



BANK OF ENGLAND

October 2013

A framework for stress testing the UK banking system

A Discussion Paper



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Background information on the FPC and the PRA

The Financial Policy Committee (FPC) was established under the Bank of England Act 1998, through amendments made in the Financial Services Act 2012. The legislation establishing the FPC came into force on 1 April 2013. The objectives of the Committee are to exercise its functions with a view to contributing to the achievement by the Bank of England of its Financial Stability Objective and, subject to that, supporting the economic policy of Her Majesty's Government, including its objectives for growth and employment. The responsibility of the Committee, with regard to the Financial Stability Objective, relates primarily to the identification of, monitoring of, and taking of action to remove or reduce, systemic risks with a view to protecting and enhancing the resilience of the UK financial system. The FPC is accountable to Parliament.

The Prudential Regulation Authority (PRA) is a part of the Bank of England and responsible for the prudential regulation and supervision of banks, building societies, credit unions, insurers and major investment firms. It sets standards and supervises financial institutions at the level of the individual firm. The PRA has two statutory objectives: to promote the safety and soundness of these firms and, specifically for insurers, to contribute to the securing of an appropriate degree of protection for policyholders. It makes an important contribution to the Bank's core purpose of protecting and enhancing the stability of the UK financial system. The PRA's most significant supervisory decisions are taken by its Board. The PRA Board is accountable to Parliament.

The Financial Policy Committee:

Mark Carney, Governor

Paul Tucker, Deputy Governor responsible for financial stability

Charles Bean, Deputy Governor responsible for monetary policy

Andrew Bailey, Deputy Governor responsible for prudential regulation

Andrew Haldane, Executive Director responsible for financial stability

Martin Wheatley, Chief Executive of the Financial Conduct Authority

Dame Clara Furse, external member

Donald Kohn, external member

Richard Sharp, external member

Martin Taylor, external member

Charles Roxburgh attends as the Treasury member in a non-voting capacity.

The Prudential Regulation Authority Board:

Mark Carney, Governor

Paul Tucker, Deputy Governor responsible for financial stability

Andrew Bailey, Deputy Governor responsible for prudential regulation

Martin Wheatley, Chief Executive of the Financial Conduct Authority

Iain Cornish, external member

Rosalind Gilmore, external member

Nick Prettejohn, external member

Charles Randell, external member.

This paper was finalised on 30 September 2013.

Foreword by the Governor

Earlier this year, a new regulatory framework came into force in the United Kingdom. The establishment of the Prudential Regulation Authority (PRA) brought prudential supervision of banks, building societies, credit unions, designated investment firms and insurance companies to the Bank of England. The creation of the Financial Policy Committee (FPC), responsible for macroprudential regulation of the UK financial system, filled a clear gap in the pre-crisis regulatory architecture. Both bodies will have to make judgements on possible threats to financial stability, and will have to take appropriate policy and supervisory actions to mitigate these threats.

This Discussion Paper sets out proposals for annual, concurrent stress tests of the UK banking system. The stress tests will provide a quantitative, forward-looking assessment of the capital adequacy of the UK banking system and individual institutions within it. They will therefore play a critical role in supporting both the FPC and the PRA in meeting their statutory objectives. Building on the new regulatory infrastructure, the stress tests will bring together expertise from across the Bank, including macroeconomists, financial stability experts and supervisors. This will materially strengthen the Bank's analytical capability to assess risks to resilience. Our intention is that stress testing evolves into an essential component of our prudential framework, complementing our capital and liquidity standards.

This paper has been produced by staff at the Bank under the guidance of the FPC and the PRA Board. Its purpose is to generate discussion about the appropriate design of the stress-testing framework in the medium term. As set out in the Executive Summary and elsewhere, the Bank is actively seeking to elicit feedback on the proposals from a broad range of stakeholders.

We look forward to receiving your responses.

A handwritten signature in black ink, appearing to read 'M Carney', with a long, sweeping underline.

October 2013

Contents

Executive summary	7
1 Introduction	9
Box 1 Principles for stress testing the UK banking system	10
Box 2 International experience of stress testing	11
2 Purpose of stress testing	13
3 Frequency and timing of stress tests	14
Box 3 A description of the annual stress-testing cycle	16
4 Coverage of institutions	17
5 Scenario design	19
6 Asset quality reviews and stress testing	22
7 Modelling of scenarios	23
Box 4 Modelling of amplification mechanisms	26
8 Outputs of stress tests	28
9 Remedial and policy actions	30
Box 5 The Financial Policy Committee's statutory powers	31
10 Disclosure	32
11 Expectations of banks	35
Box 6 Data submissions	36
12 Feedback on the Discussion Paper	38
Box 7 Emerging plans for 2014	39
References	40

A framework for stress testing the UK banking system

A Discussion Paper prepared by Bank of England staff.⁽¹⁾

Executive summary

The Financial Policy Committee (FPC) recommended in March 2013 that, 'looking to 2014 and beyond, the Bank and Prudential Regulation Authority (PRA) should develop proposals for regular stress testing of the UK banking system. The purpose of those tests would be to assess the system's capital adequacy'. This Discussion Paper — produced by staff at the Bank of England under the guidance of the FPC and the PRA Board — sets out the main features of the proposed stress-testing framework. Its aim is to elicit feedback from interested parties to help inform FPC and PRA Board decisions over the ultimate design of the stress tests.⁽²⁾

The main purpose of the stress-testing framework is to provide a quantitative, forward-looking assessment of the capital adequacy of the UK banking system and individual institutions within it. It aims to support both the FPC and the PRA in meeting their statutory objectives. To facilitate assessment of the system as a whole, stress tests will be carried out concurrently across the banks, building societies and PRA-designated investment firms (henceforth referred to as 'banks') that are in scope. The annual stress tests will deliver an integrated process for deliberations around bank capital adequacy, both at a system-wide and an individual-institution level. And they will provide a device through which the Bank can be held accountable to Parliament, and the wider public, on its financial stability objective, by allowing the FPC and the PRA Board to articulate the resilience standard against which they hold the banking system. Regular stress tests should also bolster public confidence in the stability of the system, by demonstrating the range of severe, but plausible, stresses that authorities expect banks to be able to withstand.

It is envisaged that — over the medium term — the stress tests proposed in this Discussion Paper will cover the major UK banks and significant UK subsidiaries of foreign global systemically important banks. The Discussion Paper also considers the merits of including medium-sized UK banks within this framework. And it notes that, given their importance to financial stability, the Bank is also considering the merits of a separate concurrent stress-testing regime for central counterparties.

Under the framework proposed in this Discussion Paper, stress tests would explore a range of scenarios, including: (a) common scenarios applied across all banks taking part in the exercise — these would be designed by the FPC, in consultation with the PRA Board; and (b) bespoke scenarios, designed by individual banks and approved by the PRA Board. The bespoke scenarios are intended to explore risks to which each bank would be most vulnerable. In part, this is because a key aim of the stress-testing framework is to strengthen banks' own capabilities to identify and quantify risks to their businesses. The bespoke scenarios would be expected to result in higher losses for the banks in question than the common stress scenario designed by the FPC.

The Bank expects that the stress-testing framework will use a suite of models to translate these scenarios into projections of bank profitability and capital ratios. This will involve modelling by Bank staff as well as by individual banks themselves. This approach seeks to guard against the risk that the stress test becomes excessively exposed to the unavoidable weaknesses of any single model. It also seeks to mitigate the risks associated with excessive reliance on banks' own modelling: banks may face incentives to be overly optimistic about the impact of stress scenarios on their capital position to achieve a more favourable result in the stress test. But the suite of models does leave a greater role for judgement in combining model outputs to reach an overall view on capital adequacy. Over time, Bank staff will also seek to enhance the way in which various feedbacks and amplification mechanisms — for example between the banking system and the wider economy or between individual banks — are captured as part of the Bank's analysis. These are likely to have a crucial bearing on system-wide resilience.

Bank staff, under guidance from the FPC and the PRA Board, will synthesise the outputs of these models to form a single, overall view about the performance of the system and individual banks in each scenario. Interpreting these results, and reaching a judgement around capital adequacy, will require a view on the level of capital that regulators want

(1) Unless otherwise stated, references to the Bank of England throughout this Discussion Paper include the PRA.

(2) As set out in the PRA's approach to banking supervision document, the PRA Board is involved in the most important decisions on general policy and individual cases. In line with that, this Discussion Paper makes a number of references to judgements and decisions that are expected to be made by the PRA Board.

banks to maintain in the face of such losses. This is ultimately a policy decision by the FPC and the PRA Board, according to their respective responsibilities. At the very least, banks would need to maintain sufficient capital to be able to absorb losses in the stress scenario and not fall below internationally agreed minimum standards. But the level of capital that banks would need to maintain in the stress scenario could be set above strict internationally agreed minima and vary across banks. In addition, the stress tests will produce a range of other information that is expected to inform FPC and PRA Board judgements. This will include a qualitative assessment of banks' own stress-testing and capital management processes and governance.

It is important that credible policy actions are taken in response to the results of the stress tests. To this end, the results of the stress-testing exercise are expected to be used to: (a) inform the FPC's assessment of the resilience of the financial system and, in doing so, aid formulation of policy responses; and (b) support PRA Board decisions and actions on individual banks, taking into account any system-wide actions by the FPC.

Crucially, the results of the stress tests are not expected to be mechanically linked to policy responses. This is not intended to be a simple 'pass-fail' regime. Rather, it aims to deliver a more graduated policy framework, where the magnitude of remedial actions taken would be a function of policymakers' judgement around the adequacy of banks' capital plans. For example, if the stress tests revealed that individual banks — or the system as a whole — fell below internationally agreed minima in the stress scenarios, this could point to material inadequacies in their capitalisation. In turn, this would likely

result in the PRA requiring material remedial actions to strengthen capital levels. Required remedial actions would likely be smaller if stress tests revealed that banks remained above internationally agreed minima, but still below the appropriate level of post-stress capital determined by the FPC and the PRA Board. Banks could also be required to take remedial actions in light of identified inadequacies in their stress-testing and capital management capabilities, even if the PRA Board judged that they were adequately capitalised to withstand the range of scenarios explored as part of the stress test.

A key principle underpinning the proposed framework is that the outcome of, and analysis associated with, the annual stress tests should be made public. Transparency over methodologies adopted, stress-test results as well as policy and supervisory responses by the FPC and the PRA Board will support the credibility of the framework, facilitate accountability of policy interventions and incentivise banks to engage fully with the exercise.

The Bank would welcome comments from interested parties on all aspects of this paper. A more specific list of questions on which the Bank would particularly welcome feedback is set out at the end of this Discussion Paper. Comments should be sent by 10 January 2014 to:

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Bank of England
Threadneedle Street
London, EC2R 8AH

Or by email to: stresstestingdp@bankofengland.co.uk.

1 Introduction

The Financial Policy Committee (FPC) recommended in March 2013 that, 'looking to 2014 and beyond, the Bank and Prudential Regulation Authority (PRA) should develop proposals for regular stress testing of the UK banking system. The purpose of those tests would be to assess the system's capital adequacy'. At its June 2013 meeting, the FPC discussed a set of principles that would inform the design of the stress-testing framework in the medium term, a summary of which is provided in Box 1. This staff Discussion Paper describes the main features of the proposed framework for regular stress testing of the UK banking system.

Building the Bank's capabilities to deliver the stress-testing framework outlined in this Discussion Paper will take a number of years. The 2014 exercise will be a stepping stone towards the medium-term framework. As such, it is expected to be more limited in application (see Box 7). The FPC and the PRA Board will consider the precise design of the 2014 exercise in more depth over the coming months.

The stress-testing framework set out in this Discussion Paper will provide a quantitative, forward-looking assessment of the capital adequacy of the UK banking system and individual institutions within it. To facilitate analysis of the resilience of the system as a whole, stress tests will be carried out concurrently across the banks in scope.⁽¹⁾ This will deliver an integrated framework for deliberations around bank capital adequacy, at both system-wide and individual-institution level, by the FPC and the PRA Board.

The stress tests will also provide a device through which the Bank can be held accountable to Parliament, and the wider public, on its financial stability objective. A well-understood stress-testing framework allows the FPC and the PRA Board to articulate the resilience standard against which they hold the banking system.⁽²⁾ This will facilitate the communication of policy interventions by the FPC and the PRA Board. It will also improve the public's understanding of the range of severe, but plausible, stresses that authorities want banks to be able to withstand, strengthening public confidence in the banking system.

For the purposes of this Discussion Paper, a 'stress test' is defined as the evaluation of the impact of different scenarios on the capital position of banks and the system as a whole. Crucially, the stress scenarios should not be interpreted as states of the world that the FPC or the PRA perceive as likely to happen. They characterise severe but plausible shocks, which the authorities expect banks to be able to withstand to reduce risks to financial stability. Similarly, stress testing is not about mechanistically calculating point estimates of bank capital ratios in an adverse scenario. Rather, it is a set of tools that

allows policymakers to explore vulnerabilities of the banking system, helping to identify inherent uncertainties around bank capital adequacy.

In developing the stress-testing framework proposed in this Discussion Paper, Bank staff are seeking to incorporate the lessons from the United Kingdom's past experience with supervisory and system-wide stress tests. Bank staff have also drawn on the extensive international experience with stress testing, benefiting from discussions with — and insights of — the relevant authorities (see Box 2).⁽³⁾

This Discussion Paper is issued for public comment and aims to elicit feedback from interested parties. The precise design of the following features of the framework is likely to be particularly important in delivering stress tests that are perceived as credible by the market and are useful to policymakers:

- **Scenario design:** Any stress-testing exercise will only be as credible as the adverse scenarios that are being considered. The Bank expects to explore a range of scenarios in any single exercise. This will act to reduce the risk that the system as a whole is only resilient to a single 'bad state of the world'. A key aspect of scenario design is the extent to which the degree of severity would vary through the cycle, to reflect the changing probability and impact of a systemic stress materialising. By assessing the resilience of the banking system to progressively more severe scenarios in the upswing of the cycle, stress tests can inform the setting of countercyclical policy.
- **Modelling approaches:** The Bank expects to use a suite of models to estimate the impact of stress scenarios. This approach seeks to guard against the risk that the framework becomes excessively exposed to the unavoidable weaknesses of any single model. It also leaves a greater role for judgement in combining model outputs to reach an overall view on capital adequacy. Banks will also be expected to develop and use their own models to judge the likely impact of stress scenarios. In fact, a key aim of the framework is to strengthen risk management and measurement standards within banks themselves. The outputs of those models can be used as an additional input into the Bank's overall analysis of bank capital adequacy. The Bank recognises that individual banks might seek to achieve a more favourable outcome in the stress tests by being overly optimistic about the impact that a stress scenario would have on their capital position. While the

(1) As mentioned in the Executive Summary, the term 'bank' is used throughout this Discussion Paper to refer to banks, building societies and PRA-designated investment firms.

(2) See, for example, Tucker (2013).

(3) For a broader review of stress-testing practices internationally, see IMF (2012). And for a more detailed survey of the quantitative methods developed at central banks and supervisory authorities for stress testing credit risk, see Foglia (2009).

Box 1 Principles for stress testing the UK banking system

This box summarises the key principles that are expected to guide the design of the stress-testing framework in the medium term. These build on the principles that were set out by the FPC in the June 2013 *Financial Stability Report*. They remain subject to adjustment after further analysis and discussion. Indeed, a key objective of this Discussion Paper is to elicit feedback on the development of the stress-testing framework by interested parties.

The main principles underpinning the design of the framework are:

- **Purpose of the stress tests.** The main purpose of the stress-testing framework is to provide a quantitative, forward-looking assessment of the capital adequacy of the UK banking system and individual institutions within it. In doing so, it will inform FPC and PRA Board judgements around the need for policy and supervisory interventions.
- **Frequency of stress tests.** It is envisaged that stress tests will be conducted on an annual basis and concurrently across the banks that are in scope.
- **Coverage of the banking system.** The framework is expected to cover the major UK banks as well as significant

Bank expects to be taking a number of steps to mitigate that risk, there remains a choice about how much weight it is appropriate to place on the outputs of banks' own models.

- **Disclosure:** A key principle underpinning the stress-testing framework is that the outcome of, and analysis associated with, the stress-testing exercise should be made public. But there are both benefits and costs associated with disclosure of stress-test outcomes. The Discussion Paper sets out different options for what information might be disclosed — and at what degree of granularity — to facilitate engagement of different stakeholders with the stress tests.

In considering the proposed stress-testing framework set out in this Discussion Paper, it is also important to be clear about the limitations of this tool in serving the needs of the FPC and the PRA.⁽¹⁾ The stress tests proposed here, for example, will only focus on a subset of banks whose activities are judged most likely to pose risks to UK financial stability. Smaller banks are not expected to be covered by this framework (see below for other PRA stress-testing requirements that apply to all UK-regulated banks). Moreover, the exercise will focus primarily on risks to bank solvency. At least initially, funding

UK subsidiaries of foreign global systemically important banks. Over time, medium-sized banks might also be covered by the framework, though subjected to a proportionate version of the exercise.

- **Scenario design.** For each bank, a range of scenarios would be applied as part of the exercise. These would include: (a) common scenarios, applied across all banks undertaking the stress test, designed by the FPC, in consultation with the PRA Board; (b) bespoke scenarios, designed by banks themselves and approved by the PRA Board, with a severity calibrated to at least match the common scenarios designed by the FPC.
- **Application of scenarios.** Analysis of the impact of scenarios on profitability and capital ratios would be undertaken by Bank staff. This would use a suite of models. The scenarios would also be modelled by banks themselves. The ultimate output would be a synthesised view of banks' future capital positions in each of the scenarios being considered.
- **Amplification mechanisms.** Over time, stress testing will seek to capture the effects of various feedbacks and amplification mechanisms. These are likely to have a crucial bearing on system-wide resilience.
- **Communication.** Disclosure of the outcome of, and analysis associated with, the stress tests should aim to support the credibility of the framework and facilitate accountability of policy interventions.

and liquidity vulnerabilities are likely to be incorporated only as amplification mechanisms.

As such, the stress-testing framework will not be the sole process through which the FPC and the PRA Board will articulate their assessment of bank capital adequacy. The framework will provide the two bodies with an opportunity to undertake an annual, in-depth assessment of banks' resilience to different stresses. But this should not be interpreted as an indication that supervisory actions or macroprudential policy decisions around bank capital will be made only as part of this process. Both the FPC and the PRA will consider whether interventions are required to support bank capital adequacy throughout the year, in light of new relevant information and analysis.

All PRA-regulated banks are already required to carry out stress tests and scenario analysis as part of their Internal Capital Adequacy Assessment Process (ICAAP). The PRA is proposing to maintain this requirement following the

(1) For an in-depth review of the strengths and weaknesses of stress testing see Borio, Drehmann and Tsatsaronis (2012).

Box 2 International experience of stress testing

Stress testing has long been established as a risk management tool by banks. But since the onset of the recent financial crisis, stress testing has also grown in prominence as a key micro and macroprudential tool. Notable examples of regulatory stress tests conducted during the crisis include the US Supervisory Capital Assessment Program (SCAP) in 2009⁽¹⁾ and the EU-wide banking sector stress tests in 2009–11.⁽²⁾ A number of countries have also put in place frameworks for regular stress testing of their respective banking systems. In seeking to draw lessons for the design of the UK framework, this box reviews the international experience with stress testing. **Table 1** summarises the approach taken by selected jurisdictions.

Key features of international stress-testing regimes

Most jurisdictions cover systemically important banks: Regulatory stress tests typically cover a subset of banks within a jurisdiction — usually those deemed to be systemically important. Some authorities seek to capture a larger number of banks. But, in those cases, stress tests tend to be used largely as a surveillance tool, with the results being less closely linked to policy actions. The US authorities also cover some non-bank financial companies, as required under the Dodd-Frank Act.

The majority of countries conduct stress tests on an annual basis: Most countries see benefits in conducting annual stress-testing exercises that are in line with banks' regular capital planning cycle. Other countries conduct semi-annual stress tests, the results of which are published in *Financial Stability Reports*.

Table 1 Stress-testing in selected jurisdictions

	European Banking Authority (EU)	Hong Kong ^(a)	Ireland ^(a)	Japan ^(a)	Sweden ^(a)	United States (CCAR)
Coverage	Largest EU banks.	All retail banks. ^{(b)(c)}	Largest Irish banks.	Eleven major banks and 105 regional banks for Bank of Japan (BoJ) macroprudential stress tests. All banks for Financial Services Agency (FSA) stress tests.	Four largest Swedish banks.	Bank holding companies (BHC) with assets greater than US\$50 billion. ^(d)
Frequency	Annual between 2009 and 2011. Next exercise expected in 2014.	Semi-annual. ^(b)	As per Economic Adjustment Programme commitments.	Semi-annual.	Semi-annual Riksbank and annual Finansinspektionen (FI) stress tests.	Annual regulator-led and semi-annual bank-led.
Data requirements	Private data.	Public and private data.	Private loan-level data.	Public and private data.	Public data.	Private loan and account-level data.
Modelling approach:						
(1) Banks' own models.						
(2) Granular microprudential models.	(1)	(1) (2) (3)	(1) (2)	(1) (3)	(1) (2)	(1) (2)
(3) System-wide macroprudential models.						
Scenarios used	Regulatory baseline and one regulatory stress scenario.	For (1): Banks' own scenarios and a common regulatory scenario. For (2): Two regulatory stress scenarios. For (3): Multiple regulatory stress scenarios.	Regulatory baseline and one stress scenario.	Baseline and two stress scenarios for BoJ system-wide macroprudential stress tests. Several supervisory scenarios for FSA microprudential stress tests.	One stress scenario in Riksbank stress test. FI does not have an explicit stress scenario; exogenous increase in loan losses is assumed.	Six scenarios in total: regulatory baseline; adverse; and severely adverse as well as bank equivalents of those.
Disclosure	Granular individual-institution disclosures. Supplemented in 2011 by detailed disclosures of sovereign and loan book exposures.	Only results of system-wide macroprudential stress tests are disclosed. Disclosures made on aggregate basis.	Granular individual-institution disclosures.	Only results of system-wide macroprudential stress tests are disclosed. Disclosures made on aggregate basis.	Individual-institution disclosures and system-wide estimates of credit losses.	Individual-institution disclosures.
Use of outputs	Stressed capital ratios relative to hurdle rate implied a capital shortfall which had to be met. Banks and supervisors required to present strategy for meeting the shortfall.	Input into Pillar 2 assessment. Results used to inform supervisory strategy and as one of the inputs to inform micro and macroprudential policy.	Input into Pillar 2 assessment. In 2011, used to inform the required capital injections into Irish banks and their deleveraging plans under the Financial Measures Programme.	Input into Pillar 2 assessment and to inform FSA micro and macroprudential supervisory policy. BoJ system-wide macroprudential stress-test results used as part of risk surveillance.	Input into Pillar 2 assessment. Results used to inform supervisory strategy and as one of the inputs to inform micro and macroprudential policy.	Results feed into assessment of banks' capital plans, which are subject to approval by the Federal Reserve.

(a) Under Basel II, all banks are required to run their own stress tests as part of the Pillar 2 process. The information in this column relates to stress-testing practices over and above those.

(b) Coverage and frequency vary across the different stress tests conducted by the Hong Kong authorities. This information refers to system-wide macroprudential stress tests only. For instance, microprudential stress tests are conducted on a quarterly basis and cover all locally incorporated banks.

(c) Retail banks comprise all the locally incorporated banks plus a number of the larger foreign banks with similar operations (ie banks that operate as branches in Hong Kong and are active in retail banking).

(d) Separate regime exists for BHCs with assets of US\$10 billion–US\$50 billion.

Data requirements vary across jurisdictions: Some countries (such as Sweden) rely exclusively on publicly available data to run supervisory stress tests. Other countries (such as Ireland and the United States), require banks to provide granular loan-level data for the majority of their loan books as an input to their stress-testing processes.

Most countries use a suite of models: As a minimum, all countries that have adopted Basel II assess the quality and results of bank-led stress tests as part of the Internal Capital Adequacy Assessment Process (ICAAP). In addition, a number of countries also carry out regulator-led stress tests using granular models of banks' income statement items. In the United States, for example, authorities have publicly stated that they have 40 in-house models to project banks' losses and revenues. Furthermore, a growing number of authorities have been developing their system-wide stress-testing capabilities.

Most jurisdictions use a range of scenarios: Regulators internationally recognise the risks associated with relying on a single stress scenario and seek to incorporate a range of adverse scenarios as part of their stress tests. There is a

growing emphasis on bank-designed scenarios, where banks are asked to design scenarios most relevant to their business model.

Disclosure of stress-testing methods and results varies substantially across jurisdictions: Some authorities have been very open about the methodologies they employ and the scenarios they use and also publish very granular bank-by-bank stress-test results. Others have opted to keep aspects of their stress-testing regimes private.

The use of stress-test outputs also varies across countries: Some stress tests, such as the US SCAP and the CCAR, as well as the European Banking Authority (EBA) exercises in Europe, have direct implications for banks' capital plans and distributions. In most countries, the results of stress-testing exercises are used as one of a set of inputs into policy decisions around bank capital.

(1) Board of Governors of the Federal Reserve System (2009).
 (2) See, for example, European Banking Authority (2011).

implementation of CRD IV and is consulting on a draft general stress test and scenario analysis rule as part of its consultation on implementing CRD IV.⁽¹⁾ This rule would apply to all banks, including those covered by the proposed stress-testing framework set out in this Discussion Paper. It is expected that a bank's participation in the concurrent stress tests proposed in this paper will replace the stress testing that banks are currently required to conduct to inform the PRA's Capital Planning Buffer. But this framework will not replace the requirement that banks undertake stress tests for their own risk management purposes.

In addition to domestic stress tests, a number of banks will continue to be subject to stress tests co-ordinated by other authorities. For example, the largest UK banks have historically been included in the European Banking Authority (EBA) stress tests and the IMF's Financial Sector Assessment Program (FSAP) exercises.⁽²⁾ And banks with significant operations in the United States will likely be included in the Comprehensive Capital Analysis and Review (CCAR) operated by the Federal Reserve.⁽³⁾ These remain valuable exercises, but serve different objectives and are likely to be conducted in a different way from the stress tests described in this paper. The Bank will continue to engage with relevant authorities internationally to consider how the various initiatives around stress testing can be co-ordinated to minimise any unnecessary costs of compliance for banks.

The remainder of this Discussion Paper is structured as follows. Section 2 sets out the main objectives of the stress-testing

framework. Sections 3 and 4 outline key operational considerations, focusing on frequency and timing as well as coverage of institutions. The subsequent sections focus on the key features of the Bank's analytical approach to stress testing: scenario design (Section 5), the use of asset quality reviews to inform stress tests (Section 6), modelling of stress scenarios (Section 7) and the use of stress-test outputs to assess bank capital adequacy (Section 8). Section 9 covers the remedial actions that could be required in response to the results of the stress tests and Section 10 explores different options around disclosure. Finally, Section 11 sets out the expectations that the PRA is likely to have from banks in relation to this exercise. Given the role of this framework in informing policy and supervisory judgements by the FPC and the PRA Board, the PRA expects a clear step-up in engagement by banks with the stress tests — including by their Boards and senior management. Section 12 outlines a set of questions on which the Bank would particularly welcome feedback from respondents to this Discussion Paper.

(1) Prudential Regulation Authority (2013a).

(2) International Monetary Fund (2011).

(3) Board of Governors of the Federal Reserve System (2012).

2 Purpose of stress testing

The main purpose of this stress-testing framework is to provide a quantitative, forward-looking assessment of the capital adequacy of the UK banking system and individual institutions within it. In doing so, it will support both the FPC and the PRA in meeting their statutory objectives.

The FPC's primary objective is to identify, monitor and take action to remove or reduce systemic risks, with a view to protecting and enhancing the resilience of the UK financial system. Its secondary objective is to support the economic policy of the Government. The PRA has a statutory objective to promote the safety and soundness of the firms it regulates, with particular focus on the harm that firms can cause to the stability of the UK financial system.

The stress-testing framework will inform the FPC's judgement on the resilience of the UK banking system to possible future systemic stresses. It will equip the FPC with an evidence base and a quantitative apparatus to assess the need for policy interventions, given emerging risks or vulnerabilities. As such, it will help the FPC evaluate the benefits of any policy interventions designed to mitigate those risks. The stress-testing framework will also inform judgements of the PRA Board on the safety and soundness of individual institutions. It will help the PRA Board assess the need for, and impact of, supervisory responses, taking into account any system-wide policy actions by the FPC. The results of the stress tests are not expected to be mechanically linked to supervisory responses by the PRA Board or system-wide policy actions by the FPC.

By informing FPC and PRA Board judgements around bank capital adequacy, the stress-testing framework will result in:

- **An integrated, regular process for decision-making around bank capital adequacy.** The stress-testing exercise will contribute to an integrated framework for deliberations around capital adequacy, at both system-wide and individual-institution level, by the FPC and the PRA Board. This will provide greater clarity to the market about how these decisions are made.
- **A device through which the Bank can be held accountable to Parliament, and the wider public, on its financial stability objective.** A well-understood stress-testing framework offers one tool through which the FPC and the PRA Board can articulate the resilience standard against which they aim to hold the system. This will facilitate the communication of policy interventions by the two policymaking bodies.
- **A strengthened supervisory approach.** As the PRA has already set out, an inherent feature of forward-looking

supervision is that, at times, the supervisor's judgement will be at variance with that of banks.⁽¹⁾ This underscores the need for such judgements to be based on evidence. A strengthened stress-testing framework will enhance the credibility of the supervisory approach by enriching the body of evidence that informs supervisory judgements and helping articulate those judgements more clearly.

- **Enhanced public confidence in the banking system.** A credible stress-testing framework can strengthen public confidence in the stability of the banking system by demonstrating the range of severe, but plausible, stresses which authorities aim to ensure that banks can withstand.
- **Improved risk and capital management practices within banks.** The framework will provide one tool through which authorities can aim to ensure that banks are held to high standards in the areas of risk management and capital planning.

While the primary purpose of the stress-testing framework is to inform FPC and PRA Board judgements around bank capital adequacy, the framework should be expected to deliver a number of additional regulatory benefits. These include:

- **Informing a range of possible policy and supervisory interventions.** The quantitative toolkit underpinning the stress tests will be able to inform judgements around a range of potential interventions by the FPC and the PRA Board that might extend beyond bank capital requirements (see Section 9).
- **Better access to data by regulators.** The stress-testing framework should improve regulators' access to high-quality data on risk exposures, enhancing their understanding of banks' business models and risk profiles. It will also facilitate more meaningful and consistent analysis of risks and vulnerabilities across the banking system.
- **Strengthened market discipline.** A transparent stress-testing framework should enhance market discipline, by enriching market participants' information set around the resilience of individual institutions and the banking system as a whole.

(1) Prudential Regulation Authority (2013b).

3 Frequency and timing of stress tests

It is envisaged that the stress tests will be conducted on a regular basis and concurrently across the banks that are in scope.

Frequency

The stress-testing framework should aim to deliver a timely assessment of capital adequacy for individual institutions and the banking system as a whole. Banks' balance sheet composition, as well as the nature and magnitude of the risks to which they are exposed, can vary significantly over time. As a result, long lags between the exercises would be undesirable. The FPC and the PRA Board will want to respond to potential threats to stability in a timely manner and the stress-testing framework is expected to be a key input into their forward-looking judgements around bank capital adequacy.

Going in the other direction, stress testing at a very high frequency would entail material resource costs, both for banks and regulators. This could compromise the quality of the exercise. For example, it would risk the stress-testing exercise becoming an overly mechanical process, squeezing out innovative thinking around new, emerging risks or sufficient engagement by key decision-makers to interpret — and act upon — the results.

In balancing these considerations, the stress tests are expected to take place on an annual basis. This is consistent with practices in other countries, such as the United States (see Box 2), as well as the PRA's draft supervisory statement on stress testing that was published as part of the CRD IV Consultation Paper.⁽¹⁾

Conducting supervisory stress tests on a regular basis entails a number of additional benefits. It encourages banks — and the authorities — to invest continuously in their stress-testing capabilities. It can also operate as a mechanism for guarding against 'risk illusion', by forcing both banks and regulators to think hard about the types of risks that can pose threats to stability. Finally, conducting regular stress testing would avoid the risk associated with market participants interpreting an authority-initiated stress test as an adverse signal about the health of the banking sector or a particular bank.

Concurrency

The concurrent nature of the stress tests is a key element of the proposed framework. There are a number of benefits to such an approach.

Crucially, from a macroprudential perspective, carrying out the stress tests simultaneously allows the FPC to assess the resilience of the system as a whole, rather than focus solely on individual banks. For example, a concurrent exercise can help

the FPC assess the build-up of exposures to a particular sector across the financial system. And it allows the FPC to take into account potential amplification mechanisms that could arise due to the banking system's response to an adverse shock (see Box 4). These have been important mechanisms of propagation of initial shocks in previous systemic crises.

Similarly, from a microprudential perspective, the simultaneous nature of the exercise will deliver greater consistency in the PRA's approach to supervision. For example, the application of common stress scenarios at a given point in time helps ensure that the PRA holds banks against the same resilience standard.

Finally, running stress tests concurrently can help strengthen the analytical rigour of the exercise. The authorities will be better placed to challenge stress-test outputs generated by banks, for example by comparing loss rates on similar portfolios across banks, or by incorporating insights from analysis of corporate, household or other sectors produced from an assessment of the banking system as a whole. The concurrent nature of the stress tests will also facilitate benchmarking of banks' capital management and stress-testing processes.

Timing

Part of the objective of the stress-testing framework is to embed a clear and regular process for conducting in-depth analysis that informs FPC and PRA Board judgements around bank capital adequacy. Box 3 describes the expected annual stress-testing cycle in more detail. Supervisory actions or macroprudential policy decisions around bank capital adequacy will still be taken outside of this process, however, incorporating a range of relevant information and analysis.

The Bank expects that — over the medium term — the results of the stress tests are likely to be published about six or seven months after the date of the balance sheet information used as inputs for the exercises. This is broadly in line with current practice in the United States, where the CCAR stress tests take approximately six months from the data cut-off until publication. This seeks to balance a number of considerations, including:

- **Timeliness:** It is important that the inputs used, such as balance sheet data, remain relevant by the time that stress-test outputs are used to inform policymakers' judgement.
- **Quality of results:** There is often a trade-off between timeliness and quality of the stress-testing exercise. Staff at the Bank, as well as at financial institutions themselves, will

(1) Prudential Regulation Authority (2013a).

need to have sufficient time to ensure rigorous analysis and interpretation of the stress-test results.

- **Senior staff engagement:** It is crucial that Boards and senior management of the banks being stress tested engage closely with this exercise. The annual cycle should allow sufficient time for them to do so.
- **Governance and review issues:** Internal governance requirements and review periods limit how quickly the stress tests can take place. Also, for banks with European operations, remedial actions may need to be discussed by international colleges of supervisors as part of the EU's Joint Risk Assessment and Decision process, with potential implications for the length and timing of the annual cycle.
- **Interaction between banks and regulators:** The exercise will involve a period of engagement between the banks and the regulators. For example, banks will be expected to explain and justify key judgements taken in their own

modelling of the impact of stress scenarios. The annual cycle should allow sufficient time for such interactions. While it is important that there is agreement about facts, such as balance sheet data, stress-test outcomes are not the result of a negotiation between banks and regulators.

In considering the annual stress-testing cycle, a key consideration will be the precise date for the balance sheet information used for the exercise. The date of banks' annual accounts would be a natural starting point. Annual accounts have the advantage of being externally audited and this would also allow investors to assess stress-test results against information that they are already familiar with. But not all banks use the same reporting date for their annual accounts, so it would not be possible to apply this approach uniformly. Aiming to use annual accounts might also put additional strains on banks' resources at an already busy period of the year. This is an area where the Bank would welcome feedback from respondents to this Discussion Paper.

4 Coverage of institutions

The stress-testing framework outlined in this Discussion Paper is expected to focus on those banks whose activities are judged most likely to pose risks to UK financial stability. Aiming for coverage of all institutions in the financial system would be unnecessarily costly, with small marginal benefits from policymakers' perspective beyond a certain point.

Principles for determining the coverage of stress tests

There are three main considerations that the Bank expects will inform the decision to include institutions in the stress-testing exercise over the medium term.

- **Institutions' importance to UK financial stability:** Financial stability is at the core of the statutory objectives of both the FPC and the PRA. So institutions' importance to UK financial stability is a key consideration in determining their inclusion in this stress-testing framework.
- **FPC and PRA powers to require remedial actions:** Institutions would only be included if the powers of the FPC and the PRA allowed them to take appropriate actions informed by the stress-test results. Banks' legal and regulatory status in the United Kingdom therefore becomes a key consideration determining coverage.
- **Broad comparability between institutions:** Many of the benefits from including financial institutions in a concurrent stress test are likely to arise only when their activities are sufficiently similar to those of other firms covered by the exercise. Additionally, including an overly diverse range of institutions, each requiring separate analytical toolkits, would risk making the framework excessively complex to implement and communicate.

Implications of these considerations for the coverage of concurrent stress tests

Based on these considerations, the Bank envisages that the stress-testing framework will include the **major UK banks**⁽¹⁾ (see **Table A** for a ranking of UK banks by total assets). The Bank expects this group to include the eight banks that were the focus of the FPC's and PRA's recent capital shortfall exercise (Barclays Group, The Co-operative Bank plc, HSBC Holdings Group, Lloyds Banking Group, Nationwide Building Society, Royal Bank of Scotland Group, Santander UK plc and Standard Chartered Bank Group). A disorderly failure of any of these institutions, individually, could pose material threats to financial stability in the United Kingdom. The Bank will also be considering how the principal UK-regulated solo entities within these financial groups will be treated as part of the exercise.⁽²⁾

The Bank is also considering the merits of including **medium-sized UK banks** in the concurrent stress tests. One option would be to include these in the framework but

Table A Total assets of the 30 largest UK banks, end-2012^{(a)(b)(c)(d)}

Bank	£ billions
HSBC	1,665
Barclays	1,490
Royal Bank of Scotland	1,312
Lloyds Banking Group	934
Standard Chartered	394
Santander UK	293
Nationwide Building Society	191
Bank of Ireland UK	52
Co-operative Bank	50
Clydesdale Bank	38
Yorkshire Building Society	33
Coventry Building Society	27
Virgin Money	22
Schroders Group plc	15
Skipton Building Society	14
Leeds Building Society	10
Tesco Personal Finance	8
Close Brothers	7
Principality Group	7
West Bromwich Building Society	6
Sainsbury's Bank	5
Newcastle Building Society	4
Alliance Trust	3
OneSavings Bank	3
Nottingham Building Society	3
Aldermore Bank	3
C Hoare & Co.	3
Provident Financial	2
Progressive Building Society	2
Cumberland Building Society	2

Source: Annual accounts.

- (a) As mentioned in the Executive Summary, the term 'bank' is used throughout this Discussion Paper to refer to banks, building societies and PRA-designated investment firms.
- (b) Where a bank's accounting year does not end in December, the total assets figure for that bank has been taken from its most recent annual accounts.
- (c) The population of banks in this table is defined as the set of banks supervised by the PRA on a global, consolidated group basis. There are three exceptions to that: Santander UK, Bank of Ireland UK and Clydesdale. These are owned by a parent supervised on a global consolidated basis by a foreign authority. They are included in this table because they are material providers of financial services to the UK real economy.
- (d) This table is a factual ranking of UK banks by asset size. It should not be perceived as an indication of the banks that are likely to be covered by the concurrent stress tests in the medium term.

conduct the stress tests in a way that is proportionate to their scale and complexity, as well as prevailing risks to stability. This would be consistent with the PRA's duty to have regard to the need to minimise any adverse effects on competition, in this instance through the potential burden the exercise would place on banks. For example, medium-sized banks could be exempted from running some scenarios that are less relevant to their business models; or analysis might focus mostly on specific portfolios, with less detail on the rest of the balance sheet. Another option would be to exempt medium-sized banks from the concurrent stress tests as a matter of course, but retain the flexibility to change the scope of the concurrent

- (1) As mentioned in the Executive Summary, the term 'bank' is used throughout this Discussion Paper to refer to banks, building societies and PRA-designated investment firms.
- (2) For a broader discussion on the stress testing at different levels of consolidation see Cerutti and Schmieder (2012).

stress tests at certain points in time, depending on the risks being explored by the FPC and the PRA Board in a given year. The Bank's starting position is that — over time — medium-sized banks should be included in the steady-state concurrent stress tests, in a proportionate fashion. In part, this will help deliver a consistent approach to supervision, ensuring that a high proportion of the UK banking system is held to the same standards of resilience.

The regulatory benefits of including **small UK banks**, when considered individually, are unlikely to justify the costs. So the Bank proposes that these are not included in the concurrent stress tests outlined in this Discussion Paper. But historical experience — for example the UK Secondary Banking crisis of the 1970s and the US Savings and Loan crisis in the 1980s — suggests that the collective failure of smaller banks has the potential to pose threats to stability.⁽¹⁾ As a result, it will be important for the FPC to monitor the build-up of common vulnerabilities across the banking system as a whole, including those stemming from smaller UK banks. More broadly, all UK-regulated banks are required to run their own stress tests as part of existing regulatory requirements. The PRA is proposing to maintain this requirement following the implementation of CRD IV.⁽²⁾

The Bank envisages that significant **UK subsidiaries of foreign global systemically important banks** are likely to be included in the framework. These institutions (typically investment firms) are important for the functioning of UK financial markets and the continuity in provision of financial services to the real economy. But it is unlikely that **UK branches of foreign banks** would be included in the framework. Branches are not distinct legal entities with separate capital resources. For UK branches of EEA banks, the PRA's powers and responsibilities are limited under European law. For UK branches of non-EEA banks, where the home regime is considered equivalent to that of the United Kingdom and where the PRA has assured itself over resolution plans and the home regulator's supervisory approach, the PRA relies — where possible — on supervision by the home regulator.

Finally, it is not envisaged that **other types of financial institutions** will be included as part of this stress-testing framework. The modelling approach necessary to analyse non-banks, and the key risk drivers for those institutions, can be materially different relative to those for banks. For example, the types of risks faced by insurance companies — whom the PRA already requires to conduct stress tests — can be very different, including longevity risk for annuity providers or claims volatility for non-life insurers. Moreover, the types of policy actions that any stress tests would support are also likely to differ. But, as part of the FPC's regular surveillance and, potentially, as an input into this framework, it will be important for the stress tests to take account of risks stemming from, or propagating through, parts of the financial sector not included within the scope of this exercise. One way that this could be achieved is through scenario design. More broadly, the Bank will be mindful of the possibility that certain investment firms currently regulated by the Financial Conduct Authority (FCA) might, at some point in the future, warrant inclusion in the proposed framework.

Although the Bank is not currently proposing to conduct concurrent stress tests for insurers alongside those for the banking system, feedback from respondents on how the Bank might best incorporate the results of the stress tests it already conducts for insurers into the framework for banks outlined in this Discussion Paper would be welcome.

In addition, given their importance for financial stability, the Bank will separately consider the need for a stress-testing regime for central counterparties (CCPs) operating in the United Kingdom. As a first step, the Bank will be undertaking a thematic review of the adequacy of UK CCPs' internal stress-testing practices during 2014 and will report conclusions to the FPC. Building on that, the Bank will consider the merits of developing a separate regime for concurrent, cross-CCP stress testing that could complement the framework for banks outlined in this Discussion Paper. This could strengthen the Bank's system-wide analysis, for example by shedding light on the impact of higher margin calls on the system. The Bank would welcome feedback from respondents on the merits of a concurrent stress-testing regime for CCPs, to complement, and potentially inform, that for banks.

(1) See, for example, Bank of England (1978) and Curry and Shibut (2000).

(2) Prudential Regulation Authority (2013a).

5 Scenario design

There are three key elements that determine the overall analytical approach to stress testing: the design of scenarios; the approach to modelling the impact of scenarios on projected bank profitability and capital ratios; and, contingent on those outputs, the standards against which banks are assessed to reach a view on capital adequacy. This section outlines the Banks' proposed approach to scenario design. The other two aspects are considered in Sections 7 and 8 respectively. There is also a read-across between the losses expected to occur in a baseline scenario and asset quality reviews. These links are considered in Section 6.

A key principle underlying the Bank's approach to stress testing is to explore a range of scenarios. Any single scenario is almost certain not to materialise. And it is not desirable from a regulatory perspective that the banking system as a whole is only assessed against a single 'bad state of the world'. Moreover, from a practical perspective, differences in banks' business models imply that scenarios that might be stressful for one bank might be much less so for another. To make the framework useful for policymakers, stress tests should explore different vulnerabilities and manifestations of possible future stresses.

Overall, the framework is likely to incorporate three broad sets of scenarios:

- A set of **common stress scenarios** designed by the FPC, in consultation with the PRA Board, and applied across all banks undertaking the stress test.
- A set of **bespoke stress scenarios** designed by individual banks, and approved by the PRA Board, with a degree of severity calibrated to match at least that of the common stress scenarios designed by the FPC.
- A **common baseline scenario** designed by the FPC and informed by, among other things, the MPC's forecasts as communicated in the Bank's *Inflation Report*.

The stress tests would formally be applied to individual banks under the authority of the PRA, conducted by staff from across the Bank and reported back to the FPC.

Approach to the design of common stress scenarios

The **severity of the stress scenarios** is a key determinant of the overall resilience standard to which the banking system is being held by the authorities through the stress-testing exercise. The stresses being assumed need to be both sufficiently severe, but also plausible.⁽¹⁾ Crucially, the stresses should not be interpreted as states of the world that the FPC or the PRA perceive as likely to happen.

A key consideration when designing scenarios is the extent to which the severity of the scenarios being explored might vary across stress tests conducted at different points in time. An explicitly countercyclical approach to scenario design would recognise the variation in the probability and impact of systemic stresses over time. For example, as credit conditions ease and leverage builds up, the banking system may be susceptible to more severe shocks. Conversely, in a downturn, with tightening credit conditions and lower leverage, a less severe scenario might be more appropriate, depending on the particular circumstances.

In practice, two broad approaches may be taken with respect to how the severity of a given scenario relates to economic and financial conditions:

- One option would be to aim for a broad degree of consistency in the severity of the shocks applied. For example, asset prices might be assumed to fall by some percentage relative to the baseline projection, irrespective of their current level. Similarly, the stress scenario might assume a given percentage point increase in the unemployment rate relative to the baseline projection, regardless of the current unemployment rate. Such an approach could allow the authorities to identify how changes in banks' risk-taking behaviour (such as loosening in loan underwriting standards over time) might increase their vulnerability to a broadly stable set of shocks. And, in a downturn, it would ensure that the scenarios result in sufficiently stressful outcomes. At the same time, such an approach might amplify procyclicality in the financial sector, with the stress scenario effectively becoming less severe in an upturn (when profits and asset valuations are high) and *vice versa* in a downturn.
- An alternative approach might be to vary the severity of the shocks applied in the adverse scenario, depending on prevailing economic and financial conditions. For example, asset prices could be assumed to fall relative to some long-run equilibrium level. During periods when, for example, house prices were above that level, the size of the shock in the stress scenario would be larger. Similarly, the unemployment rate could increase to a given level in the stress scenario. This would mean that, at points in time when unemployment is low, the increase in the unemployment rate in the stress scenario would be larger. The severity of the shocks could be further amended to reflect the state of credit markets — for example, to help capture amplification mechanisms between the financial system and the real economy (see Box 4). The main advantage of such an approach is that it would seek to

(1) See Borio, Drehmann and Tsatsaronis (2012) and Haldane (2009) for a discussion on why designing sufficiently severe scenarios is particularly important when the economy is seemingly performing strongly.

reflect how systemic risk changes over time, reducing procyclicality in the system. But it would also require judgements by policymakers on the state of economic and financial conditions when designing scenarios.

For the medium-term framework, the Bank is considering two possible approaches to the design of the common scenarios within a given exercise:

- The first would be to employ a single common stress scenario. This would start from a 'base' methodology, aiming at a broadly constant degree of severity across stress tests conducted at different points in the cycle. The FPC would then overlay judgements to increase or reduce the severity of certain shocks over time, factoring in its views around the probability or impact of systemic risks in the design of scenarios. These judgements would likely be informed, at least in part, by the FPC's set of core indicators.⁽¹⁾ While simpler operationally, the use of a single common scenario would come at the cost of a reduced set of information to allow the FPC and the PRA Board to inform their respective policy and supervisory tools.
- An alternative approach would be to use two common stress scenarios: one that aims at a broadly constant degree of severity across stress tests, independent of economic and financial conditions; and one that seeks to take into account prevailing conditions when calibrating scenario severity, including the levels of leverage, debt and credit growth. Such a framework would allow the FPC to explore particular vulnerabilities that might be amplified by the state of the financial system and the wider economy at the time. And it would facilitate the use of the outputs of stress tests to inform the setting of the respective tools of the FPC and the PRA Board.

The Bank's approach to the design of the common stress scenarios is also likely to incorporate the following principles:

- Scenarios will seek to allow the FPC and the PRA to **explore the impact of potential tipping points** that might lead to sharp changes in the impact of stress scenarios. For example, if the economy-wide distribution of borrowers is such that repayment difficulties would increase sharply beyond a certain level of interest rates, the design of scenarios would seek to incorporate that information to ensure that banks' business models are sufficiently stressed.⁽²⁾
- While some degree of consistency of scenario severity over time might be desirable, the framework will need to be flexible enough to allow the FPC and the PRA to **explore different sources of systemic risk**, as these are likely to change over time.

- In considering the risks to be explored as part of the stress-testing exercise, the FPC and PRA will **draw on risk assessment analysis from across the Bank**. This is carried out by staff in the Financial Stability, Monetary Analysis and Supervisory areas of the Bank. The scenario design process will also seek to incorporate market views of key risks — for example, by employing insights from the Bank's *Systemic Risk Survey*⁽³⁾ and its Market Intelligence function. Synthesis of these insights already takes place — for example, during the production of the *Financial Stability Report (FSR)*. Risks highlighted in the *FSR* are particularly likely to be considered as part of scenario design.

From an operational perspective, the common stress scenarios are expected to incorporate both macroeconomic and market shocks. The Bank expects to specify paths for key variables, such as GDP growth, unemployment, interest rates, house prices, etc. The scenarios are likely to cover UK variables and, depending on the precise risks being explored by the FPC and the PRA at the time, possibly also foreign variables. A range of models as well as historical experience will help inform the derivation of variable paths by Bank staff. But future episodes of stress will almost certainly be different from those previously observed, for example due to financial innovation and changes in market structures.⁽⁴⁾ So the scenarios might include shocks to risk factors, the precise nature of which may not have been previously observed. Overall, therefore, there will be a role for judgement in designing the stress scenarios.

The duration of scenarios will be consistent with the risks that they have been designed to explore. For example, scenarios describing macroeconomic outcomes would tend to be around three to five years in duration, whereas sudden and severe events, such as market shocks, would occur over considerably shorter horizons. In practice, adverse scenarios are likely to include a combination of these elements. The Bank expects to be providing further details of its approach to designing common stress scenarios in future publications.

Approach to the design of bank-specific scenarios

All banks that take part in the concurrent stress tests proposed in this Discussion Paper are likely to be expected to design, and assess the impact of, a bespoke stress scenario. Banks, liaising with PRA staff, would be expected to develop scenarios that are more closely aligned to their particular business models. Supervisory insights may be used to identify bank-specific vulnerabilities — for example, originating from particular exposures to certain business lines or regions. Insights from reverse stress testing by banks are also likely to be useful to identify key vulnerabilities and guide the design of the bespoke

(1) Bank of England (2013a).

(2) For the importance of non-linearities in stress testing see, for example, Drehmann, Patton and Sorensen (2007).

(3) Bank of England (2013b).

(4) See, for example, Borio, Drehmann and Tsatsaronis (2012).

adverse scenarios.⁽¹⁾ This process should yield important insights to regulators, including from a system-wide perspective. For example, it might reveal that a number of banks across the system are particularly exposed to a common set of vulnerabilities that had not been identified previously.

Bespoke scenarios would need to be accompanied by a clear explanation from the banks of the process used to identify the particular type of stress being explored, the key judgements taken in determining its severity and how the paths of the variables chosen relate to each other in an economically intuitive way.

A key principle underlying the approach to designing bank-specific scenarios is that these would be expected to result in higher losses than the common scenario designed by the FPC. The motivation behind these bespoke scenarios is to explore risks to which each bank is most vulnerable. It is natural, therefore, to expect that such a scenario would generate higher losses for that bank relative to the common stress scenario. If this is not the case, banks may be asked by the PRA to redesign the bespoke scenario. Moreover, failure to design a sufficiently severe scenario is likely to be taken into account by the PRA when assessing the adequacy of a bank's stress-testing and capital planning processes.

The baseline scenario

The Bank will want to form a view of the resilience of the banking system, and individual institutions within it, under a central case. This can help inform judgements over the adequacy of banks' financial resources given current expectations about the state of the economy. For example, during the transition path to higher requirements set under Basel III and by the Independent Commission on Banking (ICB), the baseline scenario can provide useful information about the system's capacity to meet these higher standards, while continuing to provide financial services, in line with the FPC's objectives. Banks' projections under the central case are also a key input to supervisory assessments of the adequacy of banks' capital planning processes.

Bank staff will produce projections of key macroeconomic variables for the baseline scenario. These are expected to be informed by, among other things, the MPC's central view of the economy, as communicated in the Bank's *Inflation Report*. Banks running the stress tests will be expected to generate projections using the baseline scenario. But this scenario is not intended to be a substitute for banks' own articulation of central expectations of future economic conditions, which they would continue to use for a wide range of internal uses.

(1) Reverse stress testing involves exploring the size and nature of shocks that would render a firm's business model unviable or its financial position fragile. It starts from an outcome of business failure and identifies circumstances where this might occur.

6 Asset quality reviews and stress testing

Asset quality reviews are a well-established regulatory tool in the United Kingdom. This section describes the purpose of these reviews and how the Bank envisages they are likely to interact with the stress-testing exercise.

What are asset quality reviews?

Regulators conduct asset quality reviews at a business unit or portfolio level to ensure that banks' asset valuations reflect expected asset performance and to identify risks to asset performance that need to be reflected in banks' capital requirements. More specifically, supervisors use asset quality reviews to ensure that, within the constraints of accounting rules, adequate provisions are held against assets held at amortised cost. Asset quality reviews can also be used to ensure that marked-to-market assets are valued prudently. Any adjustments to provisions and valuations will have an impact on banks' measured capital resources. In addition, asset quality reviews are used to ensure that the risks inherent in the portfolios investigated are appropriately reflected in banks' Pillar 1 (and, where material, Pillar 2A)⁽¹⁾ capital calculation.

Broadly, asset quality reviews can have four levels of granularity (Table B). Level 1 reviews include an assessment of regulatory and management information on asset quality. Deeper reviews might include discussions with a bank's management, use of specialist staff, and examinations of individual loan files. The PRA's approach to asset quality reviews is proportionate to the level of risk and complexity of the assets concerned. More intense reviews are conducted on asset portfolios that can materially affect a bank's resilience, that are complex and inherently difficult to value, or that appear highly susceptible to losses. The PRA's asset quality reviews are therefore typically tailored to the bank's circumstances.

Table B Stylised gradations of asset quality review undertaken by the PRA

	Level 1	Level 2	Level 3	Level 4
Review regulatory returns, bank's data and management information	✓	✓	✓	✓
Detailed discussion with bank's management		✓	✓	✓
Technical risk review led by risk specialists			✓	✓
Detailed review including selective sampling of loan files				✓

Asset quality reviews take place continuously as part of the PRA's supervisory processes. Reviews of individual banks' assets are conducted periodically and occur at different times for each bank. Thematic reviews of particular groups of assets are also conducted, often in response to a specific risk or concern, covering multiple banks at the same time. While asset quality reviews will continue to be undertaken throughout the year, the results will be of direct relevance to stress tests. The FPC will receive regular reports on asset

quality reviews, to help identify common themes in those reviews that are relevant to UK financial stability.

Interaction with stress testing

Stress tests are used primarily to assess the amount of capital that a bank might require in the event of an adverse shock. A critical precondition to make that assessment is that banks' reported capital positions are stated accurately. Asset quality reviews help ensure this, both in terms of capital resources and capital requirements. For example, if asset quality reviews revealed that provisions held against certain loan portfolios were inadequate, the level of provisions could be adjusted, reducing the bank's measured capital resources. Alternatively, if asset quality reviews revealed inadequacies in Pillar 1 or Pillar 2A capital requirements (for example, if exposures were found to be assigned by a bank to inappropriate risk grades), adjustments could be made to increase those requirements. Stress tests would then be applied to adjusted capital positions, starting from a sound base. Full account would be taken during the stress-testing analysis of the level of provisions already held by banks.

Asset quality reviews may also reveal information about the performance of a portfolio in a stress and, so, aid the evaluation of the impact of an adverse scenario. For example, they may reveal that loans were originated when the bank had a particularly high risk appetite. Taken together with adjustments to the starting capital position, this would not 'double count' the capital required to protect the bank from an unexpected shock. Rather, the additional information from asset quality reviews would be used appropriately to assess the bank's ability to withstand that shock as part of the stress tests. In this way, the information from asset quality reviews and stress tests would be complementary.

Asset quality reviews can also help in designing stress scenarios by identifying those risks that should subsequently be explored either through common or idiosyncratic scenarios — for example, where risks to asset performance are highly concentrated. These types of weakness could increase the scale and likelihood of a bank's losses during a stress scenario but may not be apparent from more aggregated data used in a stress test.

More broadly, since the information from the baseline forecast of credit losses in a stress test will also contain useful information around the adequacy of provisioning, a comparison of the baseline forecasts of credit losses and current provisions held by banks is likely to be a useful additional diagnostic of capital adequacy.

(1) Pillar 2A refers to the component of Pillar 2 that looks at risks not captured, or only partially captured, under the Pillar 1 framework (eg interest rate risk in the non-trading book or credit concentration risk).

7 Modelling of scenarios

A necessary building block for providing a quantitative, forward-looking assessment of bank capital adequacy will be a synthesised view of banks' future capital positions in each of the scenarios being considered. This requires a set of quantitative tools to translate the macroeconomic and market variables paths into projections of bank profitability and capital ratios. The Bank expects to use a suite of models to do this, rather than rely on a single model.

Why a suite of models?

There are a number of benefits in using a suite of models as part of the stress-testing framework.

First, the banking system faces many different types of risk, including market, credit, funding and liquidity risks. Although these are often interrelated, it is not realistic to expect that a single model will capture the entirety of these risks effectively.

Moreover, reliance on a single quantitative tool heavily exposes the stress-testing exercise to 'model risk'. All models are a simplification of reality, so it is reasonable to assume that any single model will almost certainly be wrong. Having recourse to a suite helps reduce the sensitivity of the results to a particular model's 'blind spot' or miscalibration. Different models also give different insights and perspectives to policymakers, serving as a useful cross-check to each other. Indeed, the range of outputs from different models can itself be informative, providing useful insights to policymakers on uncertainties around banks' capital positions in a given scenario.

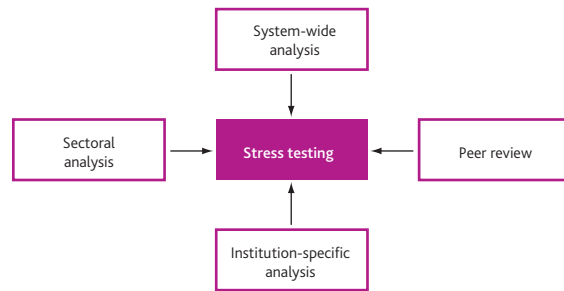
Using a suite of models also reduces the risk that individual banks might seek to 'game' the stress-testing framework by seeking to restructure their balance sheets in a way that reduces measured risk under a particular model. Finally, from a system-wide perspective, relying on a single model could have adverse consequences for diversity in risk measurement and risk management practices across the system.

Using a suite of models is not without costs, however. It will add some degree of complexity to the overall exercise. Synthesising model outputs also requires regulatory judgement, which might make the analysis less transparent to stakeholders (see Section 8). Given this, in synthesising different model outputs, transparency around the key judgements involved in reaching an overall view on capital adequacy will be important.

What range of models will the framework employ?

Models can vary in several respects — for example, in their level of granularity, the type of risks they seek to cover, or their calibration. Broadly speaking, the Bank expects to employ four main types of models and associated analysis (Chart 1):

Chart 1 Schematic representation of different pieces of analysis informing stress tests



- **Granular, regulator-developed stress-testing models:** These are mostly bank-level or asset-specific models that aim to capture the detail of specific business activities and asset types. They are calibrated and run by regulators.
- **Coarser, system-wide stress-testing models:** Less granular modelling approaches, such as the Bank's Risk Assessment Model of Systemic Institutions (RAMSI), are better able to take a system-wide view of risk.⁽¹⁾ For example, they seek to incorporate feedbacks and amplification mechanisms of initial shocks, such as interactions between institutions within the banking system or between the banking system and the wider economy (see Box 4). They can be used to explore a wider range of scenarios in a more flexible and timely manner. And they allow policymakers to impose top-down judgements more easily.
- **Banks' own stress-testing models:** These share many of the characteristics of granular, regulatory-run models. They benefit from better access to data, an even greater degree of granularity and greater tailoring to the underlying portfolios being assessed. While banks' incentives are not always fully aligned with those of regulators, valuable insights may be gained through comparing the outputs of banks' own models with those run by the authorities as well as through peer analysis.
- **Other 'satellite' models:** While not traditional 'stress-testing' models, the framework is expected to employ a number of models and analytical tools developed across the Bank to inform an economy-wide view of risks and developments across different sectors. These results can then be compared to the aggregated results across the banking system. For example, it could be that projected impairments on lending to a particular sector appear reasonable when considered on a bank-by-bank basis, but not when aggregated and compared with analysis of that sector as a whole. The Bank also expects to collaborate with other institutions — for example, the IMF or foreign regulators — when modelling losses in foreign jurisdictions.

(1) Burrows, Learmonth and McKeown (2012).

The Bank will continue to improve its capabilities and develop new models continuously. The suite of models, as a result, will evolve over time. This is an ongoing area of research, especially in the areas of incorporating system-wide amplification mechanisms in system-wide stress testing (see Box 4).

Granularity of regulatory models and analysis

Granular, regulator-developed stress-testing models are important for helping the authorities explore banks' vulnerabilities to different sources of risk. In doing so, they can strengthen prudential supervision by enriching the body of information that supports supervisory judgements. They can also help to reduce reliance on stress-test projections produced by banks' own models (see further on this below), allowing regulators to reach an independent, in-depth view of a bank's risk profile.

The appropriate degree of granularity for these regulatory models is a key design consideration. Here, granularity defines the level of detail at which banks' risk exposures are captured in data and, subsequently, modelled. For example, when considering a bank's mortgage book, relevant risk factors might include the loan to value (LTV) ratio, product type (for example, interest-only or repayment), type of borrower (prime, sub-prime or buy-to-let) and whether or not repayments are fully up-to-date or in arrears. The level of granularity determines both the number of such risk factors used in modelling; and whether data about such risk factors are collected at the level of individual loans or for a group of loans that share similar characteristics.

On the one hand, the main benefit of greater granularity is that, in principle at least, additional information about relevant risk factors should help assess the impact of different economic shocks with greater accuracy. If important information is either omitted, or reduced to summary statistics, the assessment of risks might be misleading. There is likely to be a minimum level of granularity above which the effect of material drivers of risk starts to be misrepresented — or even not reflected at all — in loss estimates for the individual portfolios concerned. For example, ignoring the distribution of LTV ratios across borrowers could result in an over or underestimation of risk in different banks' mortgage books when assessing the possible impact of a shock originating in the housing market.

On the other hand, the costs associated with high levels of detail may outweigh the benefits beyond a certain point. Most obviously, there is a resource cost for banks to produce, and regulators to process, understand and use large data sets. Moreover, there are analytical risks associated with high degrees of complexity. For example, using a large number of explanatory variables in models can lead to 'over-fitting'

problems, where estimated relationships perform well at capturing observed relationships in-sample, but less so in forecasting out-of-sample. And excessive focus on granularity risks distracting attention away from the big risks facing individual banks and the system as a whole. It may be that the correlations between risk factors or other interactions are ultimately more important indicators of systemic risks than the individual risk factors themselves. The use of a suite of models — as proposed in this Discussion Paper — will guard against some of these risks.

These considerations imply that the appropriate degree of granularity in regulatory models is likely to vary according to the type of exposure or activity being considered. For example, where banks hold a large number of comparatively homogenous assets, it may be acceptable to aggregate these into groups that share similar risk characteristics — for example, multiple mortgages that have similar LTV ratios, payment status and are within a similar product category. But other activities — such as a highly concentrated portfolio of large commercial real estate exposures — might require a loan-level assessment.

It is also important to emphasise that stress testing is not the only approach through which regulators seek to understand banks' risk exposures. There will remain a number of other complementary sources of information, including asset quality reviews (discussed in Section 6). In fact, asset quality reviews may inform the appropriate level of granularity of stress-testing models.

The Bank would welcome feedback from respondents to this Discussion Paper on the appropriate granularity for stress-testing models.

Disclosure of information around regulatory models

Irrespective of the ultimate choice of models, a key policy question is the degree of transparency around the detail of regulatory models. This involves a trade-off.

Disclosing granular information about regulatory models might reduce incentives for banks to develop and improve their own risk measurement systems. Such excessive reliance on regulatory models could have adverse consequences for system-wide diversity.⁽¹⁾ Moreover, banks might use this information to 'arbitrage' the stress tests, structuring their balance sheets in a way that might reduce measured, but not actual, risk. Similar concerns around 'managing models', rather than managing risk, have also been expressed in the context of models used to determine risk weights in the Basel framework.⁽²⁾

(1) For a discussion of the costs and benefits of transparency over regulatory stress-testing models, see Bernanke (2013).

(2) See, for example, Basel Committee on Banking Supervision (2013a).

Going in the other direction, disclosure of information around models might give banks and the market greater confidence about the approaches used by regulators. Making this information available publicly would allow academics and industry professionals to peer review these models and assist in their development. And being able to share knowledge about the advantages and disadvantages of different modelling approaches could prove fruitful from a risk management perspective.

The Bank's starting position is to favour disclosure of high-level information about the models used for stress testing, but not their precise calibration. This is an area where the Bank would welcome feedback from respondents to this Discussion Paper.

Reliance on banks' own models

The Bank expects to use the results from banks' own models as an input into its analysis to form a view of the likely size of stressed losses in adverse scenarios. The Bank recognises, however, that the use of banks' own models as part of the stress-testing exercise can lead to a 'principal-agent' problem. This is due to a possible misalignment of incentives: if the concurrent stress-testing exercise has the potential to lead to remedial actions by banks that they would not themselves have chosen to take, banks will face incentives to provide an overly optimistic view of the impact of adverse scenarios on their capital position.

The Bank expects to take a number of steps to help reduce this problem. These include:

- **Comparison of banks' projections with those from regulatory models:** The Bank will use a suite of models to produce its own projections, ranging from individual-bank portfolios to system-wide levels of granularity. Where a bank's own projections differ substantially from those produced by the Bank's suite of models, particularly in the absence of well-substantiated arguments to justify this, this will inform the relative weights attached by Bank staff to banks' own projections.
- **Peer comparison:** The concurrent nature of the stress test means that the results for similar portfolios can be compared across banks. Such peer analysis will help flag obvious outliers.
- **Regulatory experience:** The Bank will be engaging with other regulators to understand past loss experiences and

expectations of losses under stress, especially in the context of modelling losses in foreign jurisdictions.

More broadly, to help align incentives, banks will likely be required to have in place a robust governance process around stress testing (see Section 11 for more details around expectations of banks as part of this framework). Disclosure of stress-test results — to the extent that market discipline is effective — should also contribute to ensuring that banks take active action to report accurately and strengthen modelling standards.

Modelling banks' assumed responses to scenarios

Banks' business strategies continuously adapt to changes in the prevailing and expected operating environment. It is, therefore, reasonable to incorporate at least some of banks' proposed responses to macroeconomic and market shocks when evaluating the impact of scenarios on bank capital adequacy. Such responses can range from 'business as usual' actions, such as adjustments to interest rates charged on certain products following a change in Bank Rate, through to management actions taken in response to capital or liquidity pressures, such as constraining dividend distributions or reducing certain exposures.

As explained in Section 11, when banks model the impact of a given scenario, they would be expected to take a conservative approach to incorporating management actions. Such responses should be included only if banks could, and realistically would, take such actions. In making that assessment, banks should account for factors such as market conditions in the stress scenario and any effect those actions would have on the bank's reputation with its counterparties and investors. Banks would also need to be able to present their results gross and net of these management actions.

More broadly, when evaluating the impact of different scenarios on capital adequacy, Bank staff will seek to ensure that different banks' proposed responses are consistent in an aggregate sense. For example, if multiple banks expect to dispose of similar assets under a given scenario, it might be appropriate to assume that those sales would be made at lower prices than otherwise. Alternatively, if all banks intended to increase their reliance on a particular type of funding, Bank staff would assess whether the assumed cost of that funding is realistic in aggregate. In part, such assessments will allow Bank staff to incorporate some of the effects of system-wide feedbacks and amplification mechanisms (see Box 4).

Box 4 Modelling of amplification mechanisms

Relatively small initial shocks can have large adverse effects on the profitability and capital position of the banking system as a whole in the presence of amplification mechanisms. Such effects are typically not modelled in bank-specific stress tests, which tend to take a partial-equilibrium approach to risk measurement.⁽¹⁾ But, as was evident from the recent crisis, ignoring system-wide amplification channels can materially overestimate the resilience of the system.⁽²⁾ It is, therefore, crucial that the stress-testing framework seeks to account for spillovers that might arise from banks' and other agents' responses to initial adverse shocks, seeking to take a general equilibrium view of systemic stability.

This box discusses how some of these amplification mechanisms might be captured as part of the stress-testing exercise over the medium term. Because — by definition — these effects operate across banks or in the economy more broadly, it is expected that these effects would be primarily modelled by the Bank, rather than by institutions covered in the exercise. The analytical tools for fully capturing these effects are still being developed: in the short term, it is likely that they will be captured implicitly in the design of scenarios, through analysis of the system-wide consistency of banks' projected management actions (see Section 7), or incorporated through judgement.

Type of amplification mechanisms

Broadly, amplification mechanisms can occur between banks, between banks and the real economy, and between banks and non-bank financial companies.

Interactions between banks

There are different channels of contagion within the banking system that can amplify the impact of initial shocks. These include:

- **Interbank exposures:** Banks are often exposed to each other through a range of financial instruments, including interbank loans, derivatives or holdings of traded debt securities. If one bank suffers losses or defaults, exposures of other banks would fall in value, resulting in losses and an erosion of capital resources for other financial institutions in the system.⁽³⁾
- **Fire sales:** Contagion might also occur in the absence of outright default. For example, faced with a loss of access to private funding markets, banks might respond by selling assets in the market, either to raise liquidity or to cut their risk exposures. This may push down the prices of these assets and cause mark-to-market losses at other banks.⁽⁴⁾

This mechanism is likely to operate most strongly if a number of banks are exposed to similar risks or markets.

- **Liquidity hoarding:** Banks may also hoard liquidity to build up their liquid asset buffers during times of stress. Other institutions reliant on borrowing in the interbank market may, in turn, see an increase in their borrowing costs and a worsening of their liquidity positions.⁽⁵⁾ These banks may ultimately lose access to short-term funding markets or see their profitability and capital positions impaired due to higher funding costs.
- **Confidence channels:** Solvency concerns at one bank can spread to other banks via a confidence channel. For example, distress at one bank may reveal information about the likelihood of failure at other banks. So investors may become concerned about, and withdraw funding from, banks that they perceive to be similar to a distressed bank.

Interactions between the banking system and the real economy

Stress tests typically seek to model the impact of a macroeconomic scenario on banks' financial health. In doing so, they tend to focus only on the first-round effects of the shock — for example, by modelling the effect of a change in macroeconomic variables on loss rates for a given asset class. In reality, the interactions between the banking system and the real economy are richer and operate in both directions.⁽⁶⁾

The first-round effects described above will often result in either a loosening or tightening of the capital and funding constraints a bank faces. For example, an increase in impairments could lead to a reduction in a bank's capital ratio and, if this is sufficiently large or is expected to continue, a worsening of the terms on which they can access funding markets. This can affect both the size and composition of balance sheets that a bank's management will choose to operate. If a large enough proportion of the banking system responds in a similar way to a common shock, this can result in a material change in the provision of financial services to the real economy.

A change in the supply of credit is a key channel through which the real economy may be affected. This might happen through changes to price or non-price terms — for example, by changing the spread over Bank Rate charged on new floating-rate mortgages or the maximum loan to value ratio at which banks are willing to lend. To the extent that this results in material changes in the aggregate quantity of lending, it may also lead to different outcomes for economic output, asset prices and the financial health of borrowers.

There are, of course, many other ways in which changes in the scale and mix of banks' activities can affect the real economy.

A reduction in banks' risk appetite, for example, might mean they are less willing to underwrite corporate equity issuance, thereby reducing the capacity of the corporate sector to raise external financing. Alternatively, banks may be less willing to enter into financial contracts — for example, options and swaps — with companies, thereby affecting companies' ability to manage their financial risk effectively.

Where these feedbacks exist, they have a tendency to generate self-reinforcing cycles of behaviour. For example, during an economic downturn, banks might be less willing to finance commercial real estate (CRE) projects, which could contribute to CRE price declines, in turn making banks less willing to lend. In this way, an initially moderate adverse shock could develop into a more severely adverse scenario.

Interactions between banks and non-bank financial companies

The non-bank financial sector includes a wide range of financial institutions such as insurance companies, pension funds, private equity firms, hedge funds, central counterparties and money market funds (MMFs). Shocks can propagate across the financial system through the behaviour of the non-bank financial sector. For example, in the recent crisis, Lehman Brothers' default caused the Reserve Primary Fund to 'break the buck'. This, in turn, led to significant withdrawals from other MMFs. As a result, the MMF sector as a whole reduced its exposures to risky assets, including lending to the banking sector. This then led to a severe deterioration in the liquidity positions of banks reliant on funding from MMFs.

Incorporating amplification mechanisms in stress-testing models

Spillover and feedback analysis is an important element of stress tests in increasingly interconnected financial systems. But the development of stress-testing models in this area remains at a relatively early stage.

The Bank's system-wide stress-testing model (RAMSI) aims to capture at least some of the channels outlined above.⁽⁷⁾ At this stage, modelling capabilities are limited to capturing certain feedback effects between banks.⁽⁸⁾ For example, if bank fundamentals — such as bank profitability and solvency — are projected to worsen, banks experience higher funding costs in the model. And, beyond certain thresholds, banks could be entirely shut out of certain funding markets. Moreover, when banks suffer losses so severe that their capital ratio falls below a threshold ratio, feedback effects can cause losses to other banks, for example through counterparty exposures and asset fire sales.

Going forward, particularly given the G20 commitment to have all standardised OTC derivative contracts centrally cleared, central counterparties will be absolutely vital nodes in

the financial system. Given that, the Bank plans to consider the need for a stress-testing regime for central counterparties separately (see Section 4).

Other central banks also incorporate elements of amplification mechanisms in their stress-testing frameworks. The Bank of Canada, for example, incorporates a network of interbank linkages as well as asset fire sale effects in its stress-testing approach. Their results suggest that risks to the system as a whole can be materially underestimated if second-round effects are not taken into account.⁽⁹⁾ Similarly, the Bank of Japan incorporates feedback loops between the financial system and the real economy.⁽¹⁰⁾ This uses a modelling framework to gauge the impact of a contraction in the supply of lending by banks on the real economy.

Overall, there remain material challenges in capturing feedbacks and amplification mechanisms in stress tests. This is for at least two reasons:

- **Data availability:** Lack of data remains an obstacle to modelling amplification mechanisms. For example, detailed data on interbank exposure networks has only become available relatively recently. Even now, there are clear limitations to the information available to allow authorities to map the entire financial network, including non-banks. Similarly, the limited number of financial crises imply that estimates produced by models — for example in the context of the interaction between the financial system and the real economy — often reflect 'average' relationships, which might well break down in times of stress.
- **Analytical capability:** The full richness of this area has only recently started to be explored by the academic community. Issues around the relationship between the financial sector and the real economy have come to the fore again in light of the recent crisis, but remain far from perfectly understood. Similarly, the behavioural response of banks and other market participants to initial shocks is now an area of growing research, but material uncertainties remain.

(1) See, for example, Greenlaw *et al* (2011).

(2) See, for example, Brunnermeier (2009).

(3) For a survey of approaches on modelling counterparty credit risk through an interbank network, see Upper (2007).

(4) See Shleifer and Vishny (1992), Shleifer and Vishny (2011), Gai and Kapadia (2010) and Cifuentes, Ferrucci and Shin (2005).

(5) See Acharya and Skeie (2011), Acharya and Merrouche (2012) and Heider, Hoerova and Holthausen (2009).

(6) See, for example, Gertler and Kiyotaki (2010) and Chen (2001).

(7) Aikman *et al* (2009).

(8) Kapadia *et al* (2012).

(9) Gauthier and Souissi (2012).

(10) Otani *et al* (2009).

8 Outputs of stress tests

The proposed stress-testing framework will produce a range of quantitative and qualitative information. This section outlines how this information is likely to be used to inform FPC and PRA Board judgements around bank capital adequacy.

Synthesising model outputs

Using a suite of models implies that there is likely to be a range of outcomes for each bank under each scenario. There might be useful information in that range of outcomes itself, as it helps illustrate the inherent uncertainty in estimating projections and provides an indication of how much confidence policymakers can have in the results. Ultimately, though, Bank staff will need to synthesise the outputs of these models to form a single view of each bank's performance in each scenario.

There are different possible approaches to synthesising model outputs. These range from purely mechanical techniques to entirely judgement-based approaches.⁽¹⁾ On balance, the Bank expects that judgement will play a crucial role in combining model outputs. Using purely mechanical rules — for example, calculating the mean projected value across different models — risks diluting the main benefit of a suite of models approach: the fact that some models have been specifically designed to analyse certain types of risk. Knowledge of respective models' strengths and limitations can be exploited better by applying judgement to synthesise the outputs of different models.

Framework for assessing capital adequacy

The process outlined above will result in a central view of the size of stressed losses in a given scenario and, hence, remaining capital resources. Interpreting these results, and reaching a judgement around bank capital adequacy, requires a view on the level of capital that regulators want banks to maintain in the stress scenario. This is often referred to as the 'hurdle rate'.

Ultimately, this is a policy decision by the FPC and the PRA Board. But there are a number of considerations the FPC and the PRA Board might take into account in considering the level of capital banks should maintain in a stress.

A key consideration will be the minimum level of capital required by internationally agreed standards. Banks need to maintain sufficient capital resources to be able to absorb losses in the stress scenario and remain above these minimum requirements. Minimum capital standards have been set internationally by the Basel Committee on Banking Supervision and transposed into European legislation under the Capital Requirements Regulation and Directive (CRD IV). For example, under the PRA's proposed implementation of CRD IV, the minimum Pillar 1 common equity Tier 1 capital requirement will be set at 4.5% from 1 January 2015 onwards.

But requiring banks to remain above internationally agreed minima in a stress may be insufficient to mitigate risks to financial stability. There are other factors that the FPC and the PRA Board will consider when setting the hurdle rate. For example, some risks, such as credit concentration risk and interest rate risk in the banking book, are not covered by Pillar 1 capital requirements. And, in some circumstances, the Pillar 1 risk weights generated by the Basel framework might be inadequate, given prevailing economic and financial conditions. For example, capital required against banks' trading books before the financial crisis proved to be materially undercalibrated in light of realised losses. These factors could lead banks to lose access to private funding markets in a period of stress before hitting internationally agreed minima. There might be circumstances, for example, where a bank's perceived creditworthiness could be affected if its capital ratio fell, or was expected to fall, materially below 7%.⁽²⁾ In turn, this could make private funding expensive or unavailable altogether.

Funding strains can have material adverse financial stability effects. For example, banks might respond by cutting lending to the real economy, hoarding liquidity or fire selling assets. If banks' capital is adequate to maintain access to funding markets and continue to provide financial services to the real economy through a stress, prospects for financial stability will be enhanced.

Finally, uncertainty over banks' and regulators' ability to explore different stress scenarios and model their impact is also a consideration in setting the hurdle rate. Confidence that a bank will remain above a given level of capital will depend on the degree of uncertainty around projections of stressed losses. The greater that uncertainty, the higher the hurdle rate it might be prudent to set to guard against risks to financial stability. This might include any factors that have not been explicitly modelled. For example, if macroeconomic feedbacks are not taken into account, policymakers might want to set the hurdle rate at a higher level to accommodate these.

In practice, these factors mean that the level of capital that banks would need to maintain in order to survive in a stress scenario could be set above strict regulatory minima. They also imply that judgements on the appropriate hurdle rate for the banking system as a whole could vary over time, in light of the threats in the macroeconomic and financial environment. Moreover, individual banks' idiosyncrasies (such as their resolvability, the extent to which they can raise external equity capital or the size of risks not covered by Pillar 1 capital

(1) For a discussion of different mechanical approaches to combine forecasts in the context of monetary analysis, see Kapetanios, Labhard and Price (2007).

(2) Consistent with the Basel III Capital Accord, CRD IV requires banks to have at least a 2.5 percentage point buffer of capital above the 4.5% minimum. If a bank's capital falls below 7%, so that this buffer is used up, banks are required to take steps, such as cutting dividends, to rebuild their capital.

requirements) suggest that required post-stress capital ratios are likely to vary across banks. Further, as set out in Section 9, this is not intended to be a 'pass-fail' regime, but one that takes a graduated approach to remedial actions required in response to the stress tests, depending on FPC and PRA Board views around the adequacy of banks' capitalisation and the threats to the system.

The adequacy of banks' capital resources is likely to be judged not only with reference to risk-based capital ratios, but also leverage ratios. This is for a number of reasons. First, because the leverage ratio is likely to become part of the Pillar 1 framework under Basel III.⁽¹⁾ Second, partly as a result, because the market may judge banks' resilience against a leverage standard as well as risk-based standards. This matters when assessing banks' ability to maintain access to private funding markets. Finally, because leverage is less susceptible to the inadequacies of risk weights, for example due to model arbitrage and risk mismeasurement.

Outputs to inform FPC and PRA judgements

The range of outputs that the stress-testing exercise will produce — for each bank, in each scenario, in each period of the forecast horizon — is potentially very rich. Key outputs that are expected to inform FPC and PRA Board judgements around bank capital adequacy include:

- Banks' risk-based capital and leverage ratios in the range of scenarios against which they have been tested. Combined with a view on the appropriate hurdle rates, this can be translated into nominal capital shortfalls.

- Ranges of overall capital and leverage ratios projected from the suite of models — to provide an indication of the uncertainty around capital adequacy.
- Projections of the capacity of the banking system as a whole to expand lending, both under the baseline and in the range of adverse scenarios.
- Sector or portfolio-specific loss rates — either for individual banks or for the system as whole — relative to capital requirements against those exposures. These might provide useful information about the calibration of sectoral capital requirements (see Section 9).
- Changes in the impact of a stress scenario over time, which could be indicative of changes in the level of risk-taking of the banking system.
- A qualitative assessment of banks' own stress-testing and capital management processes and governance. See Section 11 for a discussion of what the PRA is likely to expect from banks in these areas.

No single quantitative output of the stress-testing exercise is expected to be linked mechanically to policy responses. The FPC and the PRA Board will use the information from the stress tests — in conjunction with other analysis — to reach an overall judgement about the capital adequacy of individual banks and the banking system as a whole.

(1) Basel Committee on Banking Supervision (2011).

9 Remedial and policy actions

It is important that credible policy actions are taken in response to the results of the stress tests. To this end, the results of the stress-testing exercise are expected to be used to: (a) inform the FPC's assessment of the resilience of the financial system and, in doing so, aid formulation of policy responses; and (b) support PRA Board decisions and actions on individual banks, taking into account any system-wide actions by the FPC.

As mentioned previously, the results of the stress-testing exercise are not expected to be mechanically linked to policy responses. This is not intended to be a simple 'pass-fail' regime. Rather, it aims to deliver a more graduated policy framework, with the magnitude of remedial actions taken being a function of regulators' judgement around capital adequacy, drawing on a range of information.

As the stress-testing exercise is focused on providing a quantitative, forward-looking assessment of capital adequacy, it is likely that policy responses by the FPC and the PRA would focus on bank capital. But the exercise might also yield insights that lead the FPC and the PRA to take actions beyond bank capital. These two sets of policy responses are discussed in turn.

Policy responses to strengthen capital adequacy

The primary outcome of the stress-testing exercise would be an assessment by the PRA Board of individual banks' capital plans. This would determine whether banks' original capital plans are sufficient to meet the required level of capitalisation determined jointly by the FPC (for system-wide purposes) and the PRA Board (for bank-specific purposes). If the PRA Board judged that this was not the case, it would have discretion to reject banks' original capital plans and powers to require additional actions to increase capital levels over a specified time period. To facilitate PRA Board decisions, when submitting their original capital plans, banks are also likely to be expected to submit a range of additional actions that could be taken to reach a higher level of capitalisation. These would be actions that banks could take immediately, to strengthen their ability to withstand shocks in the future.

The range of actions that banks could be required to take by the PRA to strengthen capitalisation levels include:

- constraining dividend distributions, share buybacks or discretionary payments on certain Tier 1 capital instruments;
- constraining (variable) remuneration to staff;
- issuing equity or other capital instruments that can definitely absorb losses on a 'going concern' basis (outside of resolution or liquidation);
- engaging in liability management exercises; and
- reducing certain risk exposures or business lines.

The magnitude of required remedial actions would be determined by the FPC's and PRA Board's judgements around bank capital adequacy. For example, if stress tests revealed that capital ratios of individual banks — or the system as a whole — fell below internationally agreed minima in any of the stress scenarios, this could point to material inadequacies in their capitalisation. In turn, this would likely result in the PRA requiring material adjustments to banks' current capital plans to strengthen their ability to withstand shocks. If stress tests revealed that capital ratios of banks — or the system as a whole — remained above the internationally agreed minimum in the stress scenarios, but still somewhat below an appropriate hurdle rate, required adjustments to capital plans would likely be smaller.

A key step in the process will be the setting of capital buffers or requirements by the FPC and the PRA Board. The results of stress tests are expected to be used as an input to inform the judgements of the two bodies around these requirements.

From a **system-wide perspective**, the FPC could choose to respond to information from, and results of, the stress tests by using its macroprudential tools (see Box 5). The setting of the countercyclical capital buffer (CCB) and sectoral capital requirements (SCR) is expected to be guided, in part, by a set of core indicators, a preliminary list of which was published in the Draft Policy Statement in January 2013. The results of the stress tests will provide a forward-looking view of a number of these indicators and a rich set of analysis on banking system resilience. For example, stress-test results might point to a generalised increase in risk-taking by the banking system, resulting in larger reductions in capital ratios in the adverse scenarios over time. This could lead the FPC to respond by increasing the CCB rate. Symmetrically, stress-test results may also inform the FPC's judgement around the release of the CCB. The outputs of stress tests might also point to specific vulnerabilities in certain sectors, which could inform the calibration of an SCR. And the FPC might use the results of the stress-testing exercise to make a range of Recommendations to the PRA around bank capital. For example, the FPC might recommend that the PRA sets a floor on certain risks weights to guard against the risk that inadequate capital is being held against a specific class of assets.

From a **bank-specific perspective**, the PRA is likely to use the results of stress tests as an input to setting the PRA Buffer, which is expected to replace the current Capital Planning Buffer in due course.⁽¹⁾ Related to this, the results of the stress tests will inform the PRA's judgement about proximity to failure, as captured in a bank's position within the Proactive Intervention Framework (PIF).⁽²⁾ A key element of the

(1) Prudential Regulation Authority (2013a).

(2) Prudential Regulation Authority (2013b).

Box 5 The Financial Policy Committee's statutory powers

The Financial Services Act 2012 created the Financial Policy Committee (FPC). The FPC's statutory responsibility is the 'identification of, monitoring of and taking of action to remove or reduce systemic risks with a view to protecting and enhancing the resilience of the UK financial system'. This is in order to meet the FPC's objectives of contributing to the Bank's Financial Stability Objective and, 'subject to that, supporting the economic policy of Her Majesty's Government, including its objectives for growth and employment'. The FPC's actions must not, in the words of the legislation, have 'a significant adverse effect on the capacity of the financial sector to contribute to the growth of the UK economy in the medium or long term'.

The FPC has two main powers at its disposal. The first is a power to make Recommendations. It can make Recommendations to anybody. But the FPC has a special power to recommend, on a 'comply or explain' basis, to the regulators — the Prudential Regulation Authority (PRA) and the Financial Conduct Authority (FCA) — that they exercise their functions in a particular way, such as to adjust the rules that banks and other regulated financial institutions must abide by. Should the regulators decide not to implement Recommendations made on a 'comply or explain' basis, they

are required by the legislation to explain publicly their reasons for not doing so.

The second power is to give Directions to those regulators to exercise their functions to ensure the implementation of a macroprudential measure. The FPC has been granted powers of Direction over sectoral capital requirements (SCRs) and the Government has proposed to make the FPC responsible for setting the countercyclical capital buffer (CCB) rate.⁽¹⁾ The CCB tool will allow the FPC to change capital requirements above normal microprudential levels in relation to all loans and exposures of banks to borrowers in the United Kingdom. The power to set the CCB will be provided to the FPC in regulations implementing the EU's Capital Requirements Directive and Regulation (CRD IV). The SCR tool is more targeted than the CCB, and allows the FPC to change capital requirements above microprudential standards on exposures to specific sectors judged to pose a risk to the system as a whole. Specifically, the FPC is able to adjust SCRs for banks' exposures to three broad sectors (residential property, including mortgages; commercial property; and other parts of the financial sector), as well as more granular subsectors (for example, to mortgages with a high loan to value or loan to income ratios at origination).

(1) In January 2013, the FPC published a statement of the general policy that it proposes to follow in relation to the exercise of its powers of Direction: 'The Financial Policy Committee's powers to supplement capital requirements', available at www.bankofengland.co.uk/financialstability/Documents/fpc/policystatement130114.pdf.

supervisory judgement about a bank's proximity to failure is the adequacy of its capital position. Stress-test results, therefore, are likely to be an important input informing that judgement.

Policy responses beyond bank capital

In addition to, or as an alternative to, actions aimed at influencing the level of capital directly, other actions could also be taken in response to the stress-test results.

From a **system-wide perspective**, the stress-testing exercise may unearth undesirable levels of interconnectedness in the banking system, which could act as propagation mechanism for shocks. In response, the FPC could choose, for example, to recommend that the PRA tightens margin requirements on

derivatives or repurchase agreements. Or it could respond by recommending that the PRA tightens liquidity requirements, so that — if a shock materialises — fire sales of illiquid assets are reduced.

From a **bank-specific perspective**, the exercise might reveal weaknesses in banks' stress-testing and capital planning processes and governance. In those circumstances the PRA would consider what action was appropriate to ensure that shortcomings were addressed. The PRA has a variety of formal powers available. Additional capital requirements might be one tool. Withdrawing certain permissions, changing banks' management and requiring specific actions to improve banks' stress testing, risk management or capital planning processes are others.

10 Disclosure

A key principle underpinning the proposed stress-testing framework is that the outcome of, and analysis associated with, the stress-testing exercise should be made public. This section explores what information might be disclosed to enhance the transparency, accountability and credibility of the stress tests. The options explored in the section relate to the medium-term framework. The precise form of disclosure is likely to evolve over time. In some cases, there are options around whether information is disclosed by the FPC, PRA or by banks themselves. The Bank will work with the institutions covered by the exercise to ensure a co-ordinated disclosure process. More broadly, published information relating to stress tests is meant to complement — rather than duplicate — the range of initiatives around strengthening bank disclosure.

Benefits and costs of disclosure

An appropriately designed disclosure regime for stress testing should deliver the following benefits:

- **Facilitate accountability of policy interventions:** A key objective of the stress-testing framework is to act as one device through which the Bank can be held accountable on its financial stability objective to Parliament and the wider public and explain its policy decisions. Achieving this objective requires transparency about the exercise.
- **Support the credibility of the framework with market participants and other stakeholders:** Disclosure can help assure stakeholders — including Parliament and the public — that the overall methodological approach is sensible, the final results are plausible and the process that generates those results is robust.
- **Incentivise banks to engage fully with the exercise:** Revealing information about banks' performance in stress tests to the public, coupled with a commitment on behalf of the authorities to follow up findings with policy actions, will incentivise banks to engage more fully with the exercise.
- **Enhance market discipline by reducing information asymmetries:** Disclosure of results should strengthen market participants' understanding of UK banks' ability to withstand certain severe scenarios. This should strengthen market discipline in an upturn and mitigate risks to market functioning in a downturn.

There are also potential costs associated with disclosure. These include:

- **Self-fulfilling expectations:** Disclosures that reveal problems with individual institutions, or the sector as a whole, have the potential to precipitate the outcomes policymakers are trying to avoid. To mitigate the risk of

self-fulfilling outcomes, any disclosure would need to be accompanied by a credible set of remedial actions that can be implemented by banks or the authorities. That underlines the importance of progress to achieve credible resolution regimes as the ultimate backstop mechanism for dealing with undercapitalised banks. Accompanying communications would also need to make clear that the stress scenarios and the associated estimated impacts, while plausible, are not outcomes that the authorities perceive to be likely.

- **Moral hazard:** Publishing results of stress tests that suggest a bank is resilient against a severe adverse scenario may be interpreted by the market as a sign that the regulator is providing a 'clean bill of health' to individual banks and the system as a whole. This could disincentivise market participants from conducting their own, independent analysis and risk management. On the other hand, not disclosing results might induce moral hazard on behalf of the authorities, weakening their incentives to take prompt and effective policy responses.
- **Disclosure of commercially sensitive information:** Disclosure that allows market participants to infer banks' business strategies could have an adverse impact on their competitiveness.
- **Resource costs:** The increased intensity of internal validation and governance associated with public disclosures will create additional costs for both regulators and banks. These costs, however, are also likely to improve the credibility of the exercise.

Options around disclosure

Stress-testing disclosures can be grouped into three broad categories:

- **Policy outcomes/remedial actions:** This covers information about the use of formal powers by the FPC or the PRA informed by the stress-test findings, the authorities' opinion of banks' capital plans, remedial actions requested and the timescale over which authorities expect the actions to be completed.
- **Approach:** This is the set of information about how the authorities conduct stress tests. For example, it covers the scenarios being considered, the types of models employed, any loss rates assumed for particular classes of assets and the risks analysed as part by the exercise.
- **Results:** This is the set of information on the findings of the exercise and its use to inform authorities' judgements around policy actions. Results could be disclosed on an aggregate or bank-specific basis.

There is a range of options for the level of disclosure that could be made within each of these categories, which are discussed further below. Disclosure of some types of information could differ across the baseline and stress scenarios, or across the common and bank-specific scenarios. Given the need to balance the benefits and costs of disclosure, the type and granularity of disclosure is an area where the Bank would welcome feedback from respondents to this Discussion Paper.

The above areas do not cover more general disclosure of data on banks' exposures. While these can be important to strengthen transparency, published information relating to stress tests is meant to complement — rather than duplicate — the range of initiatives around strengthening bank disclosure, such as the proposals of the Financial Stability Board's Enhanced Disclosure Task Force or the PRA's intention to publish some regulatory returns.⁽¹⁾ That said, there may be instances where authorities judge that disclosure of stress tests could usefully be augmented to include the size of exposures to particular asset types.

(i) Disclosure of policy outcomes/remedial actions

The Bank expects, at a minimum, to disclose the policy decisions informed by the stress-testing exercise. This will be important to ensure that the exercise is seen as credible by the market and to facilitate public accountability of the FPC and the PRA. More specifically:

- **FPC system-wide policy actions:** This includes system-wide policy actions taken by the FPC, such as the use of macroprudential tools and any Recommendations to the PRA, FCA or other bodies. In most instances, those policy actions are expected to be reflected in the Record of the FPC meeting and the *Financial Stability Report*.
- **PRA bank-specific actions:** The PRA expects to be disclosing its assessment of the adequacy of banks' capital plans. But disclosure of specific remedial actions requested by the PRA may be better made by banks themselves, as they are likely to be in a stronger position to explain any actions in the context of their wider business strategy.

(ii) Disclosure of approach

The Bank expects to be disclosing sufficient information around the methodology to ensure key stakeholders, including Parliament and the market, can engage with the broad analytical approach of the exercise. Specific elements of the overall approach that could form part of the disclosure framework include:

- **Scenarios:** Disclosing the common regulatory scenarios against which all banks will be assessed should help market participants assess the degree of severity of the exercise. It will also allow the FPC and the PRA to communicate the resilience standard against which they aim to hold the

banking system. The PRA could also require disclosure of high-level information on bank-specific scenarios.

- **Analytical methodology:** There is a range of information on specific aspects of the methodology used that could be disclosed. Examples include the treatment of certain types of exposures, how funding risks are incorporated in the exercise and the approach taken with respect to management actions.
- **Models:** As mentioned in Section 7, there is a trade-off associated with disclosure of specific regulatory models. While it is useful to encourage public challenge to, and banks' understanding of, the modelling approaches, there are important risks associated with banks converging to the suite of regulatory models or adjusting exposures to arbitrage the stress-testing exercise.

(iii) Disclosure of results

The credibility of the stress-testing approach is not a sufficient condition for the associated policy actions also to be seen as credible and justifiable. This requires information on the eventual results of the stress tests — and how this was used to inform judgements over capital adequacy and related policy actions. This set of information is likely to be particularly important to strengthen public accountability of the FPC and PRA.

The proposed framework is likely to incorporate disclosure of results both on a system-wide and bank-specific basis. More specifically:

- **System-wide results:** Disclosure of aggregate stress-testing results can help stakeholders understand the reasons for policy actions taken by the FPC as well as illustrate key FPC judgements. Examples of aggregate results include: the distribution of post-stress capital or leverage ratios across the banking system; aggregate system-wide losses; or sector-specific loss rates. Such information can also be used to strengthen the credibility of the exercise. For example, publication of aggregate loss rates — and comparison of those with loss rates during the Great Depression — contributed to strengthening the credibility of the US Supervisory Capital Assessment Program (SCAP) in 2009.
- **Bank-specific results:** Disclosure of individual banks' performance in the stress test (eg stressed risk-based capital and leverage ratios) could supplement disclosures on an aggregate level to enhance the transparency of the stress tests. However, while a certain level of transparency may be desirable, there is a question around the optimal degree of granularity in disclosing bank-specific results. For example,

(1) Bank of England (2011).

disclosing individual banks' losses on a portfolio basis would allow the market to compare modelled, stressed loss rates across banks on a consistent basis. But, at a very granular level, it could also risk revealing commercially sensitive information.

Table C summarises possible options around disclosure of stress-test results.

Table C Possible options around disclosure of stress-test results

Disclosure of policy outcomes	Disclosure of approach	Disclosure of results
<ul style="list-style-type: none"> FPC use of powers of Recommendation or Direction informed by stress tests, including a discussion in the Record outlining key judgements and views. Approval/non-approval of banks' capital plans. Information about some remedial actions, eg restrictions on distributions, duration over which actions must be completed. 	<ul style="list-style-type: none"> Common scenarios. Hurdle rates. Information about the authorities' stress-testing models, eg modelling approaches, key features, calibration of key parameters. Information about key assumptions made when modelling scenarios, eg with respect to particular types of exposure. 	<ul style="list-style-type: none"> Aggregate and/or bank-by-bank capital positions across scenarios, eg surplus/shortfall relative to hurdle rates. Summary metrics for performance of key portfolios across scenarios, eg aggregate and/or bank-by-bank write-off rates. Summary of qualitative assessment of banks' stress-testing and capital planning processes and governance.

11 Expectations of banks

This section sets out the PRA's likely expectations of banks in relation to the regular stress tests proposed in this Discussion Paper.

Regulatory experience of banks' own stress-testing practices

The PRA, and previously the Financial Services Authority (FSA), has required banks to undertake stress-testing exercises for a number of years as part of its supervisory approach. There are a number of aspects of this that have worked well in the past. And this experience provides a good platform on which to build the concurrent stress-testing framework, from the perspective of both banks and regulators. But there are also areas where banks' stress-testing practices have fallen short of the FSA's expectations in the past. Examples include:

- insufficient engagement by banks' Boards and senior management with the stress-testing process;
- insufficient integration of stress testing with banks' annual business planning process, including the use of stress tests as a challenge to business plans;
- inadequacies in scenario design, including the failure to identify key vulnerabilities, overly optimistic baseline assumptions and insufficiently stressful adverse scenarios;
- difficulties in reconciling risk data with reported balance sheets and risk-weighted assets;
- stress-testing infrastructures that have not been suitable for bank-wide stress testing;
- insufficiently justified or internally challenged assumptions and judgements around the translation of macroeconomic shocks into projected losses, including overestimation of banks' ability to control margins and generate profits in stress scenarios; and
- inadequate determination and quantification of relevant management actions under different stress scenarios.

Such practices, where they occur, are at odds with the importance that the PRA will expect banks to attach to this stress-testing framework. The results of the stress tests proposed in this Discussion Paper will be a key input informing FPC and PRA Board judgements around bank capital adequacy. The PRA, therefore, is likely to expect a step change in the level of engagement with, and degree of rigour applied to, banks' stress-testing processes. A qualitative assessment of banks' stress-testing and capital planning processes and governance will also enable the PRA to monitor the development of banks' capabilities in these areas.

Expectations around scenario design

The framework proposed in this Discussion Paper incorporates a set of common scenarios designed by the FPC and a bespoke scenario designed by banks themselves, liaising with the PRA.

- The common scenarios will cover a limited set of macroeconomic and market variables. Banks will be expected to extend these to cover the range of variables that are necessary for their own modelling purposes. The PRA will expect banks to do this in a way that is consistent with the scenario designed by the FPC, taking a conservative approach where necessary. Banks will be expected to be able to articulate, and justify to supervisors, the key judgements made as part of this process.
- Banks will be responsible for developing the bespoke scenarios, working with the PRA. This should be tailored to a bank's particular business model, stressing the specific business lines and markets in which the bank operates. The PRA will expect the design of this scenario to be informed by banks' existing stress-testing and risk identification processes, including reverse stress testing. Banks will also be expected to explain and justify the key judgements and benchmarks they have used in devising this scenario. The outcomes of the bank-specific stress scenarios should be at least as severe as the common stress scenario.

Expectations around banks' own forecasting

As per current practices, the PRA will expect banks to be able to articulate, and justify, the key underlying assumptions and modelling choices used to derive their results as well as the limitations of their analysis.

Specific responsibilities of banks with regard to this exercise will include the following:

- Banks will be expected to supply the necessary data, as specified in Box 6, to allow Bank staff to run the common scenarios independently using their own models.
- Banks will be expected to provide the PRA with sufficiently granular outputs and qualitative explanatory information to allow a detailed comparison of their results against the Bank's own analysis.
- Banks will need to document the methodologies used and the key judgements made in deriving the output, as well as the results of the stress tests.
- Where banks have independent validation, model oversight and model approval processes for the purpose of managing regulatory models, they will need to apply the same level of rigour to the development and maintenance of their stress-testing models.

Box 6

Data submissions

Data submissions for the stress-testing framework will be determined by the modelling methodologies used by the Bank and the level of granularity at which the scenario impacts need to be understood. These are likely to build on frameworks developed by the PRA to run bank-wide stress tests on individual institutions.

Firm data submission framework

Over the past two years, the PRA (and before that the FSA) has been designing and implementing, in collaboration with a number of large UK banks, a comprehensive framework for the submission of the data necessary for conducting stress tests: the firm data submission framework (FDSF).

The FDSF is likely to be an essential component of the future stress-testing process. Given the importance of the stress tests in informing PRA Board and FPC decisions around bank capital adequacy, it is particularly important that banks consider this engagement a priority and meet the corresponding timelines as agreed with the PRA.

One of the core FDSF principles is that the PRA uses banks' own data and definitions, which are then mapped to the PRA's framework. This seeks to leverage banks' internal risk-reporting processes and avoid a disconnect between the data used by banks and those sent to the PRA. It also means that improvements in banks' own ability to aggregate and drill down into their data — the need for which has been manifest since the 2008 crisis and emphasised in the Basel Committee's Risk Data Aggregation Principles⁽¹⁾ — will benefit both the banks and the PRA.

These are data that the PRA also needs outside of the annual stress-testing cycle to run peer analyses that inform judgement-based supervision throughout the year. And it is information that banks themselves need to be able to access to manage their own risks effectively.

Under the FDSF, banks are expected to clean and check the data for quality and completeness before submitting them to

the PRA. Looking ahead, the PRA expects to move to a strict data quality regime. If data submissions do not meet specified PRA standards, the PRA is likely to reject them and require that the bank corrects and resubmits the data in a timely manner. In addition, failure of a bank to submit data of adequate quality and timeliness may, in and of itself, result in the PRA taking a conservative view on the overall outcome of the stress test for that bank.

Data infrastructure

Major banks are generally building strategic solutions to meet reporting requirements and the FDSF. Where these will not be fully in place before submission of data is due for the 2014 stress test (see Box 7), it is important that short-term solutions seek to align with strategic longer-term solutions as swiftly as possible.

It is also key that banks' senior management devote appropriate resources to the necessary upgrade of their data infrastructure to enable them to service internal and external data needs easily. Based on the PRA's observations to date, this may require the profile of data initiatives in some banks to be raised materially. The PRA — and the Bank more broadly — are themselves making substantial investments in infrastructure for collecting and handling data, to support microprudential supervision and macroprudential policymaking.

It is important that, as banks invest in infrastructure to improve their own data reporting and aggregation capabilities, they do not build structures or processes for the sole purpose of stress-testing data submissions. The ability of banks to provide these data should be a by-product of their improved internal data capabilities, integrating existing and planned architectures for other data submission requirements such as the Common Reporting Framework. It is hoped that the FDSF will considerably enhance banks' ability to provide clean and timely data for these other complementary regulatory initiatives.

In running the different scenarios, banks will be expected to project both their capital resources and their capital requirements over the specified time horizon. In assessing the impact of adverse shocks on their capital positions, banks should only include financial resources that could reasonably be relied upon as being available in the circumstances of the scenario, including by taking account of any legal or other restrictions on the use of financial resources. Additionally, banks should not assume that they benefit from a 'flight to quality' or similar effects when running scenarios.

Banks will also be expected to identify any realistic management actions that could be taken to maintain or restore their capital adequacy in a stress scenario. Here, management actions are defined as steps that banks could take in response to capital or liquidity inadequacies in the event that they were necessary in a given scenario. They are not intended to capture 'business as usual' responses that banks would in any case expect to take in that scenario. Management actions should only be included where a bank could, and realistically would, take such actions, taking into

(1) Basel Committee on Banking Supervision (2013b).

account factors such as market conditions in the stress scenario and any impact of those actions on the bank's reputation with its counterparties and investors. It is likely that these would be informed, at least in part, by the recovery plans that banks are being required to develop.⁽¹⁾ The list of management actions will be expected to be signed off by banks' Boards. Banks will need to be able to present their results gross and net of these management actions.

Banks should use the results of the stress-testing and scenario analysis not only to assess capital needs, but also to determine whether measures should be put in place to minimise the adverse effect on the bank if the risks covered by the stress test did materialise. Such measures might be a contingency plan or might be more concrete risk mitigation.

Expectations around governance

The PRA's assessment of banks' performance in the stress test will take into account the governance arrangements that banks have in place, the degree of engagement of their senior management and Boards and the rigour with which the PRA considers their stress testing to have been carried out.

- The PRA will expect full engagement by banks' Boards and senior management to ensure that their obligations under the stress test are adequately discharged. The output of the stress test must be reviewed and signed off by the governing body. This will require banks' Boards to gain a reasonable understanding of how these estimates have been arrived at.
- Banks' internal audit functions will be expected to attest that appropriate processes and controls are in place to ensure data quality, appropriate model controls and robust challenge of results.
- Banks will be expected to assign adequate resources, including IT systems, which are proportionate to the nature, scale and complexity of their activities.

As part of the annual stress-testing process, the PRA will be assessing the extent to which banks meet its expectations in relation to this framework. If these are not met, the PRA Board may consider appropriate remedial actions as set out in Section 9 of this Discussion Paper.

(1) See, for example, European Banking Authority (2013).

12 Feedback on the Discussion Paper

The Bank would welcome comments from interested parties on the different elements of the stress-testing framework proposed in this paper. In considering the development of the medium-term framework, the Bank hopes to engage with a broad range of stakeholders, including Parliament, banks, market participants, academics, foreign regulators and other interested parties. Although the Bank is keen to elicit views on all aspects of this paper, it particularly welcomes feedback on the following questions:

- What are respondents' views on the proposed coverage of the concurrent stress tests? Should medium-sized banks be included in the proposed framework?
- What are respondents' views on the merits of a stress-testing framework for other financial institutions, in particular central counterparties?
- What are respondents' views on the proposed approach to scenario design, especially on the extent to which the severity of shocks should vary through the cycle?
- What are respondents' views on the Bank's proposal to use a suite of models to assess the impact of scenarios on banks' capital ratios? How do respondents trade off the benefits of reduced reliance on a single model against the potential costs of the need to synthesise different model outputs?
- What are respondents' views on the necessary degree of granularity of stress-test disclosures to help strengthen the credibility of the stress-testing framework and facilitate accountability of the FPC and the PRA Board?
- From an operational perspective, the Bank is keen to ensure that the annual stress tests are conducted in a manner that reduces any unnecessary 'peak-load' problems for banks in scope. It would therefore welcome respondents' views on the proposed annual stress-testing cycle.

Box 7

Emerging plans for 2014

Building the Bank's stress-testing capability to deliver the framework outlined in this Discussion Paper will take a number of years. Relative to the proposed steady-state framework, the 2014 stress test is expected to focus on a smaller set of firms; incorporate a more limited assessment of system-wide amplification mechanisms; and be conducted over a longer time frame.

Coverage

The 2014 stress test will cover the eight major UK banks.⁽¹⁾ The stress-testing approach for other PRA-regulated firms will not be affected by the 2014 stress test.

Scenarios

The 2014 stress test will incorporate three scenarios: a common baseline; a common stress scenario; and an institution-specific stress scenario for each bank. The common scenarios will be designed by the FPC, in consultation with the PRA Board. The institution-specific scenarios will be designed by banks and approved by the PRA Board. The Bank expects the institution-specific stress scenarios to result in higher losses than the common stress scenario designed by the FPC.

The common scenarios will be published by 31 March 2014. Banks will need to broaden the common scenarios to cover a more comprehensive range of variables for which the Bank will not be providing a future path. Banks will need to finalise their bespoke scenarios with the Bank during April 2014.

Data

The overall exercise will be based on calendar year-end 2013 data. The majority of banks in scope for the 2014 exercise have already been engaged with the PRA for some time over the submission of detailed portfolio information. This is important for the PRA to be able to undertake its own detailed analysis. Banks are expected to adhere to the timetable for planned data submissions in order to facilitate the 2014 exercise. Where banks' data submission timetables start later than required for the 2014 exercise, or banks have not yet discussed the submission of detailed portfolio information, the PRA will be asking those banks to submit the required detailed portfolio information by 12 March 2014. The PRA may also request additional data to support the exercise. These data will also be required by 12 March 2014. To the extent that additional data are required, the PRA will publish templates and information requests by 31 December 2013.

Stress-test analysis

Banks will be expected to analyse the impact of the scenarios during 2014 Q2. The results of the analysis are expected to be

approved by each bank's Board before being submitted to the PRA by 30 June 2014. Results should be submitted both net and gross of management actions. Banks should only propose management actions that they would be prepared to enact.

In parallel, and through to 2014 Q3, Bank staff will perform their own analysis using some of the regulatory models described in Section 7. This includes running granular, regulatory models and sensitivity analysis to compare against banks' own results. Bank staff will also run coarser, system-wide models, which aim to capture feedbacks and interactions within the financial system in times of stress. And they will undertake peer analysis as well as comparisons of bank-level results with outputs of economy-wide models. Bank staff will synthesise the outputs of these models to arrive at a central view of firm profitability and capital ratios in each of the scenarios.

Banks should expect interactions with the PRA during this analysis phase to focus on questions around data accuracy and completeness as well as understanding of banks' key assumptions and judgements taken as part of their modelling approach.

FPC/PRA Board decisions and disclosure

The outcome of this analysis will be considered by the FPC and the PRA Board during 2014 Q4 and will be used to inform any remedial actions either at the system or individual-bank level. The precise form of disclosure of the 2014 exercise will be determined by the FPC and the PRA Board over the course of next year. It is anticipated that the results of the exercise will be communicated publicly by the end of 2014.

(1) As mentioned in the Executive Summary, the term 'bank' is used throughout this Discussion Paper to refer to banks, building societies and PRA-designated investment firms. The eight major UK banks are: Barclays Group, The Co-operative Bank plc, HSBC Holdings Group, Lloyds Banking Group, Nationwide Building Society, Royal Bank of Scotland Group, Santander UK plc and Standard Chartered Bank Group.

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