testing governance, infrastructure and scenarios but little detailed review of models.
- Some benchmarking and challenge of bank stress test scenarios and results by supervisors but no systematic comparison of scenarios.
- Supervisory review of stress testing may not generally lead to any outcome or action.
- Proactive plans to enhance supervisory programme.
- Peer review questionnaire response provides some commentary on bank and supervisory practices.

The following criteria were indicative of an *early* level of progress in implementing the Committee's principles:

- Rules or guidance in draft form or yet to be issued. No rules or guidance issued since prior to 2009 or rules do not appear to cover most of the Committee's principles.
- Stress testing requirements and regular supervisory review primarily limited to specific risks (eg market, liquidity).
- Supervisory stress tests not conducted, cover only specific risk shocks or portfolios or are entirely externally driven (eg FSAP).
- Little or no on-site or off-site review of bank stress testing governance, infrastructure, models or scenarios.
- Minimal commentary in peer review questionnaire to support responses.