

05/2

Financial Services Authority

# Stress Testing

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The Financial Services Authority invites comments on this Discussion Paper. Comments should reach us by 30 August 2005.

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# 1 Executive summary

*'In estimating necessary levels of risk capital, the primary concern should be to address those disturbances that occasionally do stress institutional insolvency - the negative tail of the loss distribution that is so central to modern risk management. As such the incorporation of stress scenarios into formal risk modelling would seem to be of first-order importance'*

**Alan Greenspan, Chairman of the U.S. Federal Reserve**

For the purpose of brevity, the term 'stress testing' will be used throughout this Discussion Paper (DP) to describe both stress testing and scenario analysis. For the purpose of this DP, we give fuller definitions of these terms in Annex [1].

In the past two years, we have carried out two surveys on the form and nature of stress tests undertaken by a number of banks, securities and insurance firms. This has allowed us to establish the scope of their use and to understand the level of integration of such testing into firms' risk management frameworks. We held a workshop with a small group of firms in February 2005 to explore the key findings, and the use of stress testing as a risk management tool. The firms involved were a representative industry sample of large and more complex firms – including banks, insurance firms and major infrastructure providers.

We consider stress testing an important risk management tool. In our 2005/6 Business Plan, we highlighted our commitment to stress testing and focused on the importance of senior management responsibility for risk management. More generally, in conjunction with the Treasury and the Bank of England, we are charged with responsibility for financial stability in the round. The wider use of stress testing by major firms has the potential to reduce the risks to the UK financial system and it is partly as a consequence of this remit, that we are issuing this paper.

It was encouraging to note that the representative sample of firms surveyed had some stress testing arrangements in place, although the use of a broad range of stress tests as a complement to existing risk management tools was not widespread. The stress testing of market risk was found to be at a more advanced stage than for credit, liquidity or the general aggregation of risks across a group. Methodologies have evidently moved on since the surveys, especially in terms of credit risk (prompted partly by Basel II requirements). However, participants at the workshop recognised that further development of stress testing methodologies for credit, liquidity and aggregated group-wide tests is desirable and achievable.

The surveys and workshop also identified the need for firms, particularly the large and more complex firms, to embed stress testing into their risk management frameworks. There is a general obligation on firms' senior management under the FSA's Principle 3 to take reasonable care to organise and control their firm's business responsibly and effectively, with adequate risk management systems. Stress testing is an integral element of a firm's risk management framework. It is good practice for large and more complex firms to ensure that some form of stress testing is undertaken of the major risks within their business, and for senior management to be engaged in this process.

Our existing rules and guidance already impose requirements on certain firms to undertake stress testing of the liquidity risk within their business, and for insurers this also extends to the other main risks. For example, general and life insurance firms are required to consider appropriate stress tests when assessing their level of capital under the new Individual Capital Adequacy Standards (ICAS) regime. Since the end of last year, all deposit takers, insurers and own account dealers have been required to undertake stress tests in relation to liquidity risk. On the international side, there are various strands of work being undertaken on stress testing in the context of the Capital Requirements Directive (CRD) implementation. These are likely to involve greater formalisation of the use of stress testing by those firms subject to the Directive's requirements.

### **The aims of this Discussion Paper (DP)**

The market practitioners' input reflected in this DP is not definitive; this represents the input given by a representative industry sample of 'large and more complex' firms.

The DP sets out the findings of the two surveys and the workshop and draws together the work on stress testing requirements currently being undertaken within the FSA, in the context of implementing the CRD and otherwise. It is targeted at the large and more complex firms but its themes will be relevant to the senior management of many other authorised firms.

The DP has five other objectives:

- To disseminate examples of good practice so that the industry is aware of some views currently circulating, and can provide comment on the views expressed by our representative industry sample.
- To outline, as a contribution to debate about good practice, a model for embedding stress testing into the risk management framework of firms including ensuring senior management engagement in the process (a ‘comprehensive approach’).
- To highlight the FSA’s intention to engage with the large and more complex firms in a constructive discussion on their use and development of stress testing.
- To provide a briefing document for the proposed conference on stress testing in the third quarter of 2005. This conference will discuss the development of specific stress testing methodologies and to facilitate discussions between firms and the FSA on their key risks. The idea of such further dialogue received strong support in the workshop with firms.
- To solicit input from firms in response to this DP and to utilise this input in conducting further reviews of stress testing approaches within the large and more complex firms (starting in the first quarter of 2006). Further reviews will allow us to explore the development of stress testing techniques and to develop a common view of good practice.

In due course, we will report to firms the outcome of this programme of work in the form of a ‘Dear CEO’ letter.

This DP does not provide ‘guidance’ as defined in section 157 of the Financial Services and Markets Act 2000 and there is no current intention to introduce new rules on the basis of this paper. Furthermore, this DP is not intended to provide guidance on PRU rules. It is not our current intention to introduce new Rules or Guidance in relation to stress testing beyond those described in Section 4 of this document, the subject of a current Consultation Paper (CP05/03). We would, however, be willing to do so in response to industry demand.

In addition to the fuller definitions of stress testing and scenario analysis given in Annex 1, the remaining Annexes set out the existing FSA rules and guidance [2], a summary of regulatory stress testing initiatives [3] and a summary of the questions presented to firms in this DP [4].

# 2 FSA recommendations

In this section of the DP, we consider the uses of stress testing, coverage and how it can be integrated within firms' risk management frameworks.

Stress testing allows firms to look at the impact of more extreme events on their business, which are not generally conveyed by traditional risk management models such as Value at Risk (VaR). Good risk management practice suggests that firms should conduct some form of stress testing of the key risks within their business and that senior management should be fully engaged in the process. Stress tests can benefit individual firms by strengthening their internal risk management frameworks and, more generally, benefit the stability and robustness of the overall financial system. This is a consequence of large and complex firms expanding the depth and breadth of their existing methodologies – specifically regarding the more extreme, forward-looking, scenarios. This is an area of particular interest for us in our role in seeking to ensure financial stability.

## **Uses of stress testing**

Stress tests have a wide range of uses within firms, the most important of which can be categorised as follows.

### *Determining a firm's risk profile*

Stress testing can be used by firms to determine their risk profile. Stress testing of a range of different exposures to particular counterparties may identify risks which, when aggregated, are not picked up at an individual exposure or business unit level. Firms may also use stress tests to calculate the sensitivity of a firm's portfolio to large changes in risk factors, such as moves in the yield curve or foreign exchange market shifts. Stress testing is, in addition, useful for evaluating risks where VaR models are of limited use. Risk managers have found stress testing helpful for setting limits and monitoring new products where little historical data is available.

### *Setting a firm's risk appetite and capital allocation*

A key function of senior management is the identification of a firm's risk appetite which can be articulated into a meaningful strategy to guide those responsible for conducting the day to day business of the firm. Risk appetite is normally specified in the context of a firm's preferred risk/return trade off, typically referenced to relatively 'normal' business conditions – with a modest 'confidence interval' for events to turn out better or worse than a central case. In this context, a key function of stress testing is to sensitise senior management to the concept of the 'stressed risk appetite'. A well thought out and conducted stress test can help senior management focus on whether it would be comfortable with the risk/return consequences of a set of extreme, but plausible, business conditions. If the likely outcomes are outside management's stressed risk appetite, some adjustment to the business/risk profile of the firm may be warranted. This also provides an important link for effective capital allocation by senior management.

### *Evaluating the impact of extreme, but plausible, large loss events*

Existing risk management tools such as VaR tend to reflect price behaviour in everyday markets. Stress tests aim to simulate portfolio performance in abnormal market periods. They can therefore provide information about risks that fall outside those typically captured by VaR methodologies. Such risks would include those associated with extreme price movements, and those related to forward-looking scenarios that are not reflected in the recent history of the price series used to compute VaR.

One particular area where there is benefit in developing closer dialogue with firms is in relation to the more extreme, forward-looking scenarios that firms use as part of their risk management process. One possibility would be for us to initiate a more structured comparison of the 'hot-topic' scenarios identified by firms, and our own identification of possible risks to financial stability.

### **Coverage of stress testing**

Good practice suggests that stress testing can and should be applied to the full range of material risks that a firm runs both at business unit level and on an aggregated group basis. In terms of traded market portfolios, stress testing is commonly used for interest rate, equity, foreign exchange, commodity and credit market instruments. Stress testing of credit portfolios and for liquidity/funding is becoming more developed; but stress testing for operational risk and aggregation across risk elements is at an early stage of development.

The chart below characterises our survey’s findings about firms’ current use of stress testing.



Stress Test	Type of Risk					Correlation	
	Market	Liquidity	Credit	Operational (Basel definition)	Other	Market/Credit	Other
<b>Single Variable</b>  <b>Multi Variable</b>  <b>Complete scenarios</b>						Rarely	Never
<b>Aggregated across the firm</b>	Often	Often	Rarely				

Chart 1: Firms’ stress testing: practice and assumptions

This matrix represents the dimensions of stress testing coverage, which are:

- The extent of existing coverage from single variable testing to complex integrated scenario testing (vertical axis), in terms of market, credit, liquidity, operational and other less easily quantified risks (horizontal axis).
- How far firms aggregate common types of risk (e.g. credit) for individual counterparties and across connected borrowers/sectors.
- The feasibility/practice of aggregating risks and stresses of different types of risk, under ‘correlation’ (e.g. credit and market risks).

Regulatory developments both on an international and domestic level continue to impose additional specific stress testing requirements on firms. We are not seeking to be prescriptive in setting the scope of stress testing that firms undertake. Instead, we aim to ensure that the type and frequency of such tests should be relevant to the size, complexity and nature of a particular business. For those firms which are subject to Arrow, our risk assessment process, the appropriateness of stress testing methodologies and corporate governance arrangements will be incorporated into the regular risk assessment process.

## **Integration of stress testing into firms' risk management frameworks (the 'comprehensive approach')**

Good practice suggests that stress testing should form an integral part of a firm's risk management framework. Senior management may decide to delegate the performance of stress testing to a firm's risk management department. However, it is good practice for them to be involved in determining the relevant stresses and have a clear understanding of the implications of any outputs on the business. As noted above, changes to risk appetite, capital allocation and changes in the direction of a firm's strategy may follow from these outputs.

At the workshop in February, a set of characteristics for integrating stress testing into a firm's risk management framework were discussed and found broad support amongst industry participants (particularly for large and more complex firms). The characteristics of this best practice 'comprehensive approach' are summarised below:

- senior management will be able to identify and articulate a firm's risk appetite and understand the implications of stress events within this context;
- senior management will take an active part in identifying potential stress scenarios;
- outputs from stress testing will be communicated to senior management in a comprehensible format;
- senior management will have an overview of firm-wide risks and stresses and a concept of total risk even where precise aggregation is not possible;
- senior management will consider formally the implications of stress testing for a firm's strategy or business profile; and
- IT systems, resources and procedures will allow senior management to identify, quantify and manage efficiently the stresses that affect a group.

Further discussion of this best practice approach and a request for feedback on the various characteristics described, can be found in Section 3 of this document.

## **Relevance to small firms**

The FSA's fact-finding on stress testing has been, to date, focused on large and more complex firms which:

- take on more complex risks;
- have multiple businesses and are involved in multiple activities; and
- take significant principal market risk.

The FSA hopes that smaller firms will give due consideration as to how they could incorporate elements of the approach described in this paper into their own organisations' risk management.

Fund management firms running complex series of market risks, such as hedge funds, should give consideration to the benefits of stress testing in the management of their risk portfolios.

# 3 Findings of FSA surveys and workshop

In late 2002/early 2003, we visited a sample of investment banks, retail banks, custody banks and consultancy firms to identify how senior management within large and complex financial businesses recognise and quantify potential stresses to their businesses. We also looked at the impact stress testing has on senior management perceptions of overall risk and strategic decision making. The project team did not carry out any detailed review of current stress tests or make any evaluation of the technical aspects of stress testing. The main findings of the surveys and of the subsequent workshop held in February, are given below.

## **The uses of stress testing**

Most of the large and more complex firms surveyed undertook some form of stress testing at both a business unit and a group-wide level. In addition, firms put significant resource into developing and implementing stress testing. Considerable resources were allocated to the technical infrastructure, the recruitment of highly-skilled personnel, and the maintenance of robust control structures around stress testing. However, there was considerable divergence between the firms surveyed in respect of the uses of stress testing and the levels of management that used it within the firm.

The surveys revealed that some firms use stress testing to evaluate the effect of new and potential business lines upon the overall firm/group-wide risk. Firms employing such tests were able proactively to anticipate the effects of a new business upon their firm's risk profile. This approach is clearly to be welcomed, as stress testing should be forward looking and aim to provide senior management with a view of risks that is not obtained from routine 'equilibrium state' risk assessment methodologies.

However, a general finding of the surveys was that few firms' senior management then made use of stress testing methodologies for the setting of their firm's risk appetite. There was very little evidence to suggest that risk managers or senior management more generally focus on the implications of extreme, but plausible, events on the risk/return characteristics of its business.

It was clear from the recent workshop that firms had made further progress on stress testing since the early studies, but there was general support for developing the use of this risk management tool further.

### **Coverage of stress tests**

Although, generally, the firms we visited conducted some form of stress testing, the level of sophistication of the stress tests performed and the degree of coverage of the firms' business varied markedly. The main variations between the firms were in the quality, scope and technical complexity of the stress tests carried out. It was clear that some firms were at a more advanced stage of development in stress testing than others. Stress testing awareness and competency was most developed within firms that have a short dated trading book risk profile. However, in the majority of cases, stress testing models were backward looking, i.e. focused on historical rather than future possible events.

The surveys revealed that stress testing for some types of risk was more advanced than for others. Unsurprisingly, the methodology for stress testing market risk was at a more advanced stage than for credit risk, liquidity risk or for the general aggregation of risks across a group. As a rule, the more readily available and easily modelled the data and the shorter the time horizon over which risks were likely to crystallise, the more likely it is that an advanced stress testing methodology has evolved.

Stresses based on credit risk were typically at a less advanced state of development than those based on market risks; and those based on operational or reputational risks seemed to be at a rudimentary stage. Even allowing for the difficulty of undertaking rigorous credit-risk based stress tests, there was surprisingly little evidence of firms having developed methodologies to examine the relatively straightforward and potentially important scenario of the failure of one or more major counterparties.

As for liquidity risk, the ability to stress test was also at a very early stage. Some smaller banks have explored the relatively mechanical (albeit important) process of examining the effect that ratings downgrades might have using a contractual analysis. 'Behavioural' approaches to stress testing liquidity risk in such firms were, however, at an early stage of development. This may be because of the non-linear nature of the availability of liquidity, which makes any kind of rigorous liquidity modelling difficult. Recent evidence suggests that larger and more complex banking, insurance, investment banking groups and securities firms do project both behavioural and contractual impacts of various liquidity problem scenarios. The number of scenarios covered range from one (a two notch rating downgrade only) to eleven. Development of these approaches continues. A more general conclusion from the liquidity studies was that stress tests do not evaluate the knock-on effects of stresses upon other customers and counterparties, but focus more upon the effect of a stress on the single firm.

A key challenge faced by large and complex financial organisations lies in stress testing aggregated risks. The surveys revealed that, even for the most sophisticated risk management operation, methodologies for stress testing aggregated risks are rudimentary. Several levels of aggregation are important here:

- The aggregation of exposure to individual counterparties for common types of risk (including the effects of stresses). An example of this might be the aggregation of credit risk embodied in lending, underwriting and derivatives transactions in respect of a single counterparty.
- The aggregation and stress of common types of risk (e.g. credit risk) with respect to a correlated or connected group of exposures (e.g. to aggregate from hotel chain X, to the hotel sector, to the leisure and tourism sector etc).
- The development of a concept of aggregated risks and stresses of various types (the sum of credit and market risks for example) even where a strict numerical aggregation is not possible. A qualitative ‘feel’ for the totality of the effects of stress is preferable to having no aggregation at all. This may be particularly relevant in areas such as operational risk, where quantification is at a rudimentary stage.
- The development of a methodology for understanding the aggregation of risks (and stresses) across business lines that make up a group. It needs to be recognised that risks may offset in some cases and be cumulative in others.

Where aggregation does take place, firms often assume that certain correlations remain constant over time. There was little evidence to suggest that senior management reviews these correlations on an on-going basis. A key issue is what the correlations may be during a period of stress. Data on correlations in normal periods may not turn out to be a good guide.

The workshop in February endorsed the view that the use of stress testing was most developed for market risk, with more complex tests being run than for the other risk categories. It also became apparent that aggregation across the firm is more developed for this type of risk (along with liquidity risk) and that aggregation across risk groups is only really considered for the link between market and credit risks. The coverage of operational risk (and other less easily quantifiable risks) is at a much earlier stage of development, although progress is being made.

## **Integration of stress testing into firms’ risk management frameworks**

We were encouraged to note that most of the firms we have looked at used stress testing as part of their wider risk management framework, but the consensus at the workshop was that further improvements in the scope and quality of stress tests are desirable and achievable. In a number of the firms surveyed where the

business was relatively straightforward in nature, senior management was found to be closely involved in selecting and implementing stress tests. In the more complex firms however, we found that senior management appeared to play a marginal role in determining the scope of specific stress tests that were undertaken, to pay limited attention to any results and to take little account of ‘potential’ stresses in the decision-making process. In such cases, the risk management function was often delegated the responsibility for determining the type, nature and frequency of the stress tests.

Among the firms surveyed, risk management was found in some instances to be under-represented at the most senior levels of a firm’s management. Even where stress testing is undertaken within firms, there was a tendency for the choice of stresses, the testing and the assessment of the outcomes to be undertaken in the business or control areas of the firm. As a consequence, stress testing was found often to play little or no role in the overall risk management framework of firms and senior management’s attention was not focused on the sources of potential stress or the consequences for the firm if the risk crystallised. Where risk managers were involved, there was often a lack of a common language for senior management and risk managers discussing risk – resulting in poor communication of stressed risk methodologies. Some firms took measures to train senior management and non-executive directors to ensure that there is a common understanding of risk management and stress testing.

There were significant differences among firms about their risk management systems. The level of expenditure on systems, the complexity, the sophistication, and their capacity to produce stress testing management information varied widely across firms. As a consequence, there was a wide variation in the ability of firms to conduct complex stress tests adequately. It is the role of senior management to ensure that a group’s systems can handle and conduct appropriate stress tests for the business of the group. Where a firm has multiple IT platforms and poor interfaces between systems, the data produced by a firm’s stress tests may have questionable integrity.

There were clear variations in the technical ability of risk management personnel to conduct stress testing across the firms surveyed. It is the responsibility of senior management to ensure that risk management staff have adequate training and qualifications to be able to identify and quantify stresses that affect a firm and to be able to communicate these to the senior management. This requires on-going training and robust recruitment procedures.

The management information (MI) on stress testing received by senior management of the firms surveyed was of variable quality. In addition, in some instances where stress testing was undertaken, senior management did not receive MI on a sufficiently regular basis to be able to assess the risks facing the firm adequately. In many instances it was also questionable whether the MI was aligned to the wider business needs and whether the process was sufficiently dynamic and responsive to reflect changing perceptions of risk. Good practice suggests that firms should ensure that stress tests are produced regularly enough to take account of changing market conditions and a firm's changing risk profile.

## **Conclusions from the surveys and the workshop**

### *Coverage of stress testing*

There was a general consensus that current stress testing (and risk management more generally) is risk specific, often failing to bring together the impact of stresses across different types of risk (market, credit, liquidity, operational etc) and across businesses. To promote good practice in the market, workshop attendees agreed that further work by firms to think about scenarios outside their immediate environment (such as the impact of a counterparty's failure on their business) is desirable. Workshop attendees also suggested that it would be beneficial for firms to think about developing stress testing methodologies to capture credit, operational and liquidity risks within firms. Stress testing aggregated risks remains a longer term objective.

At the workshop in February, the risk matrix (Section 2, Chart 1) was used as a simplistic tool to describe the extent of existing coverage of stress testing across individual risk elements. The shading represents where industry currently stands in terms of coverage. Participants at the workshop agreed that broadening and deepening the coverage of stress testing would be a useful and beneficial objective.

### *Integration within risk management frameworks*

Participants at the workshop also agreed that stress testing should be recognised as an important risk management tool and that it should be embedded more firmly within the risk management framework of firms and not be viewed in isolation. Specifically, it was generally accepted that senior management should be more closely involved with the approaches to, and results of, stress testing being undertaken within their firms. And they should make greater use of stress testing as a tool for determining risk appetite and capital allocation.

At the workshop, a model drawn from the industry surveys was put forward (the ‘comprehensive approach’), setting out six characteristics that underpin a well managed firm’s approach to embedding stress testing into its risk management framework. These characteristics are described below.

- i) Senior management will be able to identify and articulate a firm’s risk appetite and understand the implications of stress events within this context.

Good practice suggests that firms should have a framework that ensures that firm-wide risk is identified and captured. This may be through the establishment of clearly defined committees with responsibility for the identification and aggregation of risks and potential stresses. In the absence of such structures, firms may not understand or properly consider how the impact of usual and unusual risk events can aggregate across risks, or across group companies.

- ii) Senior management will take an active part in identifying potential stress scenarios.

In a well-managed firm, senior management will play an active part in specifying the likely sources of stress to a firm’s business. Senior management may either specify the stresses themselves or review a range of potential stresses suggested from elsewhere in the firm (generally the risk management function). The key, however, is that senior management takes responsibility for the choice of stresses to be examined as part of their responsibility for managing firm-wide risk.

In choosing stresses to be investigated, it is good practice to ensure that the firm does not rely entirely on testing for historical stress events but incorporates a full range of extreme, but plausible, stress scenarios – many of which will not have a basis in past experience. Three types of stress testing can be distinguished, all of which warrant consideration; first historical stresses (which are more widely used in current risk management); secondly the stress of a severe, but unlikely, risk to crystallise; and thirdly reversing the stress test by looking at what stresses would seriously threaten the firm (exploring ‘the point of failure’). The purpose of stress testing is to provide a future view, independent of what has happened in the past, and cover all of a firm’s businesses and the material risks it faces.

Some sources of stress will be wholly exogenous (arising from outside the firm), while others may stem from the actual or perceived condition of the firm itself. Wholly exogenous stresses would include adverse economic developments leading to asset market volatility or the failure of a major counterparty. A firm has no control over such developments but, if relevant, will look to understand their potential impact and make appropriate adjustments to mitigate its risk. An example of a partially endogenous stress (coming from inside the firm), would be the withdrawal of a source of liquidity. Such an event may stem from (and reinforce) an actual or perceived deterioration in the financial soundness of the

firm itself. It is difficult to quantify the effects of such events – liquidity in particular behaves in a notoriously non-linear way – but such (partly) endogenous stresses are just as important as wholly exogenous stresses.

- iii) Outputs from stress testing will be communicated to senior management in a comprehensible format.

When an appropriate set of stresses has been identified, the process of quantifying their effects will almost certainly fall to a specialist area – normally within risk management. Good practice suggests that the outcomes of stress tests be communicated to senior management in a form which they understand and leads them to a strategic view. The information would be clear and concise and readily comprehensible by senior management, including non-executive directors to the extent that they have an overview of risk management processes. It is likely that a dialogue with senior management will be necessary to arrive at an acceptable format; representation of the risk management function at senior management level will facilitate this.

Within the senior management group, good practice suggests there should be an appointed individual who has clear responsibility for firm-wide risk identification and aggregation.

- iv) Senior management will have an overview of firm-wide risks and stresses and a concept of total risk even where precise aggregation is not possible.

Numerical aggregation of the crystallisation of different types of risk is technically difficult and all but impossible when reputational or legal risks are involved. The surveys and the workshop suggest that current stress testing is often undertaken in isolation from other risk factors (i.e. very limited stress testing of market and credit risk together, even where portfolios/products have dual market and credit risk characteristics). Generally, the aggregation by firms of stressed risks across a business is at an embryonic stage.

Good practice is for senior management to be presented with a ‘holistic’ view of the effect of stresses (that is to say, the full implications of extreme but plausible events need to be thought through carefully) and for senior management to take an aggregated view of the implications of stresses. Where formal aggregation is not possible, an informal or impressionistic assessment of the totality of firm-wide effects will still be useful.

- v) Senior management will consider formally the implications of stress testing for the firm’s strategy or business profile.

Stress testing is not an end in itself. It is a means of highlighting the impact of potential risks to a firm as a driver of strategic and risk management decision making. If extreme but plausible scenarios are likely to result in outcomes which are outside a firm’s risk tolerance (its ‘stressed risk appetite’) then management needs to consider its response. This may take the form of altering a firm’s

portfolio balance, adjusting a lending strategy or, in extreme cases, reviewing its presence in a country or region. Appropriate structures (such as committees) – to consider stress testing output and the risk management and strategic implications of this – are likely to help the firm’s management. To operate effectively, it is good practice to ensure that such committees have appropriate delegated authority from the board in order to ensure that their decisions are executed.

- vi) IT systems, resources and procedures will allow senior management to identify, quantify and manage efficiently the stresses that affect a group.

The development of adequate human and IT resources to manage the stress testing process is likely to assist in the identification, quantification and management of stresses. Staff will be adequately trained and suitably experienced to understand the nature of the stresses affecting their business and to be able to devise appropriate methods of quantifying the effects of the stresses upon the firm. Staff will be responsible for devising and executing stress tests and should be able to communicate the results of the stress tests to senior management clearly and concisely. Naturally, it is important that the IT systems are able to handle the volume and complexity of data arising from a firm’s business. Furthermore, it is important that the IT function is adequately resourced to be able to stress test all of a firm’s businesses for all major risks that affect the firm.

Findings from the workshop and the previous surveys on stress testing have encouraged us to continue working with firms, particularly leading us to publish this DP and organise a conference in the third quarter of 2005 to explore the issues raised.

Q1: In relation to risk management and in particular scenario analysis, are there other areas - beyond the identification of key extreme but plausible risks - where firms feel dialogue with us would be beneficial?

Q2: Do firms broadly agree with our analysis of stress testing coverage - which is based on the sample of firms involved in our stress testing work to date - as representative of the extent and nature of stress testing in large and more complex firms? (see Section 2, Chart 1)

Q3: In improving the coverage of stress testing, should the priority be for firms to ‘broaden’ their stress testing by increasing the risk types they cover first, or ‘deepen’ their stress testing by looking at more complex scenarios and the aggregation of risks? (see Section 2, Chart 1)

Q4: Do the various characteristics of the ‘comprehensive approach’ capture the main elements that ‘large and more complex’ firms think need to be addressed in the governance of stress testing?

# 4 Regulatory developments

There have been, and continue to be, a number of domestic and international regulatory developments involving stress testing which have already introduced standards in this area and which will have a bearing on our future rules and guidance. This section aims to provide senior management with a brief summary of these. A table offering further explanation is given at Annex [3].

We do not propose introducing new stress testing requirements on firms in this paper, although we would explore this option if the feedback on this paper suggested industry demand to do so. However, we do aim to highlight the international initiatives that are being considered, the importance and relevance of stress testing as a core risk management tool, and to encourage firms to think about the benefits of stress testing, both within and beyond the current regulatory requirements.

## **Existing standards**

### *Liquidity*

We introduced new guidance for banks, building societies, own account dealers and insurers to conduct stress testing on liquidity from 31 December 2004 (PRU 1.2.35G). This guidance brought into effect the recommendations set out in the Basel Committee's paper 'Sound Practices for Managing Liquidity in Banking Organisations' (Feb 2000) and the IOSCO paper 'Sound Practices for the Management of Liquidity Risk at Securities Firms' of May 2002.

We offer general guidance to firms in PRU 1.2.36 and PRU 1.2.40-55 on stress testing, including how to choose appropriate scenarios, but the precise scenarios that a firm chooses will of course depend on the nature of its business and activities. However, specific guidance is offered in PRU 5.1.59 to banks, building societies, own account dealers and insurers on the issues to consider in terms of stress testing liquidity. The guidance states that these firms should normally consider scenarios based on varying degrees of stress and both firm-

specific and market-wide difficulties. In developing any scenario of extreme market-side stress that may pose systemic risk, the guidance suggests that it may be appropriate for firms to make assumptions about the likelihood of Central Bank intervention. Such tests are required at least annually.

### *Life and general insurance companies*

The individual capital adequacy standards (ICAS), which came into force on 1 January 2005, require life and general insurance firms to individually assess their capital needs. In making this assessment of capital adequacy, firms are required to identify the major risks they face and, where capital is appropriate to mitigate those risks, to quantify how much (and what type) of capital is appropriate.

In addition to testing liquidity risk as mentioned above, there is general guidance for life and general insurance firms under PRU 1.2.35G to conduct stress tests that are appropriate to the nature of any major risk identified (namely credit, market, liquidity, operational and insurance risk). PRU 2.3.5G also provides guidance that:

*‘A firm must document the results of each of the stress tests and scenario analyses undertaken and should also document, as part of the details of those tests and analyses, the key assumptions including the aggregation of the results’.*

Guidance is offered in PRU 2.3.19-34 on the factors insurers should consider under each risk category.

### **Future standards (proposed)**

The key international development which will have a direct impact on future stress testing requirements on firms (credit institutions and investment firms) is that of Basel II and the CRD, which will give effect to Basel II in the UK and the rest of the EEA.

Details of proposed CRD stress testing requirements were set out in CP05/03 and further work to produce additional guidance on these areas is currently being undertaken by the FSA in collaboration with industry expert groups.

The proposals described below in relation to the CRD are the subject of a consultation process (see CP05/03) (i.e. not yet in effect), and so are not for review in the context of this DP.

The CRD contains a number of references to stress testing. For credit risk, these include:

- the provision of sound stress testing processes for use in the assessment of its capital adequacy;

- the regular performance of credit risk stress tests to assess the effect of certain, specific conditions on its total capital requirements of credit risk;
- the consideration of capital requirements under Pillar 2; and
- the assessment of credit risk concentrations in relation to the net realisable value of collateral in the large exposure regime.

Within Basel II, Pillar 2 guidance would require that firms should conduct stress tests within their internal capital adequacy assessment processes to take into account, for instance, the risks specific to the jurisdictions in which they are operating and the particular stage of the business cycle, analysis of the impact of legislative changes and competitive environment. A number of proposed specific stress tests to be conducted in Pillar 2 are set out in the EU consultative paper on the Trading Book Review.

For all firms subject to the CRD, and therefore to Pillar 2, our draft Handbook text would require, if put into effect, that ‘firms...for each of the major sources of risks [...], must carry out stress tests that are appropriate to the nature of those major sources of risk’.

# 5 Next steps

We are seeking to build on the conclusions reached in the workshop with firms on stress testing, that:

- increasing the coverage of stress testing would benefit firms and will improve the robustness of the financial system as a whole; and
- that stress testing should be more firmly embedded in firms' risk management frameworks.

We use this DP to describe our proposed approach and to highlight the importance of working with the industry to contribute to improving the robustness of the financial system through the effective use of stress testing. To achieve the five principal objectives outlined in the 'Overview' section of this paper, our focus will be on working closely with firms as described. We hope to engage with firms through our supervisory approach, and via thematic reviews of large and more complex firms' current stress testing methodologies to enable us to lead the discussion on good practice, while having a clear understanding of the challenges that firms face. This approach ensures we develop firms' thinking on stress testing, while not adding to the current pressure of meeting new regulatory requirements.

As noted in Section 4, the proposals described in relation to the CRD are the subject of a consultation process (CP 05/03) and so are not for review in the context of this DP.

As the matrix (Section 2, Chart 1) suggests, stress testing could be expanded and deepened across individual risk elements (credit, liquidity, operational). Aggregation could also be improved – using scenario analysis to look at the impact of credit and market risk combined with the potential for increased liquidity risk (for example) in a given scenario. Depending on firms' views about the best way to develop stress testing coverage (see Question 3), the priority of firms to develop their own stress testing capabilities could be explored. We believe this is particularly relevant for large and more complex firms.

For those firms subject to our risk assessment process, we shall be monitoring the integration of stress testing within firms' risk management processes as part of the routine Arrow process. We will do this using, as a measure of good practice, the characteristics of the comprehensive approach described in the body of the DP.

We intend to follow up this paper with a conference in the third quarter of 2005, essentially for the large and more complex firms. We also propose thematic reviews of stress testing methodologies in large and complex firms from the first quarter of 2006.

In following-up this programme of work, we would intend not only to provide feedback to individual firms on points arising from a comparison with others, but also to issue a 'Dear CEO' letter setting out what we have seen as good practice for a wider audience.

Firms suggested, in the surveys and the workshop, that some insight into firms' current 'good practice' would help them develop their own thinking on stress testing. We hope that our work on stress testing, both in this DP and the outlined programme of work, will encourage a continued focus by firms on their own stress testing, and the key risks to their business, including the more extreme scenarios.

Q5: Do firms support the approach described to address the development of stress testing by firms within the current business context, or are there any suggested amendments or enhancements?

Q6: Would additional formal guidance on stress testing be helpful, or are firms content with the current programme (which consists of conferences, thematic visits with firms, supervisory focus and the publication of information, such as Dear CEO letters)?



# Definition of stress testing

The following definitions are provided for the purposes of this paper:

Stress testing typically refers to shifting the values of individual parameters that affect the financial position of a firm and determining the effect on the firm's business. Scenario analysis typically refers to a wider range of parameters being varied at the same time. Scenario analyses often examine the impact of catastrophic events on a firm's financial position, for example simultaneous movements in a number of risk categories affecting all of a firm's business operations - such as volumes, investment values and interest rate movements.

Scenarios generally could also be considered under three broad categories. For example, changes to the business plan, scenarios that involve changes in business cycles and those relating to extreme events. The scenarios can be derived in a variety of ways including stochastic models, analysis of historic experience or a repetition of a historical event. Scenarios can be developed with varying degrees of precision and depth.



# Existing Rules and Guidance

**PRU 1.2.35-36 G sets out the following rules and guidance in respect of stress testing by firms. For insurers, these apply to all of the major risk areas listed, but for other firms their scope is limited for the time being<sup>1</sup> to liquidity risk:**

For each of the major sources of risk identified in accordance with PRU 1.2.31 R, the firm must carry out stress tests that are appropriate to the nature of those major sources of risk, as part of which the firm must:

- take reasonable steps to identify an appropriate range of realistic adverse circumstances and events in which the risk identified crystallises; and
- estimate the financial resources the firm would need in each of the circumstances and events considered in order to be able to meet its liabilities as they fall due.

Stress tests should be carried out at least annually. A firm should, however, consider whether the nature of the major sources of risks identified by it in accordance with PRU 1.2.31 R and their possible impact on its financial resources suggest that such tests and analyses should be carried out more frequently. For instance, a sudden change in the economic outlook may prompt a firm to revise the parameters of some of its stress tests. Similarly, if a firm has recently become exposed to a particular sectoral concentration, it may wish to add some stress tests in order to reflect that concentration. PRU 5.1.61 E<sup>2</sup> is an evidential provision relating to PRU 1.2.35 G concerning scenario analysis in relation to liquidity risk.

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1 As noted above if CRD is implemented as proposed, other firms will also be subject to stress testing requirements for all major risks, not just liquidity.

2 PRU 5.1.61E applies only to certain deposit takers (i.e. it does not apply to insurers)

**PRU 1.2.40 G sets out the following general guidance for all firms in relation to stress testing:**

A large part of the process of managing a firm is based on an understanding of the expected outcomes of its business operations and outside events and the normal variation about these expected outcomes. To gain a comprehensive view of the risks being run by a firm, an analysis of extreme events is also needed. Such analysis may take the form of stress tests. For example, a firm may normally expect interest rates to increase or decrease by 1 or 2 percentage points due to normal variations in the economic conditions. However, in some extreme circumstances, interest rates may change by a much greater amount. The use of stress tests can give a firm's management a better understanding of the firm's true exposure in extreme circumstances.

# Regulatory stress-testing requirements; current and prospective

	<b>Institution Type(s)</b>	<b>Timing</b>	<b>Description</b>
<b>CRD Pillar 1 Credit: General</b>	Credit institutions, investment firms	January 2007*	<ul style="list-style-type: none"> <li>Stress testing to support robustness of internal ratings systems</li> </ul>
<b>CRD Pillar 1 Credit: Pro-cyclicality</b>	Credit institutions, investment firms	January 2007*	<ul style="list-style-type: none"> <li>Specific stress tests to assess the impact on regulatory capital requirements of changing economic conditions</li> </ul>
<b>Pillar 2</b>	Credit institutions, investment firms	January 2007*	<ul style="list-style-type: none"> <li>CEBS Pillar 2 guidance requires that firms should conduct stress tests within their internal capital adequacy assessment processes to take into account, for instance, the risks specific to jurisdictions in which they are operating and the particular stage of the business cycle, analysis of legislative changes and competitive environment</li> <li>A number of specific stress tests to be conducted in Pillar 2 are set out in the EU consultative paper on the Trading Book Review</li> </ul>
<b>Liquidity</b>	Deposit takers, insurers, main dealing investment firms	January 2005*	<ul style="list-style-type: none"> <li>Requirement to undertake stress testing of liquidity risk and have contingency funding plans to meet the results of stress testing</li> </ul>
<b>Revised Insurance Regime</b>	Insurers	January 2005*	<ul style="list-style-type: none"> <li>Individual capital assessment requires stress testing</li> </ul>

\* Based on the current implementation schedule for CRD and based on current proposals outlined in CP05/3



# Questions for comment

- Q1: In relation to risk management and in particular scenario analysis, are there other areas - beyond the identification of key extreme but plausible risks - where firms feel dialogue with us would be beneficial?
- Q2: Do firms broadly agree with our analysis of stress testing coverage - which is based on the sample of firms involved in our stress testing work to date - as representative of the extent and nature of stress testing in large and more complex firms? (see Section 2, Chart 1)
- Q3: In improving the coverage of stress testing, should the priority be for firms to 'broaden' their stress testing by increasing the risk types they cover first, or 'deepen' their stress testing by looking at more complex scenarios and the aggregation of risks? (see Section 2, Chart 1)
- Q4: Do the various characteristics of the 'comprehensive approach' capture the main elements that 'large and more complex' firms think need to be addressed in the governance of stress testing?
- Q5: Do firms support the approach described to address the development of stress testing by firms within the current business context, or are there any suggested amendments or enhancements?
- Q6: Would additional formal guidance on stress testing be helpful, or are firms content with the current programme (which consists of conferences, thematic visits with firms, supervisory focus and the publication of information, such as Dear CEO letters)?



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