Committee on the Global Financial System

A survey of stress tests and current practice at major financial institutions

Report by a Task Force established by the Committee on the Global Financial System of the central banks of the Group of Ten countries

April 2001

BANK FOR INTERNATIONAL SETTLEMENTS

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Preface

The Committee on the Global Financial System (CGFS), known until 1999 as the Euro-Currency Standing Committee, serves as a discussion forum for the central bank community on financial stability questions. The CGFS has frequently been asked to examine the potential implications of innovations in global financial market practices.

Recent projects by CGFS subgroups have concerned the functioning of international interbank markets, financial derivatives and the systemic consequences of standard risk management practices.

As a follow-up to previous efforts relating to issues of risk measurement and management, the CGFS decided, in March 2000, to set up a Task Force to organise a global census of stress tests in use at major financial institutions. The findings of the Task Force, as detailed in this report, were discussed at the March 2001 meeting of the CGFS. The publication of the report is intended to contribute to the general understanding of the use of stress tests as a market risk management tool.

For individual financial institutions, the survey data are expected to provide a useful benchmark for assessing their own stress test programmes against those of all surveyed firms, a sampling of financial firms including internationally active and global financial institutions. In addition, the Committee recognised the potential usefulness of survey information collected over time for the market-monitoring programme that it conducts at the request of the Governors of the G10 central banks. In this connection, it was noted that survey results could provide useful insights into market participants' views on the sources and nature of potential future stress for global financial markets. In the future, having such information could assist the development of profiles of risk taking in financial markets.

The Task Force was chaired by Alain Duchateau of the Banque de France/Commission Bancaire. He joins with the Committee in expressing appreciation for the co-operation of the surveyed banks with the Task Force. The Committee believes that the census is an excellent example of a co-operative effort between central banks and market participants. The survey responses can provide information that is valuable for the firms' own risk management purposes. They also can be used to usefully supplement standard sources of market information.

The CGFS continues to be interested in this topic. Consequently, I would like to invite comments both on the findings of the report, as well as on the likely costs and benefits of possible follow-up survey efforts.

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Executive summary

Goals and organisation of the Census of Stress Tests

The Committee on the Global Financial System (CGFS) initiated a census of stress test scenarios in early 2000. "Stress tests" are tools used by financial firms to gauge their potential vulnerability to exceptional but plausible events. In recent years stress testing has grown in importance, alongside value-at-risk (VaR) and other risk measurement tools. The CGFS, which monitors the stability of global financial markets for the G10 governors, sponsored this Task Force to learn more about the role of stress testing in risk management, to identify which exceptional events were considered by market participants to be significant risks, and to develop information on the heterogeneity of risk-taking at a point in time.

Forty-three banks (commercial and investment banks) from ten countries participated in the census. The banks were asked to report their firm-wide stress tests that captured material risks, as of 31 May 2000. Also, the banks were asked seven questions about how they perform and use stress tests in risk management. Follow-up interviews were conducted with some of the reporting banks to allow the banks to clarify and augment their responses.

Stress test scenarios

The 43 banks reporting on the census submitted 293 stress test scenarios (stress tests based on a potential market event, such as a stock market crash) and 131 sensitivity stress tests (stress tests based on standardised moves in closely-linked market risk factors, such as a parallel yield curve shift). Figure 1 and Table 2 set out information on the 293 stress test scenarios, the main part of the analysis. The four most common areas stress-tested were equity prices, interest rates, emerging markets, and credit/liquidity spreads. The next most common areas were those focused on regional stress events in Europe, Japan, or North America (including stress to foreign exchange rates). A few stress tests focused on commodities and related risk factors or on stress in options markets (shocks to volatilities).

Based on a detailed examination of these stress test scenarios, three observations can be made. First, there is a perceived asymmetry in risks. Crashes were much more likely to be stress-tested than booms for equity prices and emerging markets. Increases in interest rates and credit/liquidity spreads were more commonly stress-tested than decreases. Foreign exchange rate-related stress tests were more balanced, though "weak dollar" scenarios outnumbered "strong dollar" scenarios. Interviewed risk managers attributed this asymmetry to asymmetric exposures (eg banks are exposed to the risk of rising interest rates, declining equity prices, and widening credit spreads), asymmetric probabilities (eg high risk of a stock market crash because of historically high equity market valuations), and the historical experience of stressful events, which is perceived to be asymmetric.

Second, banks rely heavily on stress tests for markets or products whose risks may be inadequately captured by statistical risk measures like VaR. Interviewed risk managers gave several reasons why VaR may mismeasure risk for some markets or products, leading them to rely on stress tests: a lack of good historical price data, a tendency of markets to gap, illiquidity, or difficulties in estimating the highly non-linear exposures from options dealing.

Third, more stress test scenarios were focused on emerging markets than on any other area. Emerging markets was cited as a leading example of the above conclusion that some markets are particularly well-suited for stress testing.

The Task Force compared similarly-titled stress test scenarios to see how similar or dissimilar they really are and found that stress tests run by different banks are quite different, even when based on identical historical events. For example, among the 20 scenarios titled "1987 stock market crash", the magnitude of the assumed decline in the S&P 500 index ranges from 4% to 36%; 10 scenarios contain knock-on effects to interest rates, while 10 do not; in the 10 scenarios with knock-on effects, 6 have interest rates falling while 4 have rates rising. According to the interviewed risk managers, these differences can reflect differences in banks' portfolios, different time horizons in measuring shocks, and different assumptions on how fast positions could be liquidated.

The role of stress testing in risk management

The census represents, to the Task Force's knowledge, the first global survey on stress testing practices. It not only provides information on how banks view stress tests, but also serves as an overview of current practice.

According to the census responses, stress testing has become a standard risk management technique for the reporting banks. All the banks use stress tests to understand the firm's risk profile and communicate with senior management. Just over half use stress tests to set limits. One-fifth use stress tests for capital allocation. Two-thirds of banks said that stress test results had directly led them to hedge or unwind a position, while follow-up interviews indicated that such a response is by no means automatic as decisions tend to be made on a case-by-case basis. Most banks run at least some of their stress tests at a high frequency (daily or weekly), although in interviews, some banks said that the more complicated scenarios were costly to run and could only be run at a low frequency (monthly or quarterly). At one-quarter of banks, stress tests allow for limited interaction of market and counterparty (default) credit risk.

Implications

The following implications of the census can be highlighted. First, it appears that stress testing has become an integral part of banks' risk management. Second, in interpreting the results of stress tests, firms appear to take into account their position in the market, their particular approach to stress test implementation and the strategic aspects of risk management. There is thus no unique response by the reporting banks to the information gained through stress testing. In this regard, the Task Force notes a contrast between VaR, where some have suggested that the use of similar risk measures by many banks may create a link between market shocks and banks' responses, and stress testing in the sense that stress testing practices are so heterogeneous that a potential for feedback trading is not evident from the census.

1.   Goals and organisation of the census

1.1   Goals, reporting banks, and reporting format

The Census of Stress Tests was conducted by a Task Force established by the Committee on the Global Financial System (CGFS) of the G10 central banks.[1] The census was undertaken

- to enhance our understanding of the role that stress testing plays in risk management;

- to identify the exceptional events considered by banks to be significant risks; and

- to develop information on the heterogeneity of risk-taking at a point in time.

Forty-three banks from ten countries participated in the census.[2] These census reporters, which are listed in Annex 2 of this report, were selected by their national central banks, using the reporting panel for the Regular OTC Derivatives Market Statistics (the Yoshikuni Statistics) as a starting point.[3] Banks participating in the census reported to their national central bank. The data were then submitted on a no-name basis to the BIS-based secretariat to be merged into a common database.

The Task Force designed a set of reporting forms with the assistance of a group of private-sector risk managers assembled for that purpose.[4] The first reporting form asked banks to list the firm-wide stress test scenarios that captured risks material to the bank. For each stress test scenario reported in the first census form, banks were requested in the second reporting form to report the scenario's most important risk factor shocks. The third reporting form presented supplemental questions about how the banks perform and use stress tests. Banks were asked to use an as-of date of 31 May 2000.

Task Force members also conducted interviews with senior representatives of a subset of the reporting banks, to allow the banks to clarify, amplify, and augment their responses. Each national central bank decided whether interviews were necessary to interpret the banks' responses to the census.

1.2   Definition of the term "stress test"

"Stress testing" has been adopted as a generic term describing various techniques used by financial firms to gauge their potential vulnerability to exceptional but plausible events. As the term is used in this report, a "stress test" can be either a *stress test scenario* or a *sensitivity stress test*.

A *stress test scenario* contains simultaneous moves in a number of risk factors (for example, equity prices, foreign exchange rates, interest rates), reflecting an event that the firm's risk managers believe may occur in the foreseeable future. A stress test scenario can be based on a significant market event experienced in the past (a historical scenario) or on a plausible market event that has not yet happened (a hypothetical scenario). The most common stress test scenario reported on the census was the 1987 stock market crash, a historical scenario.

A *sensitivity stress test* isolates the impact on a portfolio's value of one or more predefined moves in a particular market risk factor or a small number of closely linked market risk factors. Often it contains symmetric shocks (up and down), unlike a stress test scenario which typically shocks a given market risk factor in only one direction (up or down). The most common sensitivity stress test reported on the census was a parallel yield curve shift.

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[1]   The CGFS approved the Task Force's terms of reference at its 12 March 2000 meeting. The terms of reference are reproduced as Annex 1 of this report. For previous CGFS-sponsored work on stress testing, see Committee on the Global Financial System (2000), Stress Testing by Large Financial Institutions: Current Practice and Aggregation Issues, Basel (April) (can be downloaded from http://www.bis.org).

[2]   Throughout the report, the term "banks" includes both commercial banks and investment banks/securities firms.

[3]   See Bank for International Settlements (1996), Proposals for Improving Global Derivatives Market Statistics (Yoshikuni Report), Basel (July) (can be downloaded from http://www.bis.org).

[4]   The reporting forms with instructions are reproduced as Annex 3 of this report.

Banks were asked to report both stress test scenarios and sensitivity stress tests.[5] The 43 banks reporting on the census submitted 293 stress test scenarios and 131 sensitivity stress tests run at the firm-wide level, an average of about 10 firm-wide stress tests per bank.

1.3 Limitations in using the census results

In the process of collecting census responses and conducting follow-up interviews, the Task Force became aware of several limitations of the census. Before presenting the results of the census, it seems useful to highlight four such limitations.

First, the Task Force began its work with the assumption that banks stress test what they consider to be *important* risks. The interviews with representatives of some of the reporting banks supported this assumption. However, importance is a subjective notion, and there are many reasons why a bank could consider a stress test to be important. A stress test could monitor a large exposure, monitor a hedge, or ensure that a bank is not exposed to a particular event. Thus, while a bank's stress tests are certainly related to its exposures, it should not be assumed that stress tests are a perfect mirror image of exposures. Nor should it be assumed that stress tests reflect a bank's perception of the likelihood of a given event.

Second, banks were asked to rank their firm-wide stress tests according to importance. The Task Force had hoped to aggregate the rankings to identify the "key risks" in the global financial market. But many banks did not provide a ranking of their stress tests. These banks typically said that all stress tests were equally important or that it was impossible for them to rank stress tests. Again, importance is a subjective criterion, which may have made it difficult for banks to rank their stress tests by importance. Because any aggregation of these importance rankings would be incomplete and therefore potentially misleading, no information on the relative importance of stress tests is presented in this report.

Third, the results present a portrait of stress tests in use at a point in time - 31 May 2000. As market conditions and banks' exposures have changed since then, the stress tests in use at the reporting banks have undoubtedly continued to evolve. Still, banks suggested that, while firm-wide stress tests are reviewed frequently, they are only changed infrequently. The main reason is a desire to employ stress tests as a workable means to monitor exposures over time.[6] A number of banks interviewed felt that the results produced by a given stress test over time were particularly informative about changes in the firm's overall risk profile over time.

Fourth, some banks seem to have interpreted the term "firm-wide stress test" in unintended ways. In the course of analysing the results, the Task Force tried to adjust for obvious differences in reporting. Consequently, any response that is not a firm-wide stress test, as the term is defined throughout the report, was dropped from the analysis. The dropped responses include business-level stress tests, worst-case-scenario stress tests[7] that add up each business unit's exposure to its own worst-case scenario (rather than a common firm-wide scenario), and modified Value-at-Risk (VaR) setups (eg VaR at the 99.9% confidence level).[8] Of course, despite these efforts at making the results comparable across banks, some problems undoubtedly remain.

1.4 Analytical approach

The Task Force began analysing the census responses by classifying each stress test scenario two ways: by dominant asset class and by geographical region. At this stage, sensitivity tests were

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[5] Banks were also asked to classify each stress test they reported as either a stress test scenario or a sensitivity stress test. However, there appeared to be some inconsistencies across banks in how these terms were understood. The results as presented are based on our reclassification of the responses into stress test scenarios and sensitivity stress tests.

[6] Interviews with representatives of some of the banks confirmed that business-level stress tests are more responsive to new products or changes in market conditions.

[7] Some banks appeared to find worst-case-scenario stress tests useful as an "upper bound" on potential losses.

[8] A total of 69 reported stress tests were dropped from the analysis.

excluded and their analysis is thus confined to a separate part of this report (see Section 3 below). The asset classes used to classify the scenarios are:

- commodities;
- credit (including liquidity);
- equities;
- interest rates;
- foreign exchange (FX) rates.

Scenarios with more than one dominant asset class were classified into a "multiple asset class" group. The regions used are:

- Europe;
- Japan;
- North America;
- emerging markets.

Scenarios that focus on more than one region were classified as "global". The scenarios were grouped mainly on the basis of the stress test's title, but also by looking at the scenario's most important risk factor shocks. For example, a 1987 stock market crash scenario would be put in the "equity" asset class and the "global" region. This preliminary classification is summarised in Table 1.

For further analysis, the Task Force chose to group the scenarios into nine "themes". Four of these themes are based on an asset class (commodity, credit, equity, interest rate), with each containing the "global" scenarios for that asset class. Because most of the foreign exchange rate scenarios are regional, FX scenarios are grouped with their region. Four other themes are regional (Europe, Japan, North America, emerging markets), with each containing FX rate scenarios and scenarios covering multiple asset classes for that region. An "other" theme contains the global scenarios focusing on FX rates and multiple asset classes.[9] Following this plan, the Task Force classified 238 of the 293 scenarios.

The 55 remaining scenarios were harder to classify. These are regional scenarios with a single dominant asset class. Should they be allocated to the regional theme or the asset class theme? The Task Force looked at each of these scenarios and judged whether it was a better match to the regional theme or the asset class theme. For the sake of brevity, only the results of these classifications are presented here. First, all remaining scenarios in the "emerging markets" column were assigned to the "emerging markets" theme. Next, all remaining scenarios in the "commodities", "credit", and "equities" rows were assigned to the corresponding asset class theme. Finally, scenarios that focus on interest rates in a particular region were individually assigned to either the regional theme or the interest rate theme.

The nine "themes" are high-level groupings of stress test scenarios that deal with a common type of market event. To give more granularity to the analysis, it was decided to group together similar stress tests within each of the nine themes. These groupings are listed in Box 1, along with short descriptions.

When a tabulation of the reported stress tests is presented, two numbers are reported: the number of banks and the number of stress tests. The former counts a bank once, regardless of how many stress tests of a similar nature the bank runs. The latter simply counts each stress test once. Counting the number of banks gives a more accurate idea of how widely a scenario is used in the market. Basing the analysis only on a count of the number of stress tests would be misleading in those cases where one bank runs many similar stress tests. For example, one bank runs nine New Economy equity scenarios.

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[9] Stress tests that focus on volatility shocks make up the largest component of "other" stress tests. In some of the figures, volatility stress tests are reported separately from the rest of the "other" theme.

Box 1
Description of the groupings of similar scenarios

Equities

"**Black Monday 1987**": Scenarios capturing market events on and after 19 October 1987. The main focus is on shocks to equity indices. Some of the scenarios include related events in other markets.

"**Hypothetical stock market crash**": Similar to Black Monday in terms of risk factors addressed, but the shocks used are not directly based on historical experience.

"**New Economy scenarios**": The stress tests in this group almost exclusively concentrate on equity prices. The main focus is on market corrections in New Economy equities and on the relative performance of New and Old Economy stocks.

Interest rates

"**Other historical interest rate increases/declines**": These groups combine a number of historical episodes focusing on specific interest rate changes. The focus is almost exclusively on interest rate changes as such, typically in only one or two countries (often the home country of the reporting bank).

"**Bond market crash 1994**": Scenarios capturing events in international bond markets in the first quarter of 1994. However, the focus of all of the stress tests in this group is not exclusively on bond markets but rather on all relating market events including shocks to equity prices, FX and swap rates as well as other risk factors.

"**Global tightening**": Focus on increasing short and long-term interest rates and, in some cases, interest rate volatilities across several developed markets. The underlying scenario is similar to the one of the 1994 bond market crash, however other risk factors (FX rates, equities) are only of minor importance.

"**US tightening**": Hypothetical events that could follow a US interest rate increase across several developed markets. The risk factors shocked are similar to those in the "global tightening" group, including interest rate increases in several developed markets. However, the number of countries and currencies involved is smaller.

Emerging markets

"**Asia**": Eight historical scenarios simulating the events of the Asian financial crisis in 1997-98, and seven hypothetical scenarios inspired by the Asian financial crisis. The focus is usually on equities, FX and interest rates in Asian countries as well as in G7 countries.

"**Latin America**": Six scenarios are historical based on the devaluation of the Mexican Peso on 14 December 1994. Four scenarios focus on stress in Brazil (two historical, based on 1998-99, and two hypothetical). The remaining six scenarios are hypothetical regional crises. In all scenarios in this group, stress moves are applied in more than one Latin American country, but not on risk factors in other regions.

"**Country risk**" stress tests focus on particular (sets of) countries and tend to stress interest and FX rates as well as equities. In many cases the different countries are stress-tested one after another, with the results of the stress test not necessarily being aggregated.

"**Russia**": Seven scenarios are based on the Russian devaluation on 21 August 1998 and the associated market events. The focus of both the hypothetical and historical scenarios is on the region as such and in some cases on rates in G7 countries, but not on risk factors in other regions.

"**Eastern Europe**": This group combines a number of hypothetical scenarios focusing on Eastern European FX and interest rates. Some of these set-ups also shock interest rates in developed countries.

"**Global emerging market crises**": Scenarios which are hypothetical and simulate a crisis across all emerging markets, including spillovers into the developed economies, without a clear focus on a particular region or set of risk factors.

Credit

"**Spread widening**": A widening of various credit and/or swap spreads over a wide range of countries, less frequently including shocks to equity prices and interest rates in the major currencies.

"**Fall 1998**": Scenarios focusing on the historical crisis episode following the Russian devaluation and default in August 1998. The main risk factors are similar to the spread widenings described above.

Europe

"**European stress 1992**": These scenarios refer to the crisis of the European Exchange Rate Mechanism (ERM) in 1992. The focus is thus on the interest and FX rates of European countries, but also in a few cases on the US dollar and the yen.

"**European stress/weak euro**": Hypothetical scenarios dealing with the impact of a stressful shock in European stock, bond and/or currency markets on markets in Europe, Japan, and the US.

"**European divergence**": These scenarios concentrate on divergent interest and FX rate developments between the Euro-zone and other European countries. Contrary to the weak euro stress tests, non-European currencies are typically not among those being shocked.

"**European boom/strong euro**": The focus is on the impact of FX and interest rate movements driven by rising euro interest and/or exchange rates.

Japan

"**Interest rate increase scenarios**": These scenarios stress banks' portfolios with historical and hypothetical increases of Japanese interest rates. Some of the scenarios also include shocks to Japanese equity prices and interest rates in the major currencies. Some explicitly consider an end to the zero-interest-rate policy.

"**Japan market-wide stress**": Historical and hypothetical events with a stressful impact on all Japanese markets. In terms of risk factors the focus is thus on Japanese equity prices, interest rates, and the yen exchange rate, while repercussions in the other main markets are also considered.

"**December 1998**": Scenarios focusing on the termination of the Japanese MOF-Bond Purchase Operation on 20 December 1998 and its subsequent impact on the JGB bond market. The main risk factors shocked are thus Japanese short and long-term interest rates.

"**Strong yen**" scenarios apply various historical appreciations of the Japanese yen. Shocks are limited to FX rates and volatilities.

Commodities

"**Middle East crisis**": Scenarios focusing on the financial spillovers to equities, FX and interest rates in industrialised countries from an oil shock. Four of the scenarios are historical, based on events of August 1990. Only three of the scenarios actually contain a shock to oil prices.

"**Commodity stress**": These scenarios focus on shocks to commodity prices and volatilities.

North America

"**Weak dollar**": Scenarios focusing on historical and hypothetical depreciations of the US dollar. The main risk factors are thus FX rates and volatilities, but in some cases also interest and swap rates. Three historical scenarios based on the 1985 Plaza Accord are included.

"**Strong dollar**": Like the weak dollar scenarios, these scenarios focus on movements of the US dollar. However, this time the dollar appreciates. These scenarios almost exclusively concentrate on FX rate and volatility movements.

"**US market-wide stress**" scenarios feature declines in the US dollar of 5-15%, declines in the S&P 500 index of 15-30%, increases in the US long bond yield of 75-125 basis points, and knock-on effects on other G7 markets.

Other

"**Volatility disruptions**" stress portfolios against shocks to interest rate, equity and FX volatilities as well as, in some cases, a number of additional risk factors.

To facilitate peer group comparisons, the reporting banks were divided into two groups. "Global dealer banks" are active worldwide across all market segments including derivatives markets. "Other internationally active banks" are active outside their home country but generally focus their business on a limited set of markets. Each reporting bank was classified by its national central bank.[10]

2. Stress test scenarios

2.1 Summary of stress test scenarios

Table 2 summarises the stress test scenarios run by the 43 reporting banks. The table shows the number of banks and the number of stress test scenarios for each theme and group of similar scenarios listed. The most common themes were equities (stress tested by 32 banks), interest rates (27 banks), and emerging markets (24 banks). For each theme, the table lists the most common groups of similar scenarios. Historical scenarios are listed in italics; groupings of similar historical and hypothetical scenarios are marked with an asterisk. Overall, the most common scenarios were Black Monday 1987 (stress tested by 20 banks), a widening of spreads in credit markets (15 banks), and a hypothetical stock market crash (13 banks). Figure 1 summarises the results from Table 2. The less common scenarios, which were included in the "other" lines of Table 2, are listed in Table 3. For the sake of completeness, scenarios that focus on foreign exchange rates, which are grouped with the regional themes in Table 2, are broken out in Table 4.

2.2 Analysis of stress test scenarios

Table 2 is the main output of the Task Force's work. It presents a snapshot, as of 31 May 2000, of risks that the reporting banks felt were important enough to stress test. An exhaustive analysis of Table 2 is beyond the scope this report. However, three obvious conclusions can be drawn from the table.

First, and perhaps most obviously, there is a perceived asymmetry in risks among reporting banks. For several themes, the most common scenarios feature shocks in a single direction. For equities, the risk of a crash appears to outweigh the risk of a boom. There appears to be a greater risk associated with higher interest rates than with lower interest rates. The risk of credit spread widening apparently outweighs the risk of credit spread tightening. The risk of a weak dollar outweighs the risk of a strong dollar.

Risk managers at reporting banks were asked why they treat these risks as though they are asymmetric. They gave three reasons. First, in some cases, such as the interest rate and credit themes, banks have asymmetric exposures due to the nature of their business. Banks are naturally "long" interest rate risk and credit risk.[11] Second, a scenario may reflect current views of what market stress is likely in the near future. For example, some risk managers said that their bank chose to run an equity crash scenario because equity market valuations were at historically high levels (on 31 May 2000). Third, a scenario may reflect senior managers' interest in ensuring that the bank is not exposed to particular stress events they have personally experienced, which happen to be asymmetric.

A second point to be made from Table 2 concerns the character of risks that are captured in the reported scenarios and what that reveals concerning banks' goals in using stress tests for risk

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[10] To help them classify banks, Task Force members used the following broad definition. A "global dealer bank" has: (i) direct exposures to a large number of market risk factor categories (such as various interest rate curves, foreign exchange rates and equity market categories) arising from a broad array of global financial services provided such as commercial lending, financial asset trading, insurance, and asset management; (ii) The variety of the services provided is, in turn, reflected in the variety of risks the firm is willing to take; (iii) such exposures are assumed through on-balance sheet positions and transactions in financial derivatives; (iv) an important share of these exposures arises out of the dealing activities of such firms. Any bank not meeting these criteria was classified in the "other internationally active banks" peer group.

[11] Although, as some risk managers noted, this is becoming less true over time with the growth of derivatives markets.

management. A number of the interviews with reporting banks confirmed that stress tests are often used to capture risks that would escape detection by a VaR model. (Box 2 summarises the common rationale for using stress tests).

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Box 2

Common rationale for using stress tests

"Stress tests supplement value-at-risk (VaR). VaR is used to provide a probability-based boundary on likely losses for a specified holding period and confidence level (for example, the maximum loss that is likely to be experienced over one day with a 99% level of confidence). Firms employ VaR prospectively, to assess the risk of potential portfolio allocations, and retrospectively, to assess the risk-adjusted performance of individual business units."

"Firms recognise the limited ability of statistical models such as VaR to accurately capture what happens in exceptional circumstances. In part, this is due to modelling assumptions that make it easier to compute VaR. However, there is a more fundamental problem with using statistical models like VaR for assessing risks in exceptional circumstances. By definition, exceptional circumstances occur rarely, and statistical inference is imprecise without a sufficient number of observations. Stress tests partially fill this gap, and thus complement VaR, by offering a quantitative picture of the exposure associated with a possible extreme event. In the absence of a reliable statistical measure of the probability of such an event, stress testing calls on the informed judgement of risk managers and senior executives to assess whether, and to what degree, the firm should move to limit or modify such an exposure. Even if a statistical model could be built that accurately captured risk in extreme circumstances, risk managers and senior management appear likely to prefer to continue using stress tests, because the assumptions underlying such a statistical model would not be transparent."

From: Committee on the Global Financial System (2000), Stress Testing by Large Financial Institutions: Current Practice and Aggregation Issues, Basel (April), pp. 7-8.

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Interviewed risk managers mentioned the following deficiencies in VaR models: these models assume liquid markets, require good historical price data, have difficulty handling markets where price jumps are common, and have difficulty handling highly non-linear exposures, such as those arising from out-of-the-money options.

To give a specific example of how stress tests are used to complement VaR, consider that VaR models use correlations based on normal market movements.[12] If stress tests are used to measure the impact of changing correlations in stressful times, the comovement of risk factors in stress test scenarios should be different from their historical comovement.[13] A close look at the stress test scenarios listed in Table 2 shows that this is indeed the case. For example, the single most common type of stress test scenario is a global equity crash. Typically, this involves a sharp coincident drop in stock markets in the United States, Europe and Japan, suggesting strong comovements in equity prices in these markets in stressful times. However, in normal times, these markets are only weakly linked; the average correlation among G3 stock markets is 0.40.[14] Interest rate scenarios are a second example. A common historical interest rate scenario is the Bond Market Crash of 1994, when yields on G3 government bonds moved sharply upward in the first quarter of 1994. In normal times, G3

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[12] For a discussion of issues related to changing correlations in times of market stress, see Loretan and English (2000), "Evaluating changes in correlations during periods of high market volatility", BIS Quarterly Review, Basel (June), pp 29-36 (can be downloaded from http://www.bis.org).

[13] Two banks reported scenarios measuring firm-wide exposure to risk arbitrage deal breaks, another risk that would escape a risk measurement technique based on historical comovements. Risk arbitrage deal breaks seemed to be a common business-level stress test, according to the interviews held with risk managers.

[14] This correlation is computed using weekly returns on major market indices in Germany, Japan, and the United States over 1996-2000.

government bond yields do not move together that strongly; they have an average correlation of only 0.18.[15]

A final point to be made from Table 2 is the popularity and diversity of scenarios run with the theme of emerging markets. Emerging markets is the most common theme when measured by the number of scenarios. The large difference between the number of banks running emerging markets scenarios and the total number of emerging markets scenarios indicates that some banks are running multiple scenarios on emerging markets. As suggested by the groupings listed in the table, it is common for a bank to run emerging markets scenarios for several different regions (Asia, Latin America, Russia, Eastern Europe).

The popularity of stress tests for emerging markets may be linked to the point mentioned above about the character of risks captured by stress testing. In the interviews, risk managers cited the recent financial crises in emerging markets as events where markets that became illiquid as a result of the crisis moved together in ways quite different from their historical comovements. One risk manager commented that VaR was not relevant for assessing the riskiness of a bank's exposure to emerging markets, citing some of the reasons mentioned above (lack of good data, illiquidity, tendency of emerging markets to gap). Instead, this risk manager said, stress tests should be relied on. The census results and the interviews taken together support the conclusion that stress testing may be an attractive way to measure emerging market risk exposures.[16]

The group of scenarios labelled "Country risk" under the emerging markets theme requires further explanation. These scenarios track a bank's exposure to a stress event in a single emerging market (country or region) and contain shocks across multiple asset classes (a sovereign bond spread, an exchange rate, and, less frequently, an equity index).[17] Each bank that reported a country risk scenario runs it for multiple emerging markets. In the interviews, some risk managers commented that their banks base country risk limits on the results of country risk stress tests. Although the table reports seven banks running nine scenarios, in fact the total number of scenarios would be much higher if all the individual emerging markets that each bank runs its country risk scenarios for were counted separately.

2.3   Comparing stress test scenarios

Grouping similar scenarios together gives a high-level view of the risks that are of concern to the reporting banks. So far the question of how similar or dissimilar the actual stress test scenarios run by different banks are has not been addressed. Figures 2-10 provide a visual sense of the commonality or divergence among scenarios. All nine figures have the same structure. Each column represents a class of risk factor shocks. Each row represents a single scenario reported on the census. The scenarios are grouped as in Table 2. In each row, a column is shaded if that scenario contained a shock to that column's risk factor. An arrow indicates the direction of the shock. Scenarios that have similar underlying shocks will have similar shading patterns. Dissimilar scenarios will have different shading patterns. When looking at these figures, one has to keep in mind that reporting banks were asked to list only the *most important* risk factor shocks in each scenario. A close reading of the banks' responses shows that different banks provided different levels of detail. This will make the scenarios appear to be more dissimilar than they really are.[18]

Figures 2-10 illustrate one of the important findings of the census: stress tests run by different banks are quite different. This can be seen by the diverse shading patterns among similar scenarios. The diversity within groupings is especially striking, as these stress tests have similar titles, are intending to

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[15]   This correlation is computed using weekly changes in benchmark (10 year) bond yields in Germany, Japan, and the United States over 1996-2000.

[16]   The same might be true of other markets where low liquidity in stressful times makes historical comovements of prices less useful for assessing potential losses under stress.

[17]   The other emerging market scenarios, both historical and hypothetical, often had the same structure, with a simultaneous shock to a sovereign bond spread, exchange rate, and, in some cases, a stock market index.

[18]   This caveat applies equally to the entire analysis, as the number of scenarios reported by each bank depends on its definition of what it regards as an "important" scenario.

capture similar risks, or are based on the same historical stress event. The large amount of diversity is over and above what can be attributed to differences in the amount of detail reported by different banks, as mentioned above.

Figures 2-10 allow one to compare the breadth of risk factors covered in a scenario, but they do not show the magnitude of shocks. One of the striking results of the census is that the magnitude of shocks varies substantially among scenarios that, on the surface, look quite similar. This was true even for historical scenarios, where banks base their scenario on an historical event whose shocks are common knowledge. One source of differences is that banks use different time horizons to measure historical shocks. One bank may use a one-day shock, another may use a two-week shock, a third may use the peak-to-trough shock.[19] Different time horizons will give different shock sizes in most historical episodes. In addition, the magnitude of risk factor shocks may vary because of differences in banks' portfolios.

Table 5 illustrates this point. It displays the magnitude of the shocks to stock market indices in the United States, Europe, and Japan that banks use in their "Black Monday 1987" and "Hypothetical Stock Market Crash" scenarios. The table is sorted by the average size of the US stock market crash assumed in the scenario. It is obvious that banks use quite different size shocks to capture an equity crash. Whether a crash scenario is historical or hypothetical does not seem to be a good predictor for the magnitude of the equity shocks assumed in the scenario, as hypothetical crash scenarios contain some of the largest and smallest crashes reported.[20]

To give more insight into the cross-market effects assumed for the equity crash scenarios, the last column in Table 5 shows what, if any, interest rate shocks are assumed as part of the equity crash scenarios run by reporting banks. It can be seen that sixteen equity crash scenarios shock interest rates in addition to equity price indices. Of these sixteen scenarios, nine assume interest rates to decline, while five assume increasing rates. Two scenarios assume a mixture of rising and falling rates across countries. The disparate treatment of cross-market effects is another factor contributing to the dissimilarity of stress tests across reporting banks.

In addition, Figures 2-10 allow one to see what, if any, cross-market effects are assumed within *all* reported stress test scenarios. For example, Figure 2 presents the 53 equity scenarios submitted by the census reporters. The block of risk factors representing equity markets is quite dark, indicating that most equity scenarios contain shocks across several global equity markets. The block for equity volatility is filled in for 8 of the 20 Black Monday scenarios and 6 of the 13 hypothetical equity crash scenarios. In these cases, banks have chosen to shock equity volatilities as part of their equity crash stress test. The block for foreign exchange risk factors is almost completely unshaded, indicating that most banks do not consider shocks to foreign exchange rates as part of their equity crash scenarios.

Risk managers were asked about the large amount of diversity across banks in what cross-market effects are assumed within similar stress test scenarios. One reason they gave was that different banks have different underlying portfolios and would thus assume different cross-market effects. Another reason cited was that while some risk managers may have decided to run multiple stress tests based on a single asset class each, others have taken a decision to run scenarios based on multiple risk factors and hence to include cross-market effects.

Volatility shocks play only a minor role in firm-wide stress testing, as Figures 2-10 show. Only 92 of the 293 firm-wide stress test scenarios (31%) stress a volatility risk factor. Interviewed risk managers suggested the scarcity of volatility shocks reflects the concentrated nature of options markets, since the only way to be exposed to shocks to volatility is by trading in options.

Figure 11 breaks down the number of scenarios reported for each theme by peer group.[21] Overall, global dealer banks accounted for just over half of the scenarios reported on the census. Global dealer banks seem to place particular emphasis on equities, emerging markets, and credit spreads. For three themes - interest rates, Europe, and Japan - internationally active banks were over-represented. This

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[19]   These different time horizons may reflect different assumptions on the availability of market liquidity in stress.

[20]   A similar presentation of the diversity in the magnitude of assumed shocks could also be made for other themes such as emerging markets or interest rates.

[21]   Annex 4 presents the underlying data on the peer group breakdown.

may reflect the different nature of risk-taking at the internationally active banks, compared with the global dealer banks: their risk exposures are more closely linked to traditional banking businesses (leading to a greater concern with interest rate risk) and to their home market (leading to a greater concern with regional stress).

3. Sensitivity stress tests

3.1 Summary of sensitivity stress tests

To classify sensitivity stress tests, the Task Force made use of the same nine themes used above, plus an "exchange rate" theme. Table 6 summarises the firm-wide sensitivity stress tests run by the 43 reporting banks. As in Table 2, the numbers in the table show the number of banks and the number of sensitivity stress tests for each theme and grouping of similar stress tests listed. The most common themes addressed by sensitivity stress tests were interest rates (by 23 banks), equities (16 banks), and exchange rates (11 banks). A parallel yield curve shift was the most common type of sensitivity stress test (run by 14 banks). Figure 12 summarises the results from Table 6.

3.2 Analysis of sensitivity stress tests

Interest rates are the most common theme among the sensitivity stress tests reported on the census. Comparing Tables 2 and 6, 65 of 131 sensitivity stress tests (50%) concern shocks to interest rates, compared with only 47 of 293 stress test scenarios (16%). It thus appears that banks are comfortable controlling their interest rate risk with sensitivity tests rather than scenario analysis. This may be due to the fact that sensitivity stress tests for interest rates, such as shifting a yield curve up 100 basis points and down 100 basis points, are a simple and transparent way to measure interest rate risk. Parallel yield curve shifts are closely related to duration, the oldest and most basic measure of interest rate risk.[22] Among the 19 parallel yield curve shift sensitivity stress tests reported on the census, 100 basis points is the most common magnitude by far (with 50 basis points a distant second).

Figure 13 presents the number of sensitivity stress tests reported for each theme by peer group.[23] Internationally active banks account for 59% of the reported sensitivity stress tests, with the remaining 41% run by global dealer banks. The distribution across themes is similar for the two peer groups. For both peer groups, interest rate sensitivity stress tests are the most common by far. Equity-related sensitivity stress tests are more heavily used by global dealer banks, while all other themes seem to be dominated by internationally active banks.

4. Comparing the two types of stress tests

Sensitivity stress tests are different from stress test scenarios in many ways but, essentially, they are simpler. They typically only stress a single risk factor or a set of closely related risk factors (such as a yield curve). Their simplicity means they may be less able to satisfy the goal of capturing risks that cannot be detected by other risk measurement methodologies, like VaR. So it is perhaps not surprising that banks reported running fewer sensitivity stress tests than stress test scenarios. Also, some banks may do firm-wide sensitivity stress tests but may not have reported them because they consider them to be less important than stress test scenarios.

The different way banks use sensitivity stress tests and stress test scenarios is clear from Figure 14, which compares the number of stress test scenarios and sensitivity stress tests run for each theme.

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[22] Modified duration approximates the percentage change in an asset or portfolio's value in response to a 1 percentage point change in interest rates.

[23] Annex 4 presents the underlying data on the peer group breakdown.

For interest rates, exchange rates, and volatility, sensitivity stress tests are more common. For the other themes, stress test scenarios are more common.

Figure 15 compares the relative use of stress test scenarios versus sensitivity stress tests across the two peer groups of reporting banks.[24] Each shaded bar in the figure represents the fraction of stress tests that are stress test scenarios or sensitivity stress tests at a single reporting bank. The mix between scenarios and sensitivity tests does appear to be different across the two groups. For global dealer banks, on average 74% of the stress tests are scenarios. For internationally active banks, the comparable figure is 64%.

This difference may reflect the different character of risk-taking across the two groups of banks as well as different degrees of sophistication in terms of the general approaches to risk management taken by the two peer groups. As discussed in Section 2.2 above, stress test scenarios may be most useful for business lines where other risk measurement techniques, such as VaR, do not perform well. By the way the reporting banks are split into peer groups, global dealer banks should be relatively more involved in business lines that require stress testing for good risk measurement (ie acting as a dealer in derivatives markets). For much the same reason, internationally active banks may focus more on traditional banking business (ie managing interest rate risk), which tends to focus on liquid markets with ample historical price data. Risk measurement methods other than scenario analysis would therefore perform reasonably well, limiting the immediate need for extensive use of stress test scenarios.

5.   The role of stress testing in risk management

In the third census reporting form, banks were asked to answer some supplementary questions on their use of stress testing in risk management. Their answers, broken down into the two peer groups, are summarised in Table 7.[25] The Task Force believes that this is the first global survey on stress testing practices. As such, it might serve as a useful point of reference.[26] Furthermore, it is meant to add to the small but growing literature on the role of stress testing in risk management.[27]

Question 1 asked banks how they use stress test results. Nearly all banks responded that stress tests are used as a tool for risk managers to understand the firm's risk profile and communicate that information to senior management. According to the interviews, senior management generally examines the results of stress testing through a high-level "Risk Committee" meeting on a regular basis (eg monthly). Nearly 80% of global dealer banks, but only 45% of internationally active banks, reported using stress tests to set limits. This difference is statistically significant. About half of the banks used stress tests to conduct contingency planning for times of market stress. One-quarter or fewer used stress tests to allocate capital or to monitor liquidity risk.

Banks use stress test limits in combination with other limits, on notional position size, position sensitivity (ie delta), or VaR. In the discussions with risk managers, it became clear that there is a range of responses that a bank could take following a breach of a stress test limit. Possible responses range from mild (a discussion between the risk manager and the business unit about why the stress test limit was breached) to severe (mandatory unwinding of positions), with a great deal of room in-between. Whether a bank chooses a response at the mild or the severe end of the range depends on the bank's general attitude toward stress test limits, the level within the firm of the limit breach, and market conditions. The strongest response, to require a position to be unwound, is rarely automatic; it is almost always done on a case-by-case basis.

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[24]   The two peer groups do roughly equal numbers of firm-wide stress tests. The mean number of stress tests per bank is 11 for global dealer banks and 9 for other internationally active banks. Annex 4 presents the underlying data on the relative use of stress test scenarios and sensitivity stress tests across peer groups.

[25]   Nearly all the differences across the peer groups are not statistically significant. Differences that are statistically significant (using a 10% confidence level and a one-tailed test) are noted in the text.

[26]   The Task Force does not intend Table 7 to be interpreted as "best practice" in using stress testing in risk management, since each institution must choose the risk management techniques that best meet its own needs.

[27]   Previous work sponsored by the CGFS in this area was cited in footnote 1.

Question 2 reveals that a majority of the reporting banks have acted on the results of stress tests. Three-quarters of global dealer banks and just over half of internationally active banks answered that stress tests have led to the unwinding or hedging of a position. The interviews held with risk managers revealed two ways that banks act in response to stress test results that are "too high" relative to the bank's risk appetite. One way is to allow business units to maintain the positions that are leading to the stress exposure, but put on a "macro hedge" at the firm-wide level to reduce the stress exposure. Another way is to require business units to reduce their stress exposure. Of course, there is no reason a firm could not take both approaches in different situations.

Question 3 asked how many firm-wide stress tests the firm ran on a regular basis. The mean response was 31, with not much difference between the two peer groups. Five banks that reported doing 100 or more stress tests skewed the average. Without these five, the mean would be 11.8. Note that the average number of stress tests listed on the first reporting form was only 9.9. This difference suggests that some banks are likely to have reported the details of their most important stress tests only, as requested on the reporting form.

Question 4 asked how often firm-wide stress tests were run, giving five answers to choose from: daily, weekly, monthly, quarterly, and other. Banks were allowed to check more than one answer, so the percentages for this question do not add to 100. Daily, weekly, and monthly were the most common answers to this question. Interviewed banks said that the frequency of stress testing is influenced by both the technical burden of running stress tests and the frequency of shifts in portfolio positions. Some banks said their higher frequency answer (ie daily) reflects sensitivity stress tests, which are easier to run; their lower frequency answer (ie monthly) reflects stress test scenarios, which are more costly to run. There is a small difference between peer groups with global dealer banks running stress tests at a slightly higher frequency.

Question 5 asked how often stress test results are presented to senior management. Again, banks were allowed to check more than one answer, so the percentages do not add to 100. The most popular answers were weekly (for global dealer banks) and monthly (for internationally active banks). The difference between the peer groups for the monthly response is statistically significant.

This difference may arise from the different character of risk-taking at the two groups. As discussed in Section 4 above, global dealer banks are more active in derivatives markets where exposures are non-linear functions of underlying risk factors. As such, they are potentially exposed to greater "tail risk" (risk of large shocks leading to extreme losses), and their senior management may take a greater interest in seeing that "tail risk" is quantified through stress tests.

Questions 4 and 5 taken together highlight a practice that was confirmed in the interviews: risk managers conduct stress tests at a higher frequency than they are regularly reported to senior management. It also appears from the interviews that during times of stress, risk managers will conduct stress tests and report the results to senior management on an as-needed basis, eg daily or even several times a day.

Question 6 asked about the extent of risks captured by stress tests. All banks reported that stress tests covered the trading book, while two-thirds reported that stress tests also covered the banking book. While only a minority of banks in both peer groups includes offline/spreadsheet deals and the specific risk of individual securities in their stress tests, global dealer banks were more likely to capture these two types of risk.[28] These last two differences between peer groups were statistically significant.

Question 7 asked whether stress tests allow for the interaction of market risk and counterparty credit (default) risk. This interaction has been flagged by many as an area in need of improvement in the wake of events in 1997-98.[29] Eight global dealer banks and three internationally active banks said this interaction was captured by their stress tests. The difference across peer groups is statistically significant. However, no interviewed bank claimed a complete integration of market and counterparty credit risk. Banks answering yes to this question indicated in interviews that, at present, such

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[28] Offline/spreadsheet deals typically represent new structured products that are not (yet) incorporated into a bank's risk management information systems.

[29] See, for example, the June 1999 report of the Counterparty Risk Management Policy Group (can be downloaded at http://www.crmpolicygroup.org/).

interactions are limited to business lines or products where they are thought to have a material impact on exposure.[30]

6. Summary and implications

6.1 Summary of findings

The terms of reference of the Task Force on a Census of Stress Tests, which were approved by the CGFS at its March 2000 meeting, list three objectives that were to be met by the Task Force. According to these goals, the census was undertaken

- to enhance our understanding of the role that stress testing plays in risk management;
- to identify those exposures to exceptional events which have been identified as significant risks; and
- to develop information on the heterogeneity of risk taking at a point in time.

On the first objective, the census provides **the first comprehensive international survey on stress testing.** The responses provide a unique perspective into the incorporation of stress testing into risk management programmes. Among the more important insights generated by the report are the following:

- Stress testing has become a standard risk management technique for the firms reporting on the census. Risk managers tend to view stress tests as a supplementary source of information on the market risk exposures being run by their firms.

- Reliance on stress test data to provide measures of risk information has become particularly well established for markets most prone to discrete price jumps, such as emerging market debt or equity markets, but also for products with non-linear risk profiles, such as out-of-the-money options. That is, as suggested by the very definition of stress testing, market participants seem to view stress testing as particularly useful to measure risk exposures to markets that tend to be illiquid in times of stress or even under normal market conditions. This is evident, for example, from the survey's findings concerning the popularity of reported scenarios being run under the emerging market theme.

- Stress tests have been employed, by some banks, to determine "hard" trading limits, ie the maximum losses banks are willing to accept under a particular scenario, given their current exposures. That is, stress tests determine trading limits at which remedial actions take place. Before undertaking large one-off deals, stress tests are also used to evaluate the maximum loss limits associated with these deals. However, interviews with banks' risk managers imply that this practice applies to the business unit and is not generally applied at firm level.

- Hard trading limits can prompt immediate unwinding of positions, unwinding of positions over time or entry into offset "hedge" positions. Banks consistently respond when positions exceed stress test limits but vary responses according to their individual circumstances, as well as to those of the market as a whole. Those banks not employing "hard" trading limits emphasised the role of stress tests as a trigger for further inquiry by risk managers. There is thus no automatic response to stress test results across banks or even through time for a given bank.

On the second objective, banks' exposure to exceptional events, the census revealed that banks place **particular emphasis on stress testing equity and emerging market exposures.** Banks indicated that their focus on these two areas is likely to be mainly influenced by either their underlying exposures or large shocks that these markets have experienced in the past. More specifically, the Task Force finds the following:

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[30] The Task Force did not ask banks about stress tests for operational risk. One interviewed risk manager volunteered that such stress tests may soon be feasible given the priority currently given to improving the measurement of operational risk.

- The design of stress tests draws heavily on historical events, even for hypothetical scenarios. In case of the scenarios devoted to emerging markets, the Asian and Russian crises in 1997 and 1998 are obvious examples of recent crisis periods that are widely used to stress test bank portfolios. For equity markets, the high valuation of most markets and the first signs of weakness, in March 2000, of the "new economy" sector could explain why the 1987 equity crash is the most popular stress test.

- Scenarios with identical themes tend to reflect a perceived asymmetry in risks among reporting banks. Survey responses highlighted downside risks in equity, fixed income and emerging markets. On the currency side, the scenarios were more balanced, although the risk of dollar weakness vis-à-vis the euro seems to outweigh the risk of a strong dollar. These asymmetries seem to be dictated by the fact that banks, by the very nature of their business, tend to be long product, implying asymmetric exposures to equity, fixed income, and emerging markets. Interviewed risk managers also attributed the asymmetry to asymmetric probabilities (for example, high risk of a stock market crash because of historically high equity market valuations), differences in the speed of price movements in boom as opposed to bust periods and the historical experience of stressful events, which is perceived to be asymmetric.

- In terms of inferring banks' exposures to exceptional events from the stress tests reported, the results of the census should be interpreted with due caution. It appears that the scenarios run depend on past as much as on current exposures. On the one hand, banks tend to run scenarios that are specific to current exposure. On the other hand, however, they tend to stick to scenarios through time as a way to monitor risks even if they are no longer heavily exposed to these risks. Furthermore, with the census being a single snapshot of market practice at end-May 2000, it cannot be concluded whether stress tests are more a reflection of past shocks or of banks' actual exposures at the time. Such an assessment would rely on comparisons of banks' stress testing programmes at various points in time. Finally, banks may also run scenarios for reasons unrelated to past as well as current exposures.

On the third objective, namely to develop information on the heterogeneity of risk taking, the census depicted a *wide array of risks covered by the surveyed stress tests*, both geographically and by type of the risk factors involved. Although, as pointed out earlier, the ability to infer banks' exposures from the design of their stress tests is generally limited, there is a degree of diversity across scenarios that might be highlighted:

- Strikingly, even when several banks referred to the same historical scenario, for example the 1987 equity market crash, the magnitude of the shocks run and the range of risk factors tested varied significantly. This reflects the considerable degree of discretion by risk managers when devising stress test scenarios, including the choice of the time horizon employed, and the subjective nature of this risk management tool.

- One interpretation of the diversity of risks covered by stress tests is that the census does not provide any evidence of undue concentrations of exposures to specific market risks. However, in making this assertion, one needs to keep in mind a number of limitations, as stated in the report. Furthermore, as no reference to country-specific data has been made in the analysis of the census, the above conclusion does not necessarily hold at the country or region level. Regional reporting (US, EU and Japan) of survey results should be considered, even if country reporting is not feasible because of confidentiality concerns.

6.2 Implications of findings

Having summarised the main findings of the report, the Task Force would like to highlight two implications of the census. First, it appears that stress testing has become an integral part of banks' risk management. In devising their stress tests, risk managers seem to recognise the character of firms' exposures as well as the relative merits of scenario analysis and other techniques, such as VaR and sensitivity analysis, in dealing with specific exposures and different markets.

Second, in interpreting the results, firms appear to take into account their position in the market and the strategic aspects of risk management. There is thus no mechanistic response by the reporting banks to the information gained through stress testing. In particular, there is no indication that banks

reporting on the census apply strict policies to unwind positions if the corresponding stress test limits are being breached. Interviewed risk managers suggested that the appropriate reaction to a stress test will depend on the relationship between their bank's positions, other banks' positions, and the size of the market. In this regard, the Task Force notes a contrast between VaR, where some have suggested that a mechanical link between market shocks and banks' responses has led to an increase in positive feedback trading and higher volatility, and stress testing, where practices and uses of stress testing are so heterogeneous that a potential for feedback trading is not evident from the census.

6.3   Discussion on a potential follow-up

The Task Force report was discussed at the March 2001 meeting of the CGFS. At this meeting, attendees commented positively on the value of the information provided by the census of stress tests. In the course of the discussion, they also commented on the potential of the survey information to improve understanding of current usage of stress tests as a market risk management tool. They also exchanged views on the interpretation of the survey responses and on the influence of stress test results on how firms would actually manage risk exposures in periods of market stress.

The Committee then turned to a discussion of the potential usefulness of the collection of survey information over time. First, it was noted that surveyed firms had commented in interviews on the potential benchmark value of survey information. A number of interviewed risk managers expressed interest in receiving timely survey information on current market practices concerning the character of stress tests being run and what role stress tests played in firms' overall risk management programmes. Second, the Committee then considered how follow-up information on the character of scenarios employed in stress tests could be useful for market monitoring efforts, such as those regularly conducted by the CGFS with a focus on potential sources of financial vulnerability.

The potential benefits of any future survey exercise, however, have to be weighted against the costs involved. Against this background, it was suggested that a better-informed decision on whether or not to repeat the census and on the frequency and scope of any future follow-up could be made after receiving feedback from the private sector on the usefulness of this report. The CGFS thus invites comments and suggestions by interested parties on the usefulness of the current survey and on the potential value of developing information through follow-up surveys.[31] Particularly invited are comments of actual and potential census reporters as to how follow-up surveys might be designed to strike an appropriate balance of the costs and benefits involved. The CGFS will return to the subject in the near future and any comments received will be used as background for the Committee's review of the issue.

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[31]   Comments should be addressed to the CGFS Secretariat, Bank for International Settlements, Centralbahnplatz 2, CH-4002 Basel, Switzerland.

Tables and figures

Table 1

Preliminary classification of firm-wide stress test scenarios reported on the census

(number of scenarios)

Dominant asset class	Geographical region					
	Global	**Europe**	**Japan**	**North America**	**Emerging markets**	**Total**
Commodities	14	1	0	0	0	15
Credit	32	0	1	0	2	35
Equities	47	1	1	4	4	57
Interest rates	30	19	13	7	2	71
FX rates	2	3	11	11	3	30
Multiple	9	13	14	4	45	85
TOTAL	**134**	**37**	**40**	**26**	**56**	**293**

Notes: Multiple asset scenarios have two or more dominant asset classes; global scenarios cover two or more regions.

Table 2
Firm-wide stress test scenarios reported on the census

Dominant theme	Number of		Common stress test scenarios	Number of	
	banks	scenarios		banks	scenarios
Equities	32	53	*Black Monday 1987*	20	20
			Hypothetical stock market crashes	13	13
			New Economy scenarios[1]	5	13
			Other[1]	6	7
Interest rates	27	47	*Other historical interest rate increases*	9	16
			Bond market crash 1994	9	9
			Global tightening	6	7
			US tightening	5	5
			Other historical interest rate declines	3	5
			Other[1]	5	5
Emerging markets	24	56	Asia[1]	12	14
			Latin America[1]	8	16
			Country risk[1]	7	9
			Russia[1]	7	8
			Eastern Europe	4	4
			Global emerging markets crises	3	4
			Other	1	1
Credit	19	33	Spread widening[1]	15	22
			Fall 1998	8	9
			Other	2	2
Europe	19	25	*European stress 1992*	11	11
			European stress/weak euro	5	5
			European divergence	4	5
			European boom/strong euro	4	4
Japan	12	38	Interest rate increase scenarios[1]	5	11
			Japan market-wide stress[1]	5	7
			December 1998	4	4
			Strong yen	4	6
			Other[1]	4	10
Commodities	11	15	Middle East crisis[1]	7	8
			Commodity stress[1]	5	7

Table 2 (contd)

Dominant theme	Number of		Common stress test scenarios	Number of	
	banks	scenarios		banks	scenarios
North America	10	15	Weak dollar[1]	7	8
			Strong dollar[1]	3	3
			US market-wide stress	3	3
			Other	1	1
Other	9	11	Volatility disruption	3	4
			Other	6	7
TOTAL		**293**			**293**

Historical scenarios are in *italics*. A [1] indicates a mix of historical and hypothetical scenarios. "Other" scenarios are listed in Table 3.

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Table 3

Scenarios termed "other" in Table 2

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Dominant theme	Number of		Common stress test scenarios	Number of	
	banks	scenarios		banks	scenarios
Equities	6	7	*Historical equity market declines*	2	3
			Risk arbitrage deal break	2	2
			Equity market boom	1	1
			Equity exotics stress	1	1
Interest rates	5	5	*Worst-case scenarios*	2	2
			Differential shocks to G3 short rates	1	1
			Spike in repo rates	1	1
			Yield curve twist	1	1
Emerging markets	1	1	Emerging market boom	1	1
Credit	2	2	Credit spread tightening	1	1
			Effect of liquidation of trading positions	1	1
Japan	4	10	Weak yen[1]	2	5
			Historical lower interest rates	2	3
			Hypothetical stock market decline	2	2
North America	1	1	Canada stress	1	1
Other	6	7	Worst-case scenarios in global FX rates[1]	2	2
			Australasian crisis	1	1
			Global boom	1	1
			Global crash	1	1
			Global real estate collapse	1	1
			Stress to large exposures	1	1
TOTAL		**33**			**33**

Historical scenarios are in *italics*. A [1] indicates a mix of historical and hypothetical scenarios.

Table 4

FX-focused scenarios reported on the census

Dominant theme	Number of		Common stress test scenarios	Number of	
	banks	**scenarios**		**banks**	**scenarios**
Emerging markets	3	3	Country risk	1	1
			Eastern Europe	1	1
			Latin America	1	1
Europe	2	3	Weak euro	2	2
			Strong euro	1	1
Japan	5	11	*Strong yen*	4	6
			Weak yen[1]	2	5
North America	7	11	Weak dollar[1]	7	8
			Strong dollar[1]	3	3
Other	2	2	Worst-case scenarios in global FX rates[1]	2	2
TOTAL		**30**			**30**

Historical scenarios are in *italics*. A [1] indicates a mix of historical and hypothetical scenarios.

Table 5

Comparing stock market crash scenarios across banks[A]

No	Name	Peer group	Size of market crash (%)			Size of interest rate shock
			North America	Europe	Japan	
1	Bank 20	Other	− 40.0	− 40.0	− 40.0	
2	Bank 24	Global	− 40.0	− 40.0[B]	− 20.0	EM: + 800bp Other: − 200bp
3	Bank 08	Global	− 36.0	− 30.0		Short: − 90bp Long: + 30bp
4	Bank 05[C]	Global	− 35.0	− 35.0	− 35.0	
5	Bank 09[D]	Other	− 33.0			
6	Bank 34	Global	− 31.8[E]	− 28.6[B]	− 25.0	
7	Bank 05	Global	− 31.5[F]	− 28.0[F]	− 16.5[F]	
8	Bank 09[G]	Other	− 30.0	− 30.0	− 30.0	
9	Bank 18	Global	− 30.0[E,B]	− 22.5[B]	− 20.0[H]	G3: + 105bp Other: + 300bp
10	Bank 19	Global	− 30.0	− 30.0	− 30.0	
11	Bank 35	Global	− 30.0	− 30.0	− 30.0	
12	Bank 43	Other	− 30.0[E,B]	− 9.0[B]	− 15.0[H]	US: − 10bp Other: − 8bp
13	Bank 23	Global	− 29.0			US: + 46bp
14	Bank 22	Global	− 28.0	− 28.0[J]	− 16.0[J]	Short: − 25% Long: − 11%
15	Bank 06	Other	− 25.7	− 24.5[J]	− 30.0	US: − 120bp
16	Bank 10	Global	− 25.0			
17	Bank 01	Other	− 23.0	− 23.0	− 23.0	
18	Bank 38	Other	− 23.0	− 12.0	− 15.0[H]	
19	Bank 04[K]	Other	− 22.6[L]	− 7.9		− 12.66%
20	Bank 07	Global	− 22.6	− 22.6	− 22.6	US − 131bp Other: − 69bp
21	Bank 14	Other	− 21.11[M]		− 9.85[M]	US: + 100bp Other: + 50bp
22	Bank 37	Global	− 20.0	− 20.0	− 20.0	
23	Bank 11	Other	− 20.0	− 12.0[B]	− 15.0	
24	Bank 16	Global	− 20.0		− 15.0[H]	
25	Bank 10	Global	− 20.0			US − 7.1%
26	Bank 03	Other	− 19.0	− 7.0		
27	Bank 14	Other	− 17.6[N]		− 18.7[N]	
28	Bank 36	Global	− 15.0	− 15.0	− 25.0	EM: + 1000bp
29	Bank 31	Global	− 15.0	− 15.0	− 15.0	− 25bp
30	Bank 08	Global	− 10.0	− 9.0		US: − 30bp
31	Bank 12	Other	− 8.0[L]		− 4.0	Max: + 11bp Min: − 10bp

No	Name	Peer group	Size of market crash (%)			Size of interest rate shock
			North America	Europe	Japan	
32	Bank 25	Global	− 7.0	− 7.0	− 7.0	US: − 58bp Other: − 37.5bp
33	*Bank 17*	*Other*	*− 4.0*	*− 9.4*	*−14.9*	
34	*Bank 30[C]*	*Other*		*− 30.0*		
35	*Bank 32*	*Other*	*Volatilities times 4*	*Volatilities times 4*	*Volatilities times 4*	

Historical equity crash scenarios are listed in *italics*. [A] US equity shocks refer, unless otherwise stated, to the S&P 500, Japanese shocks to the TOPIX, and equity shocks in other countries to the broadest index. The interest rate shocks shown represent the most extreme shocks applied per scenario. [B] Bank applies shocks of different size to different indices/countries; most extreme shock is shown on the table. [C] Bank runs scenario on business unit level only. [D] Bank runs (smaller) shocks on other (sub-)indices as well. [E] US equity shock refers to NASDAQ rather than S&P500. [F] Bank applies worst 10-day shocks to various indices. The worst 10-day S&P500 price shock observed during October 1987 (between 5 and 19 October) was −31.468%, the corresponding worst price shock to other indices were −24.387% for the DAX (15-29 October), −27.984% for the FTSE (12-26 October), and −16.485% for the TOPIX (15-29 October). [G] Bank runs two October 1987 scenarios. The one concentrates on equity changes, the other on interest rates. The latter one is thus included in the interest rate theme group. [H] Japanese equity shock refers to NIKKEI rather than TOPIX. [J] Bank provided a range of shocks; low end of range is shown on the table. [K] Bank provided a range of shocks stretching over several days; the first day's shocks are shown. [L] US equity shock refers to DOW JONES rather than S&P500. [M] Bank reports shock sizes in points rather than percentages. On 31 May 2000 the S&P 500 index stood at 1420.6 points. A decline by 300 points thus translates into a negative change of 21.11%, while a 150 points TOPIX decline was roughly equal to a change of −9.85% on the same day. [N] Bank reports shock sizes in points rather than percentages. On 31 May 2000 the S&P 500 index stood at 1420.6 points. A decline by 250 points thus translates into a negative change of 17.59%, while a 285 points TOPIX decline was roughly equal to a change of −18.71% on the same day.

Table 6
Firm-wide sensitivity stress tests reported on the census

Dominant theme	Number of		Common sensitivity test categories	Number of	
	banks	tests		banks	tests
Interest rates	23	65	Parallel yield curve shift	14	19
			Change of yield curve slope	7	23
			Shift of curve and changing slope	6	12
			Shocks to swap spreads	3	6
			Shocks to rates and volatilities	3	3
			Other	2	2
Equities	16	21	Shocks to levels and volatilities	11	12
			Shocks to levels only	6	7
			Shocks to volatilities only	2	2
Exchange rates	11	14	Shocks to levels only	7	9
			Shocks to levels and volatilities	5	5
Credit	8	9	Shocks to credit spreads	8	9
Commodities	2	2	Shocks to levels and volatilities	2	2
Emerging markets	1	4	Parallel yield curve shift	1	3
			Shocks to interest rates and volatilities	1	1
Other	7	16	Shocks to various volatilities	5	12
			Other	3	4
TOTAL		**131**			**131**

Table 7
Answers to census questions on the uses of stress testing

Question and answers	All reporters		Global peer group		Int'l peer group	
	Banks	**Pct**	**Banks**	**Pct**	**Banks**	**Pct**
1. How are stress test results used? (Check all that apply)						
To help risk managers communicate the nature of the firm's risk profile to senior management	43	100.0	19	100.0	24	100.0
To help risk managers better understand the nature of the firm's risk profile	41	95.3	18	94.7	23	95.8
To set limits	26	60.5	15	78.9	11	45.3
To conduct contingency/emergency planning for times of market stress	21	48.8	8	42.1	13	54.2
To monitor liquidity risk	11	25.6	6	31.6	5	20.8
To allocate capital	8	18.6	4	21.1	4	16.7
2. Have the results of stress tests ever led your firm to hedge or unwind a position?						
Yes	28	65.1	14	73.7	14	58.3
No	15	34.9	5	26.3	10	41.7
3. How many firm-wide stress tests does your firm do regularly?	Mean: 31.0		Mean: 28.3		Mean: 33.3	
4. How often are firm-wide stress tests run? (Check all that apply)						
Daily	18	41.9	9	47.4	9	37.5
Weekly	20	46.5	8	42.1	12	50.0
Monthly	22	51.2	8	42.1	14	58.3
Quarterly	9	20.9	3	15.8	6	25.0
5. How often are firm-wide stress test results presented to senior management? (Check all that apply)						
Daily	10	23.3	6	31.6	4	16.7
Weekly	17	39.5	9	47.4	8	33.3
Monthly	23	53.5	6	31.6	17	70.8
Quarterly	10	23.3	5	26.3	5	20.8

Question and answers	All reporters		Global peer group		Int'l peer group	
	Banks	**Pct**	**Banks**	**Pct**	**Banks**	**Pct**
6. Which business line risks are captured by your stress tests? (Check all that apply)						
Trading book	43	100.0	19	100.0	24	100.0
Banking book	29	67.4	13	68.4	16	66.7
Offline/spreadsheet deals	14	32.6	9	47.4	5	20.8
Specific risk of individual securities	12	27.9	8	42.1	4	16.7
7. Do any of your stress tests allow for the interaction of market risk and counterparty (default) credit risk?						
Yes	11	25.6	8	42.1	3	12.5
No	32	74.4	11	57.9	21	87.5

Table 7 (contd)

Figure 1

Stress test scenarios: by theme
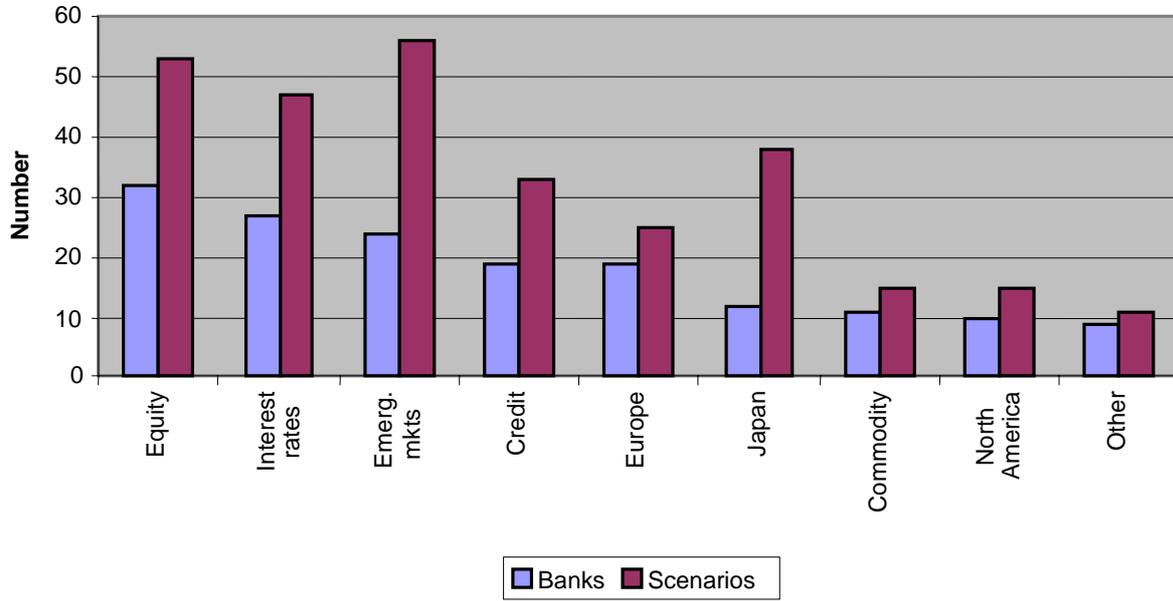
Figure 2
Stress test scenarios: equity

Category	Bank	Equity prices					Interest rates					Foreign exchange rates					Swap rates				Volatlities			Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	Other	Equity	IR	FX	
Black Monday	1	↓	↓	↓	↓	↓																		
	3	↓	↓															↑	↑					
	4	↑				↓	↓	↓	↓	↓	↓													
	5	↓	↓	↓	↓	↓															↑			
	6	↓	↓	↓	↓	↓	↓																	↑
	7	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑			
	8	↓	↓		↓	↓	↑				↑	↓	↑		↑									↑
	9	↓	↓	↓	↓																↑			
	10	↓					↓																	
	11	↓	↓	↓	↓	↓																		
	14	↓		↓																				
	16	↓		↓																				
	17	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓						↓	↓	↓	↓				
	18	↓	↓	↓	↓	↓	↑	↑	↑	↑	↑						↑	↑	↑	↑	↑	↑	↑	
	19	↓	↓	↓	↓	↓															↑			
	22	↓	↓	↓	↓	↓	↓				↓										↑	↑		
	23	↓					↑														↑			↑
	32																				↑			
	34	↓	↓	↓	↓	↓																		
	38	↓		↓	↓	↓																		
Hypothetical stock market crashes	8	↓	↓		↓	↓	↓				↓										↑			↑
	9					↓															↓			
	10	↓																						
	12	↓		↓			↑	↑	↑	↓				↑		↓			↑					
	14	↓		↓			↑		↑															
	20	↓	↓	↓	↓	↓																		
	24	↓	↓	↓	↓	↓	↓	↓	↓	↓	↑													↑
	25	↓	↓	↓	↓	↓															↑			
	31	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑
	35	↓	↓	↓	↓	↓																		
	36	↓	↓	↓	↓	↓					↑										↑			↑
	37	↓	↓	↓	↓	↓															↑			
	43	↓	↓	↓	↓		↓	↓	↓	↓		↓	↑	↑										

Figure 2 (cont)

Category	Bank	Equity prices					Interest rates					Foreign exchange rates					Swap rates				Volatlities			Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	Other	Equity	IR	FX	
New economy	18	↓	↓	↓	↓	↓																		
	18	↑	↑	↑	↑	↑																		
	18																							
	18																							
	18	↓	↓	↓	↓	↓																		
	18	↑	↑	↑	↑	↑																		
	18	↓	↓	↓	↓	↓																		
	18																							
	18	↑	↑	↑	↑	↑																		
	23	↓	↓	↓	↓	↓																		↑
	26	↓																			↑			↑
	27	↓	↓	↓	↓	↓	↑	↑	↑	↑	↑	↑	↓	↓	↓	↓	↑	↓	↓		↑	↑	↑	
	43	↓	↓	↓	↓		↓	↑	↓	↑		↓	↑	↑	↑									
Other	1					↓																		
	14			↓			↑																	
	14			↓																				
	19																							
	19																							
	21																							
	25	↑	↑	↑	↑	↑															↑			

Note: Legend appears following Figure 10.

Figure 3

Stress test scenarios: interest rates

Category	Bank	Short-term (<=1yr) interest rates					Long-term interest rates					Vols	Equity prices					Foreign exchange rates					Swap rates				Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	Other	
Other historical IR increases	1					↑					↑																	
	3										↑							↓				↑					↑
	3										↑							↓	↑								↑
	3							↑										↓				↑					↑
	3										↑			↓													↑
	10					↑													↑		↑	↓					
	11	↑					↑																				
	12	↑	↑	↑					↑																↑		
	13				↑					↑																	
	13	↑					↑																				
	13		↑					↑																			
	15	↑	↑				↑	↑																			
	15	↑	↑				↑	↑																			
	15	↑	↑				↑	↑										↑	↑	↓							
	16	↑		↑			↑		↑						↓												
	23	↑					↑																				
1994 bond market	5																										
	7	↑			↑		↑	↑	↑	↑	↑		↓	↓	↓	↓	↓										
	8	↑	↑			↑	↑	↑			↑		↓	↓			↓		↑			↓	↑				↑
	17	↑	↑	↓	↑	↑								↓	↓	↓	↓						↑	↑	↑	↑	
	18						↑	↑	↑	↑	↑		↓	↓	↓	↓	↓						↑	↑	↑	↑	
	22	↑	↑	↑	↑		↑	↑	↑	↑								↑	↓	↓	↓	↓					↑
	23						↑			↑			↓														
	31																										
	38	↑					↑						↓														
Global tightening	6	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑		↓	↓	↓	↓	↓										↑
	12	↑	↑		↑			↑	↑																↑		
	12	↑	↑				↑								↓				↑			↓			↑		
	25	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑															
	37	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑															
	38		↑		↑			↑		↑				↓				↑	↓		↓						
	39	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑															

Figure 3 (cont)

Category	Bank	Short-term (<=1yr) interest rates					Long-term interest rates					Vols	Equity prices					Foreign exchange rates					Swap rates				Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	Other	
US tightening	6	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑		↓	↓	↓	↓	↓										↑
	8	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↓	↓	↓	↓										↑
	12	↑	↑		↑				↑																↑		
	14	↑					↑		↑																		
	27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↓	↓	↓	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	
Other historical IR decreases	9	↓				↓	↓				↓	↑						↑	↑	↑	↑	↓	↓			↓	
	10										↓																
	13	↓					↓																				
	13		↓					↓																			
	13			↓						↓																	
Other scenarios	15	↓	↑	↑			↑	↑	↓									↓		↑							
	20		↑	↑				↑	↑																		
	30																										
	31	↑	↓		↑																						
	34																										
	46																										

Note: Legend appears following Figure 10.

Figure 4

Stress test scenarios: emerging markets

Category	Bank	Asia						Eastern Europe						Latin America						G7 and other industrialised countries						Volatilities			Other
		IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	
Asia	7		↓																	↓	↓						↑		
	8		↓	↓																↑	↓	↑							
	9			↓																		↑							
	14																				↓								
	18	↑	↓	↓	↑	↑		↑	↓	↓	↑	↑		↑	↓	↓	↑	↑		↑	↓	↑	↓	↑		↑	↑	↑	
	20	↑		↓																		↑				↑			
	22	↑	↓	↓		↑		↑		↓				↑		↓				↑	↓	↑				↑	↑	↑	
	23		↓	↓																		↑							
	24	↑		↓										↑		↓				↓	↓	↑		↑			↑	↑	
	29																												
	29																												
	29																												
	31																												
	43																				↓								
Country risk	19	↑		↓		↑		↑		↓		↑		↑		↓		↑											
	25																												
	26																												
	26																												
	29																												
	32																											↑	
	32																										↑		
	34	↑	↓	↓		↑		↑	↓	↓		↑		↑	↓	↓		↑											
	37																												

Figure 4 (cont)

Category	Bank	Asia						Eastern Europe						Latin America						G7 and other industrialised countries						Volatilities			Other
		IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	Swap spread	Credit spread	Other	IR	Equity	FX	
Latin America	6													↑	↓	↓		↑											
	6													↑	↓	↓		↑											
	14																			↑	↓								
	14																				↓								
	20				↑	↑					↑	↑					↑	↑					↑	↑					
	20					↑						↑						↑						↑					
	21															↓						↑							
	21													↑															
	23				↑	↑					↑	↑		↑	↓	↓	↑	↑											
	23														↓			↑											
	24													↑	↓	↓										↑		↑	
	24													↑	↓	↓										↑		↑	
	24							↓						↑	↓	↓					↓	↑	↑					↑	
	29																												
	29	↓		↓				↑		↓						↓													
	31																												
Russia	3																				↓	↑							
	6							↑	↓	↓																			
	14																			↑	↓								
	14																				↓								
	22		↓					↑	↓	↓				↑	↓	↓				↓	↓	↑							
	23									↓		↑									↓			↑			↑		
	24									↓	↑			↑		↓				↑	↓					↑	↑		
	38							↑	↓	↓																			
Eastern Europe	2									↓																			
	7							↑																					
	20							↑		↓										↑									
	29							↑		↓										↓		↑							
Global EM crisis	29																												
	36	↑	↓	↓		↑		↑	↓	↓		↑		↑	↓	↓		↑		↑	↓			↑		↑	↑	↑	
	36	↑	↓	↓		↑		↑	↓	↓		↑		↑	↓	↓		↑		↑	↓			↑		↑	↑	↑	
	43																			↑	↓								
Other	18	↓	↑	↓	↓	↑		↓	↑	↓	↓	↑		↓	↑	↓	↓	↑		↓	↑	↓	↓	↓		↓	↓	↓	

Note: Legend appears following Figure 10.

Figure 5

Stress test scenarios: credit

Category	Bank	Interest rates				Equity prices				Foreign exchange rates				Volatilities			Swap spreads			Credit spreads							Other
		US	EURO	JP	Other	US	EURO	JP	Other	US	EURO	JP	Other	IR	Equity	FX	US	G7	Other	G7	Asia	A>	BBB	BB	B	Other	
Spread widening	8	↑			↑	↓	↓	↓	↓						↑		↑								↑	↑		
	8					↓									↑			↑				↑	↑	↑	↑		
	9	↑	↑	↑	↑					↑	↓	↓	↓	↑		↑	↑	↑	↑								
	11																					↑					
	18																			↑	↑					↑	
	18																			↑	↑					↑	
	19																↑	↑	↑								
	19																					↑	↑	↑	↑	↑	
	20																			↑				↑	↑	↑	
	22	↓	↓		↑	↓	↓	↓	↓	↑	↓	↓	↓				↑	↑	↑			↑	↑	↑	↑	↑	
	23																			↑				↑	↑	↑	
	25																↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	
	25																↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	
	27	↓	↓			↓	↓	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	
	27	↓	↓			↓	↓	↓	↓	↓	↑	↑	↑	↑	↑	↑				↑	↑	↑	↑	↑	↑	↑	
	31																					↑	↑	↑			
	31	↑	↓																			↑	↑	↑	↑	↑	
	34																↑	↑	↑			↑	↑	↑	↑	↑	
	36	↓	↓	↓	↑	↓	↓	↓	↓					↑	↑						↑	↑	↑	↑	↑	↑	
	37																↑	↑	↑			↑	↑	↑	↑	↑	
	37																					↑	↑	↑	↑	↑	
	43		↓												↑							↑	↑			↑	
Fall 1998	4					↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	
	7	↓	↓	↓	↓	↓	↓	↓	↓						↑												
	8	↓			↓		↓		↓						↑		↑							↑	↑	↑	
	16	↑	↑							↓	↑	↑															
	22	↓	↓	↓		↑	↑	↑		↓	↑	↑					↑										
	26																										
	26																										
	31																										
	43	↓	↓	↓	↓	↓	↓	↓	↓	↓	↑																
Other	18																			↓	↓					↓	
	26																										

Note: Legend appears following Figure 10.

Figure 6
Stress test scenarios: Europe

Category	Bank	Interest rates					Equity prices					Foreign exchange rates					Swap rates			Credit spreads			Volatlities		
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	Other	US	EURO	Other	IR	Equity	FX
European stress	1					↑																			
	3					↑													↑						
	4					↑																			
	5																								
	11				↑																				
	12	↓		↑													↓		↑						
	16	↑	↓									↑	↓												
	17	↑	↓	↑	↓	↓	↓	↑	↓	↓	↓	↑					↑	↓							
	23		↓		↓							↑	↓		↓										
	30																								
	38				↑							↑	↓												
European stress/weak euro	5	↓		↓		↓																			
	6		↑					↓				↑	↓								↑				
	14	↑	↑	↑					↓																
	35											↑	↓	↑	↑	↑									
	38	↓	↑	↑	↑	↓	↑	↓	↑			↑	↓	↑	↑										
Euro divergence	1		↓			↑																			
	1		↓	↓	↑	↑																			
	7					↑							↑			↓			↑						
	18		↑		↑	↑	↓	↓		↓	↓	↑	↓			↓		↑	↑	↑	↑		↑	↑	↑
	29				↑									↑	↓										
European boom/ strong euro	14	↑	↑	↑																					
	22	↓	↓		↓	↓		↑			↓	↓	↑	↓	↓	↓		↑	↑				↑	↑	
	31		↑										↑			↓									
	35											↓	↑	↓	↓	↓									

Note: Legend appears following Figure 10.

Figure 7

Stress test scenarios: Japan

Category	Bank	Japan						US						Other developed						Other countries					Volatilities			Other
		IR	Yields	Equity	FX	Swaps	Other	IR	Yields	Equity	FX	Swaps	Other	IR	Yields	Equity	FX	Swaps	Other	IR	Yields	Equity	FX	Other	IR	Equity	FX	
IR increases	11	↑	↑																									
	12	↑	↑			↑		↑																				
	12	↑	↑			↑		↑						↑														
	12	↑	↑			↑		↑																				
	12		↑		↓	↑		↑			↑			↑														
	13	↑	↑																									
	14		↑	↓					↑																			
	14		↑																									
	14	↑	↑	↓																								
	14	↑	↑						↑						↑													
	16	↑	↑																									
Marketwide stress	8	↓	↓	↓	↓	↑		↓	↓	↓		↑		↓	↓	↓		↑								↑		
	8			↓	↓			↑		↓				↑		↓										↑		
	14	↑	↑	↓					↑						↑													
	14	↑	↑	↓					↑						↑													
	16	↑	↑	↓						↓																		
	22		↓	↓	↓	↑		↓		↓	↑	↑		↓		↓	↑	↑				↓	↑		↑	↑	↑	
	29																			↓	↓		↑		↑		↑	
December 1998	12	↑	↑			↑		↑	↑			↑		↑														
	13	↑	↑																									
	14		↑	↓																								
	15	↑	↑																									
Strong yen	10				↑																						↑	
	13				↑						↓																	
	13				↑												↓											
	13				↑												↓											
	16			↓	↑						↓																	
	20				↑						↑						↑								↑		↑	

Figure 7 (cont)

Category	Bank	Japan						US						Other developed						Other countries					Volatilities			Other
		IR	Yields	Equity	FX	Swaps	Other	IR	Yields	Equity	FX	Swaps	Other	IR	Yields	Equity	FX	Swaps	Other	IR	Yields	Equity	FX	Other	IR	Equity	FX	
Other scenarios	12	↓		↓	↑			↑				↑						↓		↑			↓					
	12	↓	↑		↓	↑		↓			↑			↓			↑	↓										
	12	↓		↓	↓	↑		↓	↑		↑	↑		↑			↑	↓		↑								
	13				↓						↑																	
	13				↓												↑											
	13				↓												↑											
	13	↓	↓																									
	13	↓	↓																									
	15	↓	↓																									
	23			↓	↓																				↑	↑		

Note: Legend appears following Figure 10.

Figure 8

Stress test scenarios: commodities

Category	Bank	Interest rates					Equity prices					Foreign exchange rates					Swaps	Commodities				Volatilities						Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	GB	Other		Oil	Gas	Gold	Other	Oil	Gold	Equity	IR	FX	Other	
Middle East crisis	3					↑		↓									↑											
	8	↑	↑		↑	↑	↓	↓	↓	↓	↑			↓		↑		↑				↑						
	8					↑	↓	↓	↓		↓			↓				↑		↑		↑		↑		↑		↑
	14	↑		↑					↓																			
	23	↑					↓	↓		↓								↑	↑		↑							↑
	29	↑	↑										↓	↑														
	31	↑	↑	↑	↑	↑	↓	↓	↓	↓	↓	↓	↓	↓	↑	↓												
	43	↑	↑	↑	↑		↓	↓	↓	↓		↑	↑	↓	↓		↓											
Commodity stress	9																	↑	↑	↑	↑	↑						
	9																	↑	↑									
	19																			↑			↑					
	25																	↑	↑	↑	↑	↑	↑				↑	
	25																	↓	↓	↓	↓	↑	↑				↑	
	29																											
	34																											

Note: Legend appears following Figure 10.

Figure 9
Stress test scenarios: North America

Category	Bank	Interest rates					Equity prices					Foreign exchange rates								Volatilities			Swap rates		Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	GB	Asia	Gold	Silver	Other	IR	Equity	FX	US	Other	
Weak dollar	9	↑	↑	↑	↑	↑						↓	↑	↑	↑	↑			↑			↑	↑	↑	
	10											↓	↑	↑	↑							↑			
	11											↓	↑	↑	↑	↑			↑						
	18											↓	↑	↑	↑	↑	↑	↓				↑			
	18											↓	↓	↑	↑	↑	↑	↓				↑			
	20																					↑			
	25											↓	↑	↑	↑	↑			↑			↑			
	29	↑	↑		↑	↑						↓	↑	↑	↑	↑			↑						
Strong dollar	9	↑	↑	↑	↑	↑						↑	↓	↓	↓	↓	↓		↓			↑	↑	↑	
	18											↑	↓	↓	↓	↓	↑	↑				↑			
	25											↑	↓	↓	↓	↓			↓			↑			
Market-wide stress	6	↑					↓					↓													
	18	↑	↑	↑	↑	↑	↓	↓	↓	↓	↓	↑	↓	↓	↓				↓	↑	↑	↑	↑	↑	↑
	22	↑	↓		↓		↓	↓		↓	↓	↓	↑	↑	↑					↑	↑	↑	↑	↑	↑
Other	8					↑					↓								↓	↑	↑	↑			

Note: Legend appears following Figure 10.

Figure 10
Stress test scenarios: other

Category	Bank	Interest rates					Equity prices					Foreign exchange rates					Commodities			Volatilities			Spreads		Other
		US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	US	EURO	JP	GB	Other	Gold	Gas	Other	IR	Equity	FX	Swap	Credit	
Volatility disruption	19																			■					
	25	↓	↓	↓	↓	↓														↑					
	25																			↓	↓	↓			
	27	↓	↓									↓						↓	↓	↓	↓	↓	↓	↓	■
Other	9											↑	↓	↓	↓	↓						↑			
	29					■																			
	29	■		■	■							■		■	■	■									
	34																								■
	36	↑	↑	↑	↑		↑	↑	↑	↑	↑													↓	
	37																		↓						
	38	↑	↑		↑		↓	↓	↓				↑	↓	↑										

Legend to figures 2-10:

Shaded with up arrow = upward shock/steepening
Shaded with down arrow = downward shock/flattening
Shaded without arrow = shock of unspecified or changing direction
Unshaded = not shocked

Figure 11
Stress test scenarios: by peer group and theme
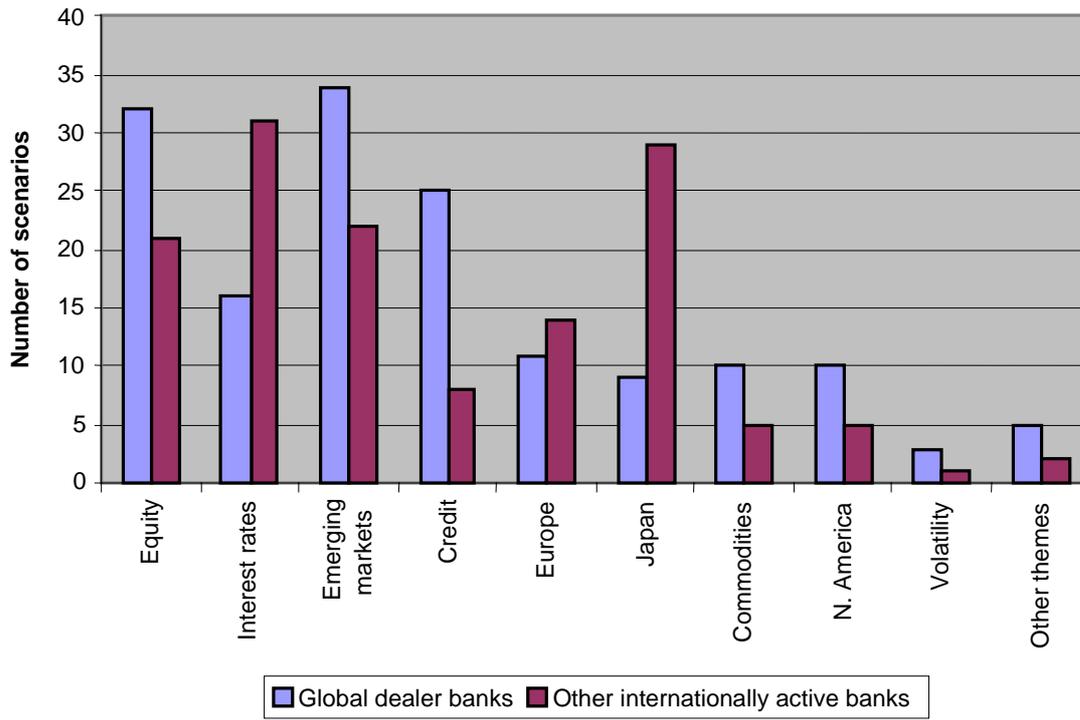
Figure 12
Sensitivity stress tests: by theme
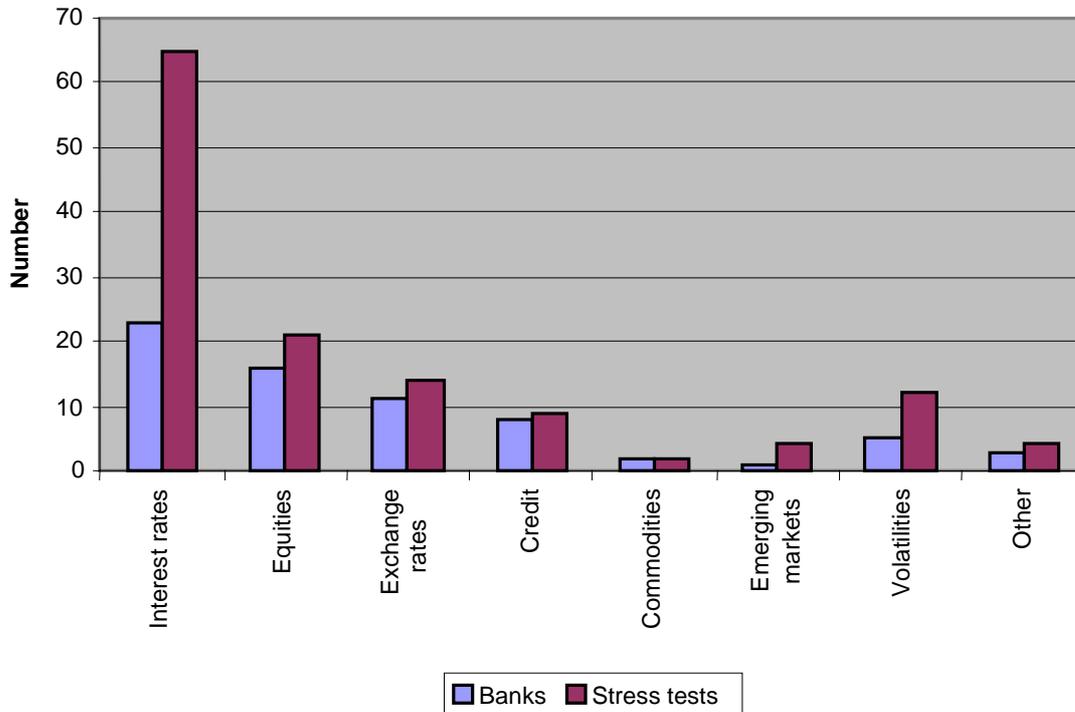
Figure 13

Sensitivity stress tests: by peer group and theme
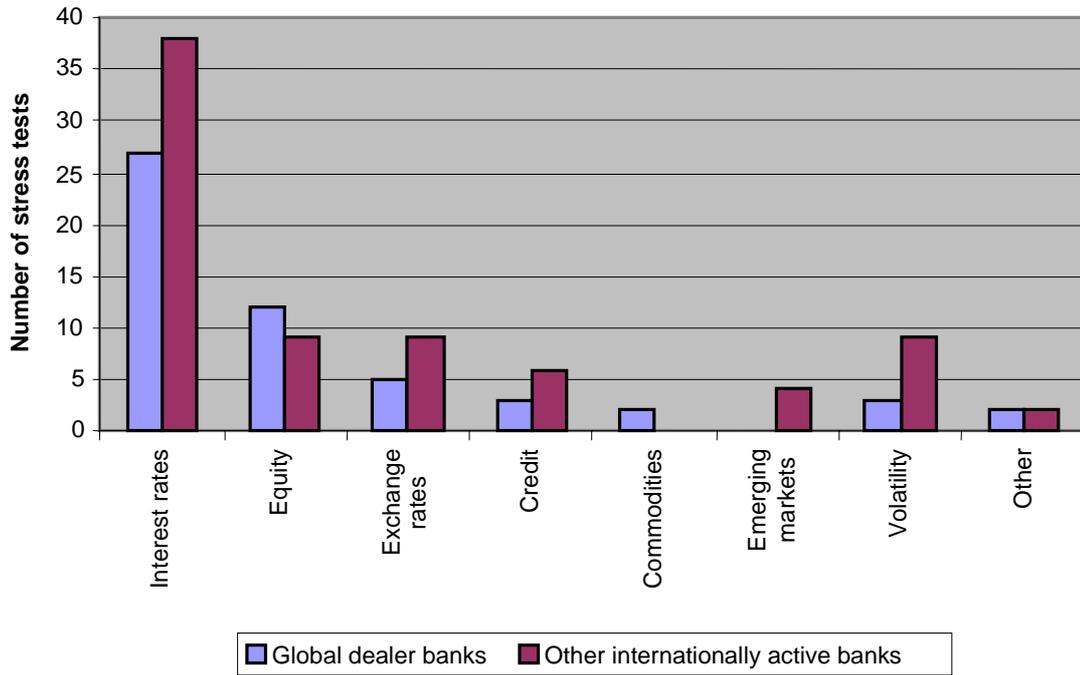
Figure 14

Stress tests: by theme and type
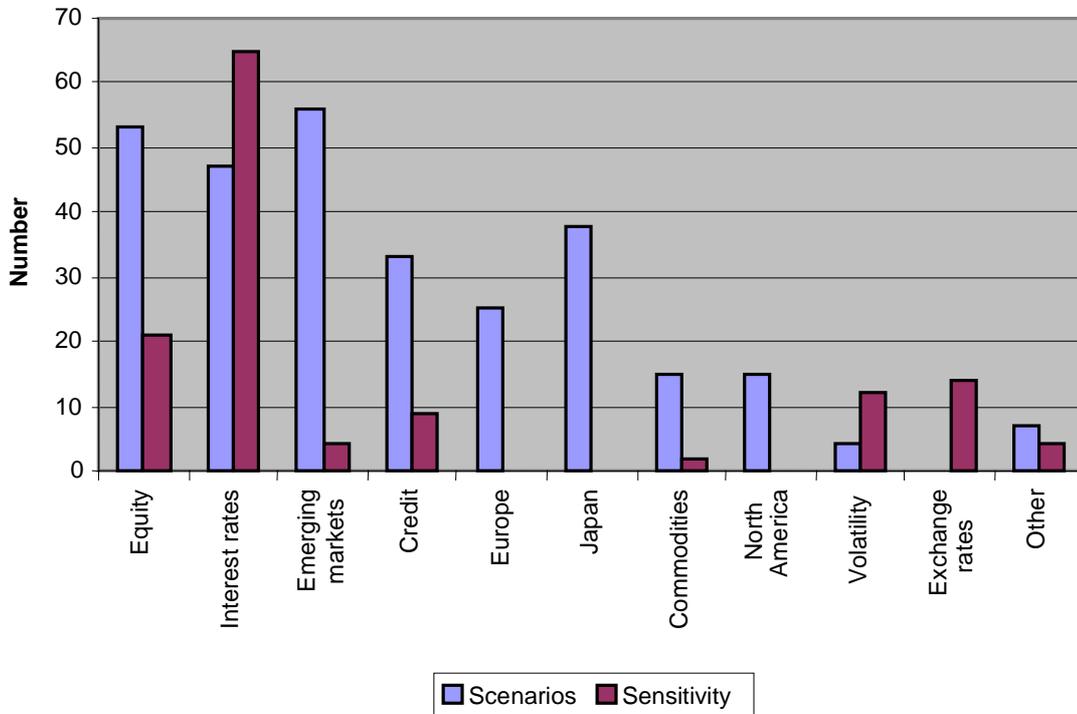
Figure 15

**Relative use of stress test scenarios and
sensitivity stress tests by peer group**
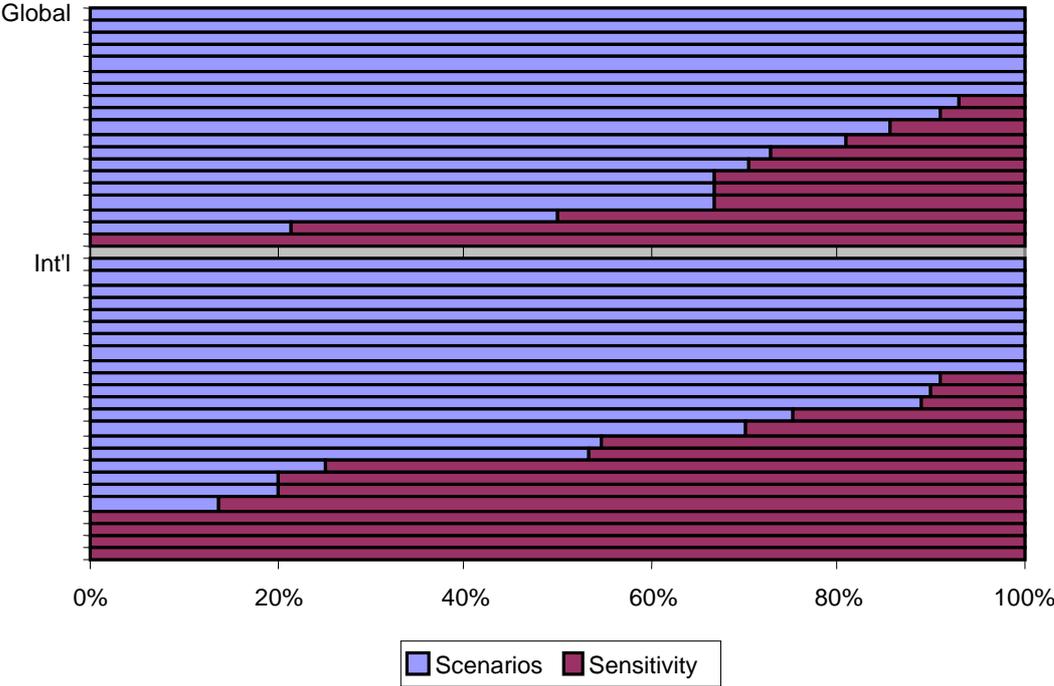
Annex 1: Terms of reference of the Task Force

The following terms of reference were approved by the Committee on the Global Financial System of the central banks of the Group of Ten countries at its 12 March 2000 meeting.

"The Task Force has been formed to set out, organise and conduct a survey of banks and securities firms that are core intermediaries in global financial markets. It is understood that banks and securities firms now routinely incorporate scenario analysis in risk management processes. The Task Force will report to the Committee the results of a census of scenarios employed by surveyed firms. It is expected that the Task Force will consult on the design of the census with a group of risk managers from financial firms. The survey is being undertaken (i) to enhance central understanding of the role that stress testing plays in risk management; (ii) to identify those exposures to exceptional events which have been identified as significant risks; and (iii) to develop information on the heterogeneity of risk taking at a point in time. The results of a census are to be discussed with the surveyed firms. Finally, it is anticipated that the Task Force will prepare a public version of its report."

Annex 2: List of financial institutions participating in the census

The following 43 financial institutions from 10 countries agreed to participate in the CGFS census of stress tests organised by the Task Force (in alphabetical order):[32]

ABN AMRO	Gruppo Bancario SANPAOLO IMI
Banca Commerciale Italiana	Gruppo Bancaroma
Banca Nazionale del Lavoro	Gruppo Unicredito Italiano
Bank of America, N.A.	HSBC Investment Bank plc
Bank of Montreal	HypoVereinsbank AG
The Bank of Tokyo-Mitsubishi, Ltd	The Industrial Bank of Japan, Limited
Barclays plc	ING GROUP
BNP Paribas SA	J. P. Morgan and Co.
CIBC Canadian Imperial Bank of Commerce	Lloyds TSB Group Plc
The Chase Manhattan Corporation	MeritaNordbanken AB
Citigroup	Merrill Lynch & Co., Inc.
Commerzbank AG	Rabobank International
Credit Suisse Group	Royal Bank of Canada
Deutsche Bank AG	The Royal Bank of Scotland Group Plc
The Dai-Ichi Kangyo Bank, Limited	The Sakura Bank, Limited
Credit Commercial de France SA	Skandinaviska Enskilda Banken AB
Credit Lyonnais SA	Societe Generale SA
Dresdner Bank AG	The Sumitomo Bank, Limited
FöreningsSparbanken AB	Svenska Handelsbanken AB
The Fuji Bank, Limited	The Tokai Bank, Ltd
The Goldman Sachs Group, Inc.	UBS AG
Gruppo Banca Intesa	

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[32] The alphabetical ordering does not reflect the numbering of the different banks throughout the report.

Annex 3: Census reporting forms

Census of stress test scenarios   May 2000

Background

The G10 central banks are conducting a census of stress test scenarios. As a core intermediary in financial markets, your firm has been selected to participate. The census is conducted under the auspices of the Committee on the Global Financial System (CGFS).

The CGFS understands that financial institutions use stress testing and scenario analysis to monitor their vulnerability to exceptional market events. In particular, dealer financial firms run stress tests using scenarios which they believe would have a material effect on their firms. A census of stress test scenarios will identify extreme but plausible market events that are regularly monitored by core intermediaries. The results of the census will help the CGFS fulfill its mandate to understand the risks faced by the global financial system.

The results of the census will be aggregated to preserve confidentiality and published.

Note: The Committee on the Global Financial System is a central bank forum established by the Governors of the G10 central banks to monitor and examine broad issues relating to financial markets and systems with a view to elaborating appropriate policy recommendations to support the central banks in the fulfilment of their responsibilities with regard to monetary and financial stability. In carrying out these tasks, the Committee places particular emphasis on assisting the Governors in recognising, analysing and responding to threats to the stability of financial markets and the global financial system.

Version 1.3 (19 May 2000)

Census reporting forms

Census of stress test scenarios

Instructions

The census consists of three tables. We would like you to base your answers on an "as of date" on or close to May 31, 2000.

Table 1 asks you to list the titles of the firm-wide stress test scenarios that capture material risks to your firm at present. If a scenario does not have a formal title, please provide a short description. Please list between five and twenty scenarios in order of importance, starting with the most important. Your ranking of "importance" can be based on an objective criterion, such as financial impact, or a subjective opinion. Note that we are not asking for your firm's actual exposure under each scenario, merely a ranking of their importance to your firm at present. Please check off the scenario's type (historical, hypothetical, or simple sensitivity test) in the spaces provided.

Table 2 asks you to list the risk factor shocks that are the driving force behind each scenario listed in Table 1. Please list the key risk factor shocks for each scenario in order of importance, starting with the most important. This detail will help us see whether scenarios at different firms with the same title are similar enough to be grouped together when we tabulate the census responses. Please provide enough detail so it is clear what the main shocks underlying the scenario are. This is especially important for hypothetical scenarios.

The description of each risk factor shock can include the name of the risk factor, the direction of the move, and the magnitude. For example, a 1987 equity market crash scenario might include the following risk factor shock: "20% decline in the S&P 500 index".

Table 3 asks a few supplemental questions about how stress testing is done and how it is used within your firm.

If you have any questions, please refer to the accompanying cover letter for the contact person at your national central bank.

Census reporting forms

Census of stress test scenarios

Table 1

Name of reporting institution:

List between five and 20 stress test scenarios in order of their importance to your firm at present, starting with the most important. See the "Instructions" page for further details.

Importance	Scenario title	Check one		
		Historical	Hypothetical	Simple sensitivity test
Example	1987 stock market crash	X		

Census reporting forms

Census of stress test scenarios

Table 2

For each scenario listed in Table 1, describe the most important risk factor shocks in the scenario in order of importance, starting with the most important. See the "Instructions" page for further details.

Scenario number: Example
Scenario title: 1987 equity market crash

Risk factor shock number	Description of risk factor shock
1	20% decline in the S&P 500 index
2	15% decline in the Nikkei 225 index
3	11% decline in the FTSE 100 index
4	and so on
5	
6	

Census reporting forms

(one page to be filled out for each scenario)

Census of stress test scenarios

Table 2 (cont)

Name of reporting institution:

Scenario number 1
Scenario title:

Risk factor shock number	Description of risk factor shock
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Census reporting forms

Census of stress test scenarios

Table 3

Name of reporting institution:

Please answer the following supplemental questions about your firm's stress testing practices:

Q1. How are stress test results used?
(Check all that apply)

To help risk managers better understand the nature of the firm's risk profile	
To help risk managers communicate the nature of the firm's risk profile to senior management	
To set limits	
To allocate capital	
To conduct contingency or emergency planning for times of market stress	
To monitor liquidity risk	
Other (please specify):	

Q2. Have the results of stress tests ever directly led your firm to hedge or unwind a position?

Yes	
No	

Q3. How many firmwide stress tests does your firm do regularly?

Q4. How often are firmwide stress tests run? (Check all that apply)

Daily	
Weekly	
Monthly	
Quarterly	
Other (please specify):	

Census reporting forms

Table 3 (cont)

Q5. How often are firmwide stress test results presented to senior management? (Check all that apply)

Daily	
Weekly	
Monthly	
Quarterly	
Other (please specify):	

Q6. Which business line risks are captured by your stress tests? (Check all that apply)

Trading book	
Banking book	
Offline/spreadsheet deals	
Specific risk of individual securities	

Q7. Do any of your stress test scenarios allow for the interaction of market risk and counterparty (default) credit risk?

Yes	
No	

Annex 4: Additional tables

Classification of firm-wide stress tests by theme, type, and peer group

(number of stress tests)

Dominant theme	Global peer group	Int'l peer group	Total
Equities			
Scenarios	32	21	53
Sensitivity tests	12	9	21
Interest rates			
Scenarios	16	31	47
Sensitivity tests	27	38	65
Emerging markets			
Scenarios	34	22	56
Sensitivity tests	0	4	4
Credit			
Scenarios	25	8	33
Sensitivity tests	3	6	9
Europe			
Scenarios	11	14	25
Sensitivity tests	0	0	0
Japan			
Scenarios	9	29	38
Sensitivity tests	0	0	0
Commodities			
Scenarios	10	5	15
Sensitivity tests	2	0	2
North America			
Scenarios	10	5	15
Sensitivity tests	na	na	na
Exchange rates			
Scenarios	na	na	na
Sensitivity tests	5	9	14
Other			
Scenarios	8	3	11
Sensitivity tests	5	11	16
TOTAL	**209**	**215**	**424**
Scenarios	**155**	**138**	**293**
Sensitivity tests	**54**	**77**	**131**

Firm-wide stress test types used per bank (by peer group)

(number of stress tests)

Global dealer banks				Other internationally active banks			
Name	**Total**	**Scenarios**	**Sensitivity**	**Name**	**Total**	**Scenarios**	**Sensitivity**
bank 05	6	4	2	bank 01	11	6	5
bank 07	9	6	3	bank 02	5	1	4
bank 08	14	13	1	bank 03	9	8	1
bank 10	6	6	0	bank 04	4	3	1
bank 16	7	7	0	bank 06	8	8	0
bank 18	26	21	5	bank 09	11	10	1
bank 19	11	8	3	bank 11	6	6	0
bank 22	9	9	0	bank 12	14	14	0
bank 23	17	12	5	bank 13	30	16	14
bank 24	7	6	1	bank 14	20	20	0
bank 25	12	12	0	bank 15	6	6	0
bank 26	9	6	3	bank 17	3	3	0
bank 28	13	0	13	bank 20	10	9	1
bank 29	15	15	0	bank 21	12	3	9
bank 31	11	10	1	bank 27	5	5	0
bank 34	12	6	6	bank 30	2	2	0
bank 35	14	3	11	bank 32	22	3	19
bank 36	5	5	0	bank 33	4	0	4
bank 37	6	6	0	bank 38	10	7	3
				bank 39	5	1	4
				bank 40	6	0	6
				bank 41	1	0	1
				bank 42	4	0	4
				bank 43	7	7	0
SUM	**209**	**155**	**54**	**SUM**	**215**	**138**	**77**

Members of the Task Force on a Census of Stress Tests

Chairperson
Banque de France/Commission Bancaire   Mr Alain Duchateau

Bank of Canada   Mr Younes Bensalah

Banque de France   Ms Florence Zeitoun-Verhille

Deutsche Bundesbank   Mr Bernd Strueber

Banca d'Italia   Ms Antonella Foglia

Bank of Japan   Ms Tokiko Shimizu

De Nederlandsche Bank   Ms Monique Hemerijck

Sveriges Riksbank   Mr Tor Jacobson

Swiss National Bank   Mr Robert Bichsel

Bank of England   Mr Paul Sanderson

Federal Reserve Bank of New York   Ms Patricia Mosser

Board of Governors of the Federal Reserve System   Mr Michael Gibson

European Central Bank   Mr Jukka Vesala

Basel Committee on Banking Supervision   Mr Jean-Philippe Svoronos

Bank for International Settlements   Mr Allen Frankel (Secretary)

Mr Ingo Fender