Perspectives on Macroprudential Policy and Stress Testing from the Bank of England

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Bank of England

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* The views expressed in this presentation are those of the presenters and not necessarily those of the Bank of England. Not for further distribution.
Outline

• Institutional arrangements in the UK: the Financial Policy Committee (FPC) and its powers

• Which macroprudential tools?

• Case study: operationalising the countercyclical capital buffer in the UK

• Stress testing: framework and modelling approach
Role of the Financial Policy Committee (FPC)

• FPC set up to take a macroprudential view

• Part of a wider change to the UK regulatory architecture
  – Microprudential regulator, the PRA, moved back inside BoE
  – New Financial Conduct Authority (FCA)

• Committee composition:
  – 4 Bank members (3 sit on MPC)
  – Heads of PRA and FCA
  – 4 external members
  – 1 HM Treasury (non-voting)
The FPC’s objective

• “remove or reduce systemic risks with a view to enhancing and protecting the resilience of the UK financial system”

• Systemic risks defined to include:
  – “structural features of financial markets, such as connections between financial institutions” and “distribution of risks within the financial sector”
  – “unsustainable levels of leverage, debt or credit growth”

• Growth considerations:
  – secondary objective to support the economic policy of the Government, including its objectives for growth and employment
  – cannot act “in a way that would in its opinion be likely to 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’s powers

Directions
- Binding instructions: strong statutory force
- Important when implementation is time-critical
- Only for specific, well-defined tools
- Better suited to “cyclical” instruments

Comply-or-Explain Recommendations
- Likely to be more one-off in nature
- Better suited for tackling structural, cross-sectional risks

General Recommendations
- Including to HM Treasury over:
  - regulatory perimeter
  - its own Direction powers

Microprudential regulators (PRA and FCA)
The FPC’s macroprudential tools

• Statutory Direction tools
  – Countercyclical capital buffer (CCB)
  – Sectoral capital requirements (SCRs)

• Future Direction tool (from 2018, subject to review in 2017)
  – Time-varying leverage ratio

• Future candidate Direction tools
  – Time-varying liquidity tool
  – Margining requirements

• LTV / LTI restrictions

• Recommendation powers deemed sufficient at present for other (largely structural) instruments
Motivation for macroprudential tools

Key references:

Cyclical and structural risks (Borio and Crockett, 2000)

Credit and GDP cycles in the UK (Aikman et al, 2010)

Network of large exposures between UK banks in 2006
# Tools organising framework

<table>
<thead>
<tr>
<th>Key Amplification Channels/Tools</th>
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<th>Cross-section risk: network risk, opacity, complexity</th>
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Disclosure requirements
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Countercyclical capital buffer (CCB)

- Part of Basel III framework

- Additional temporary capital buffer applied at an aggregate level
  - FPC sets CCB rate for UK lending
  - Reciprocity principle for overseas lending

(a) ‘Additional buffers’ refers to the capital conservation buffer, systemic risk buffers and any forward-looking guidance on capital levels by the microprudential regulators.
The importance of sectoral capital requirements

UK Commercial real estate boom

Intra-financial system lending in the UK

Sources: Bank of England, ONS and Bank calculations.

(a) Lending by UK-resident monetary financial institutions (MFIs) and specialist lenders to the private non-financial sector.
(b) Lending to private non-financial corporations. The breakdown of corporate lending into commercial real estate (CRE) and non-CRE sectors is not available before 1998. Before 1998, CRE lending is included under ‘Lending to corporates’. In addition, the CRE breakdown only captures MFI loans and reverse repos; the wider corporate lending series includes MFI holdings of debt securities in CRE companies.
(c) Based on the guidance variable for the Basel III countercyclical buffer. This trend is based on a one-sided Hodrick-Prescott filter with a smoothing parameter of 400,000. For a full description of the calculation, see BCBS (2010b).
Sectoral capital: examples of past use

Risk weights against loans to commercial real estate in India

- APRA also successfully tightened risk weights on low-doc mortgages in 2004
Sectoral capital requirements (SCRs)

- FPC sets *temporary* additional capital requirements on
  - Residential mortgages
  - Commercial property exposures
  - Exposures to other financial sector entities

- Could target risky sub-sectors
  - High-LTV mortgages
  - Financial sector: institutions (eg exposures to SPVs) or instruments (eg repos)

- Could apply to stock of existing loans or just new lending
The importance of leverage ratios (1)

End-2006 leverage ratios of major global banks and subsequent failure

End-2006 capital ratios of major global banks and subsequent failure

The importance of leverage ratios (2)

Variation in estimated probabilities of default on common hypothetical portfolios (BoE FSR, Dec. 2011)

Risk and leverage under different regimes

![Graph showing estimated mean probability of default (per cent) for different asset classes (Sovereign, Bank, Corporate) and RWA/Assets ratio for various banks.](image)
The importance of liquidity tools

Average maturity of selected debt securities issued by banks

US bank holdings of US Treasuries

Proportion of total assets, per cent

Macroprudential Strategy Division, Bank of England
Which liquidity tool?

Core funding ratio in New Zealand

End-2006 loan-to-deposit ratios of major global banks and subsequent failure (Aikman et al, 2013)
LTV / LTI restrictions

- Experience in other countries suggests may be effective in limiting financial instability
- Send a clear and strong public signal
- Require high level of public acceptability as directly affects amount which can be borrowed
- Sectoral capital requirements on high-LTV lending may partially substitute
- Warrant further analysis, reflection and public debate
Case study: operationalising the countercyclical capital buffer in the UK

Key references:


Policy process

Risk assessment process → FPC decisions → Coordination process → Implementation → Impact
Core indicators

• Concise indicator table for each tool for routine review
  – Internally: Starting point for analysis, consistency
  – Externally: Transparency, accountability, predictability

“The greater the degree of imbalance as measured by the core indicators, the more homogeneous the picture that the different indicators convey, and the more consistent that picture is with market and supervisory intelligence, the more likely it is that the FPC will adjust the CCB or SCRs in response.”

• Complementary to stress tests
• Key role for judgement
• Core indicators may also be used to gauge success
Approach to specifying indicators

• When might CCB be increased / reduced?
  – Complements to the credit-to-GDP gap

• Indicators need to be relatively timeless
  – But may be refined with experience, new data and research

• Simple and high-level: prompts for further analysis

• Evidence and case studies (Giese et al, 2013)

• Categories: (i) bank balance sheet stretch; (ii) non-bank balance sheet stretch; (iii) conditions and terms in markets
## CCB: Bank balance sheet stretch

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Average, 1987-2006</th>
<th>Average 2006</th>
<th>Max since 1987</th>
<th>Min since 1987</th>
<th>Previous value (oya)</th>
<th>Latest value</th>
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</thead>
<tbody>
<tr>
<td>Bank balance sheet stretch</td>
<td></td>
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<tr>
<td>1 Core Tier 1 capital ratio</td>
<td>6.6%</td>
<td>6.3%</td>
<td>11.0%</td>
<td>6.1%</td>
<td>10.3%</td>
<td>11.0% (2012)</td>
</tr>
<tr>
<td>2 Leverage ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>4.7%</td>
<td>4.1%</td>
<td>5.4%</td>
<td>2.9%</td>
<td>5.1%</td>
<td>5.2% (2012)</td>
</tr>
<tr>
<td>Basel III</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>4.0%</td>
<td>4.1% (Dec 2012)</td>
</tr>
<tr>
<td>3 Average risk weights</td>
<td>53.6%</td>
<td>46.2%</td>
<td>65.4%</td>
<td>35.7%</td>
<td>36.4%</td>
<td>36.4% (2012)</td>
</tr>
<tr>
<td>4 Return on assets before tax</td>
<td>1.0%</td>
<td>1.1%</td>
<td>1.5%</td>
<td>-0.2%</td>
<td>0.4%</td>
<td>0.4% (2012)</td>
</tr>
<tr>
<td>5 Loan-to-deposit ratio</td>
<td>114.0%</td>
<td>132.4%</td>
<td>133.4%</td>
<td>96.0%</td>
<td>109.0%</td>
<td>103.1% (2012)</td>
</tr>
<tr>
<td>Overseas concentration indicator: countries to which UK banks have ‘large’ and ‘rapidly growing’ total exposures.</td>
<td>In 2006 Q4: BR, CH, CN, ES, FR, IE, IN, LU, NL</td>
<td>In 2011 Q4: CN, NL</td>
<td>In 2012 Q4: CA, CH, DE, MX, MY, NL, SG</td>
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</tbody>
</table>
Sources: Published accounts, FSA supervisory data and Bank calculations.
Loan to deposit ratio

Norway 1987  Finland 1991
Japan 1992  Thailand 1996
Korea 1997  UK 2007
USA 2007  Ireland 2007
Spain 2008

Index: start of crisis = 100

Years from start of crisis

Sources: World Bank, published accounts and Bank calculations.
Market-based banking system indicators

Sources: Markit Group Limited, UBS Delta, Thomson Reuters Datastream, published accounts and Bank calculations.
CCB: Non-bank balance sheet stretch: Credit-related indicators

Sources: Bank of England, ONS and Bank calculations.
External national balance sheet
Current account deficit

Sources: IMF World Economic Outlook, October 2012 and Bank calculations.

(a) The years beside the country names give the dates of the first year of a banking crisis, based on Reinhart and Rogoff (2009).
## CCB: Conditions and terms in markets

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<tr>
<td>14 Long-term real interest rate</td>
<td>3.10%</td>
<td>1.27%</td>
<td>5.29%</td>
<td>-0.48%</td>
<td>0.08%</td>
<td>0.04% (Jun 2013)</td>
</tr>
<tr>
<td>15 VIX</td>
<td>19.1</td>
<td>12.8</td>
<td>65.4</td>
<td>10.6</td>
<td>23.1%</td>
<td>15.4 (Jun 2013)</td>
</tr>
<tr>
<td><strong>16 Global spreads</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Corporate bond spreads</td>
<td>115 bps</td>
<td>87 bps</td>
<td>486 bps</td>
<td>52 bps</td>
<td>182 bps</td>
<td>131 bps (Jun 2013)</td>
</tr>
<tr>
<td>Collateralised and securitised debt spreads</td>
<td>50 bps</td>
<td>46 bps</td>
<td>257 bps</td>
<td>15 bps</td>
<td>105 bps</td>
<td>71 bps (Jun 2013)</td>
</tr>
<tr>
<td><strong>17 Spreads on new UK lending</strong></td>
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<tr>
<td>Mortgage lending</td>
<td>82 bps</td>
<td>52 bps</td>
<td>352 bps</td>
<td>36 bps</td>
<td>331 bps</td>
<td>289 bps (April 2013)</td>
</tr>
<tr>
<td>Corporate lending</td>
<td>103 bps</td>
<td>99 bps</td>
<td>392 bps</td>
<td>89 bps</td>
<td>346 bps</td>
<td>308 bps (2013 Q1)</td>
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Formal analysis of indicators (Bush et al, in progress)

<table>
<thead>
<tr>
<th>Estimation method</th>
<th>Probit</th>
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<tbody>
<tr>
<td>Coef/se</td>
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<tr>
<td>Credit gap</td>
<td>2.43**</td>
</tr>
<tr>
<td>Change in credit gap</td>
<td>7.31**</td>
</tr>
<tr>
<td>Leverage</td>
<td>-0.64**</td>
</tr>
<tr>
<td>Change in leverage</td>
<td>-0.89*</td>
</tr>
<tr>
<td>VIX</td>
<td>-0.57***</td>
</tr>
<tr>
<td>Change in VIX</td>
<td>-0.23</td>
</tr>
<tr>
<td>Constant</td>
<td>3.86**</td>
</tr>
<tr>
<td>Number of observations</td>
<td>213</td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td>-16.36</td>
</tr>
</tbody>
</table>

Notes: all variables are third lags; *** p<0.01, ** p<0.05, * p<0.1
When to release buffers?

Policy Statement distinguishes three situations:

• Threats are judged to have receded (good outcome)

• Banks have sufficient capital given threats, so relaxing boosts credit conditions (and resilience?)

• Banks have insufficient capital, so relaxing CCB has little effect
Indicators in the current conjuncture (1)

Weak credit...

...and elevated spreads on new lending

Sources: Bank of England, ONS and Bank calculations.

Source: Bank of England, Council of Mortgage Lenders (CML), British Bankers’ Association, Bank of America Merrill Lynch, de Montfort University, Bloomberg and Bank calculations.
but weak profitability...

...and low investor confidence

at a time of heightened sovereign and banking sector risks in some euro-area countries, and with capital starting from a weak position
FPC recommendations on capital

• PRA should assess current capital adequacy using the Basel III definition of equity capital but after:
  – (i) making deductions to reflect an assessment of expected future losses and a realistic assessment of future costs of conduct redress;
  – (ii) adjusting for a more prudent calculation of risk weights.

• By end-2013, major UK banks should hold capital resources equivalent to at least 7% of RWAs, as assessed above.
  – Major UK banks aggregate shortfall currently around £25 billion

• Major UK banks should meet requirements by issuing new capital or restructuring balance sheets in a way that does not hinder lending to the economy.
  – Newly-issued capital, including contingent capital, must be capable of absorbing losses in going concern to enable banks to continue lending
Impact: transmission mechanism

CCB → Banks’ capital ratios → Resilience

Voluntary buffers → Regulatory arbitrage/leakages → Medium-to-long term level of GDP
Impact: transmission mechanism

CCB → Banks' capital ratios → Risk-weighted assets → Retained earnings/equity issuance → Expectations/confidence

Voluntary buffers → Regulatory arbitrage/leakages

Funding costs → Credit conditions/asset prices → Short term GDP growth

Resilience → Medium-to-long term level of GDP
Cross-border spillovers

• Large potential positive cross-border spillovers from enhancing resilience

• **Negative** spillovers also possible
  – host credit conditions affected if acting at group level
  – evidence points to large leakages if policy is uncoordinated: eg Aiyar et al (2012) find that 1/3 of the impact of higher capital requirements offset by foreign branches

• Need to balance coordination with avoiding inaction bias
Networks: ‘Tipping Points’ and ‘Super-spreaders’

• When will a disease spread through a population?

• Suppose everyone spreads the disease to 1 in 10 of their friends:
  – If everyone has exactly 9 friends, the disease will die out
  – But if everyone has exactly 11 friends, it will go viral
Networks: ‘Tipping Points’ and ‘Super-spreaders’

• In reality, some are better connected than others.
  – People with more friends spread the disease more widely.
  – But they are also more likely to catch it in the first place, since they have many friends to catch it from.

• So connectivity enters twice. A person with 10 friends is 10x10 = 100 times important in spreading the disease than someone with 1 friend.

• Highly connected ‘super-spreaders’ are key to the propagation of contagion.

• Policy response: target super-spreaders (eg vaccines, education programmes)
Why complex networks for finance?

• Examples highlight usefulness of approach:
  – Contagion
  – Nonlinearities and phase transitions (big effects from small shocks)
  – Seemingly Identical Shocks \(\rightarrow\) Different Outcomes
  – Heterogeneity – role of key players (fat tails)
  – Network externalities
  – Dynamics and Path Dependence

• All key dimensions of systemic risk
Epidemiology and finance

• Financial systems have particular features:
  – Balance sheets (more complex nodes)
  – Links which are directed and weighted
  – Possibility for risk sharing
  – Local dependence

• Behavioural responses key
  – But may be analogies to ‘hide’ (Memphis yellow fever outbreak, 1878) and ‘flight’ (SARS and self-quarantining)
Modelling financial networks: results and methods

• Different types of contagion: default contagion, fire sales, liquidity hoarding, confidence effects / behaviour

• Results (see Haldane and May, 2011, for overview)
  – financial networks robust-yet-fragile; very different effect from a priori indistinguishable shocks (Gai and Kapadia, 2010; Acemoglu et al, 2013)
  – ambiguous effects of greater connectivity / diversification (Nier et al, 2007; Gai and Kapadia, 2010; Battiston et al, 2011; Elliott et al, 2013)
  – role of diversity / integration (May and Arinaminpathy, 2010; Elliott et al, 2013)
  – network externalities (Gai et al, 2011; Acemoglu et al, 2013)
  – target super-spreaders (Gai et al, 2011; Arinaminpathy et al, 2012)
  – stress tests (Upper, 2010; BoE RAMSI model)
Open issues and challenges

• How should macroprudential policy handle uncertainty?
• How ‘activist’ should policy be?
• Rules versus discretion
• Macroprudential policy in a downturn: how to balance ‘resilience’ with ‘credit supply’?
• Coordination issues:
  – among different macroprudential tools
  – with the microprudential regime
  – with monetary policy
  – internationally
• Making mistakes without losing credibility
Stress testing
Outline

• Proposals for regular stress tests of the UK banking system

• System-wide stress testing at the Bank of England (RAMSI)
  – Basic description of the model
  – Amplifications and feedbacks in RAMSI
Outline

• Proposals for regular stress tests of the UK banking system

• System-wide stress testing at the Bank of England (RAMSI)
  – Basic description of the model
  – Amplifications and feedbacks in RAMSI
Background to new proposals

• 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’.

• *Discussion Paper* published on 1 October.
Objectives of the stress testing framework

• Provide a quantitative, forward-looking assessment of the resilience of the banking system as a whole and individual institutions within it.

• Serve needs of both FPC and PRA Board, contributing to:
  – Integrated decision-making process around bank capital adequacy;
  – An accountability device;
  – Strengthened supervisory approach;
  – Improved risk and capital management practices within banks;
  – Enhanced public confidence in the banking system.
Overview of the proposed framework

- Annual stress tests, run concurrently across banks in scope
- Cover major UK banks and significant UK subsidiaries of foreign G-SIBs
- Bring together analytical insights from across the Bank, including macroeconomists, financial stability experts and supervisors
- Inform macro- and micro-prudential policy interventions
- Disclosure to enhance accountability and credibility
Scenario design

• Explore range of scenarios in each stress test:
  
  o **Common stress scenarios**, designed by FPC.

  o **Bespoke stress scenarios**, designed by individual banks. Severity to at least match common stress scenarios.

  o **Common baseline**, designed by FPC and informed by MPC’s forecasts as communicated in the Bank’s Inflation Report.
Scenario design

• How might severity of stress scenarios vary through time?

• **Option 1**: Apply broadly constant shocks over time, eg:
  - Unemployment always rises by $X_{pp}$, irrespective of current level
  - House prices always fall by $Y\%$, irrespective of current level

  Abstracts from state of the cycle. But might result in a framework that requires more capital in a downturn (risks adding to pro-cyclicality).

• **Option 2**: Change severity of shocks over time, eg:
  - Unemployment rises to a given level in the stress
  - House prices always fall by $Y\%$ relative to long-run trend

  Acts counter-cyclically. But requires policymakers to make judgements about state of the cycle. And might not be sufficiently severe in a downturn.
Modelling approaches

• Suite of models:
  – Granular, regulatory stress-testing models
    • Capture detail of business models; deliver consistency in outcomes
  – Coarser, system-wide, stress-testing models
    • Capture system-wide amplification mechanisms; allow more flexibility
  – Banks’ own stress-testing models
    • Even greater degree of granularity; but incentives not aligned
  – Other ‘satellite’ models
    • Sector-wide view to act as a cross-check of bank-specific results
Hurdle rates

• Reaching a judgement around capital adequacy requires a view on level of capital that regulators want banks to maintain in stress

• Relevant considerations in determining hurdle rates:
  – Internationally-set minimum requirements
  – Ability to maintain access to funding and continue lending in a stress
  – Uncertainty

• Capital adequacy to be judged against both risk-based capital and leverage metrics
Use of stress tests to inform macro-prudential policy

• FPC Direction tools expected to be guided, at least in part, by a set of core indicators

• Stress tests can provide additional information:
  – Tool for calibrating the amount of capital system needs to withstand shocks of concern to FPC and run ‘what if’ experiments
  – Quantify rising system vulnerability due to: feedbacks / amplification mechanisms; ‘risking up’ of the banking system (eg looser loan underwriting standards, etc)
  – Explore system-wide concentrations in segments of credit markets (eg Commercial Real Estate)

• Potentially inform policy interventions beyond bank capital
October 2013
A framework for stress testing the UK banking system
A Discussion Paper

http://www.bankofengland.co.uk/financialstability/fsc/Documents/discussionpaper1013.pdf
Outline

• Proposals for regular stress tests of the UK banking system

• System-wide stress testing at the Bank of England (RAMSI)
  – Basic description of the model
  – Amplifications and feedbacks in RAMSI
RAMSI: Overview

• Model designed to assess the solvency and liquidity risks faced by the UK banking system.

• Forecasts banks’ income statements and balance sheets, using:
  – Reduced-form econometric equations
  – Simple behavioural rules / heuristics

• Tractable model that facilitates mapping of outcomes to macro-financial drivers, allowing economically-intuitive explanations for changes in the model’s projections.
Sequencing of events in RAMSI

Bank A
- Income statement and balance sheet
- Income statement forecast
- Capital ratio = (Retained earnings + capital (last period)) / Risk-weighted assets (last period)
- Feedback within a bank and contagion across banks
- Reinvestment rules: capital and balance sheet size

Bank B
- Income statement and balance sheet
- Income statement forecast
- Capital ratio = (Retained earnings + capital (last period)) / Risk-weighted assets (last period)
- Feedback within a bank and contagion across banks
- Reinvestment rules: capital and balance sheet size

Macrofinancial forecasts
Key model inputs: macro-financial risk drivers

• 26 domestic and foreign macro-financial variables used to articulate a scenario in RAMSI

• For stress testing purposes, typically impose paths for each of these (potentially informed by macro models, market prices, etc)

• RAMSI also has a BVAR module that can be used to generate distributions of macro profiles.
Key model inputs: balance sheets

- Balance sheets include approximately 400 asset and 250 liability classes
- Primarily constructed from published accounts – plus some interpolation
- Currently focus on major UK banks

<table>
<thead>
<tr>
<th>Balance sheet dataset dimensions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets/Liabilities</td>
<td>650</td>
</tr>
<tr>
<td>Maturity buckets</td>
<td>5</td>
</tr>
<tr>
<td>Repricing buckets</td>
<td>5</td>
</tr>
<tr>
<td>Annual data entries per bank</td>
<td>6,500</td>
</tr>
</tbody>
</table>
Projections of income statement items

• Credit risk
  o Exposures split by region (UK, US, EA, RoW) and sector (corporate, mortgages, credit cards, other unsecured)
  o For each type of exposure, RAMSI models economy-wide probabilities of default and write-off rates. These are then translated to bank-specific write-off rates.

• Net interest income
  o Shape of risk-free yield curve
  o (Endogenous) spread charged to reflect perceived riskiness of borrowers
  o (Exogenous or endogenous) spread on banks’ own funding costs.

• Trading and other income and expenses
Reinvestment of retained earnings

**Income components:**
- Net interest income
- Non-interest income
- Trading, insurance, fees
- Credit losses
- Operating expenses
  
  **Profit before tax**

**Capital ratio:**

\[
\text{Capital ratio:} \quad \frac{\text{Retained earnings} + \text{existing capital}}{\text{Risk-weighted assets}}
\]

**Negative retained earnings:**
Capital falls, balance sheet in run-off

**Positive retained earnings AND actual capital ratio below target ratio:**
Retained earnings used to build capital, bank buys assets with zero risk-weight

**Positive retained earnings AND actual capital ratio above target ratio:**
Bank returns to target ratio by instantaneously expanding assets, in proportion to initial asset split
Feedback mechanisms

• Interbank exposures network

• Access to funding markets

• Contagion via defensive actions
  o Liquidity hoarding;
  o Asset fire sales.
Interbank exposures network

• Banks suffer interbank losses when counterparties fail, and may themselves default as a result.

• Network also includes smaller UK banks, foreign banks and other LCFIs. These cannot generate contagion but can transmit it.

• Interbank asset-liability matrix based on regulatory large exposures data.
Access to funding markets

- Funding market closure in RAMSI is an endogenous response to perceived solvency risks

- Simple scoring approach
  - Allocate points according to the proximity of metrics to calibrated thresholds

- Two thresholds where unsecured funding markets close: long-term first, then short-term

- ‘Funding default’ occurs when both have shut

![Diagram showing the relationship between funding costs increasing, interbank spread, and closure of funding markets.](attachment:diagram.png)
Access to funding markets

• Outputs from the rest of the model are mapped into indicators of funding stress related to three areas

• Feedback occurs through confidence channel
Access to funding markets

<table>
<thead>
<tr>
<th>Factor</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected future Tier 1 ratio (solvency)</td>
<td>30</td>
</tr>
<tr>
<td>Short-term wholesale maturity mismatch (liquidity)</td>
<td>60</td>
</tr>
<tr>
<td>Market funds reliance (liquidity)</td>
<td>40</td>
</tr>
<tr>
<td>Past profitability – unanticipated shock as a % of assets (confidence)</td>
<td>60</td>
</tr>
<tr>
<td>Similarity to troubled bank (confidence)</td>
<td>50</td>
</tr>
<tr>
<td>Market interbank spread (bps) (confidence)</td>
<td>40</td>
</tr>
<tr>
<td>Equity market fall (confidence)</td>
<td>30</td>
</tr>
<tr>
<td>GDP past (confidence)</td>
<td>20</td>
</tr>
</tbody>
</table>

Financial markets

- Retail deposits gradually flow out
- Long-term unsecured markets close
- Short-term unsecured markets close
What happens when banks are shut out of funding markets?

- **Upper threshold**: ‘funding default’

- **Lower threshold**: defensive actions

  - Banks may refinance expiring long-term funding with short-term funding, but this increases their score on the ‘short-term wholesale maturity mismatch’ score.

  - Two other possible defensive actions that have spill-over effects
Contagion via defensive actions

- **Fire sales**: banks in distress liquidate available for sale assets
  - Selling pressure *temporarily* pushes down asset prices
  - Other banks temporarily incur mark-to-market losses, but these may in some circumstances be sufficient to trigger failure (possibly through a funding liquidity spiral)
  - The marginal price impact on asset $j$ is increasing in the volume of the fire-sale

- **Liquidity hoarding**: banks may roll over maturing wholesale assets only at short-term maturities (i.e. <3m). This improves that bank’s short-term wholesale maturity mismatch, but worsens other banks’
Application: using RAMSI for the UK’s IMF FSAP

- IMF FSAP run using both top-down and bottom-up models
- Included three scenarios and baseline – severe double-dip shown here

**UK real GDP growth**

**Non-financial asset prices**

![Graph showing UK real GDP growth and non-financial asset prices over the years 2007 to 2015, with indicators for stress and baseline scenarios, and indices for residential and commercial property prices.]
Application: using RAMSI for the UK’s IMF FSAP

- Significant reduction in core tier 1 ratios in stress relative to baseline...
- ...with a similar impact in the bottom-up stress tests
Open issues and challenges

- Moving towards a general-equilibrium approach to stress testing:
  o Intra-banking system feedbacks
  o Interactions between banking system and non-banks
  o Interactions between banking system and the real economy?

- How to ensure sufficient imagination in scenario design?

- How granular should regulatory models aim to be to underpin credibility?

- How much weight to place on banks’ own model outputs?

- Appropriate disclosure of stress test results?
Reserve slides
The UK’s new framework for financial regulation

- Financial Policy Committee
- Prudential supervision returns to the Bank of England

Bank of England
Protecting and enhancing the stability of the UK financial system

Financial Policy Committee (FPC)
Charged with taking action to reduce or remove systemic risks

Prudential Regulation Authority (PRA)
Prudential regulation of banks, insurers and complex firms

Financial Conduct Authority (FCA)
Protecting and enhancing confidence in financial services and markets, including by protecting consumers
Terms and conditions of transactions in financial markets

High LTV and LTI mortgages as a proportion of new mortgages

- LTI > 3.5 and LTV > 80%
- LTI > 4 and LTV > 90%

Secured lending margins and prices of MBS rated AAA at issuance

- Estimated average margin (left-hand scale)
- Average margin (left-hand scale)
- Price (right-hand scale)
Chart 14: Nominal credit growth before and after major banking crises\(^{(a)}\)

Sources: IMF International Financial Statistics, ONS and Bank calculations.

\(^{(a)}\) The years beside the country names give the dates of the first year of a banking crisis, based on Reinhart and Rogoff (2009).

\(^{(b)}\) For the UK definition of credit please see Chart 15.
External national balance sheet

Sources: ONS and Bank calculations.
Chart 20: Long-term real interest rate\(^{(a)}\)

Sources: Bloomberg and Bank calculations.

\(^{(a)}\) 5 year real interest rates 5 years forward, derived from the Bank's index-linked government liabilities curve.
Chart 21: VIX\(^{(a)}\)

Sources: Bloomberg and Bank calculations.

(a) One-month moving average. The VIX is a measure of market expectations of 30-day volatility as conveyed by S&P 500 stock index options prices.
Chart 22: Global debt spreads\(^{(a)}\)

Sources: Bank of America Merrill Lynch, Bloomberg and Bank calculations.

(a) Option adjusted spreads, which are the number of basis points the matched-maturity government spot curve is shifted in order to match a bond's present value of discounted cash flows. One-month moving averages.

(b) Global corporate debt spreads refers to the global broad market industrial spread. This tracks the performance of non-financial, investment grade corporate debt publicly issued in the major domestic and eurobond markets. Index constituents are capitalisation-weighted based on their current amount outstanding.

(c) Global securitised and collateralised debt spreads refers to the global broad market collateralized spread. This tracks the performance of investment grade securitised and collateralised debt issued in major currencies, including mortgage backed, asset backed, commercial mortgage backed, covered bond, Pfandbrief and US mortgage pass-through securities publicly issued in the major domestic and eurobond markets.
Sectoral credit growth...

Sources: ONS, Bank of England, published accounts and Bank calculations.
...and indebtedness

Sources: ONS, Bank of England, Bank of Finland, Bank of Japan, Bank of Korea, Economic and Social Research Institute (Japan), OECD, the Riksbank, Statistics Finland and Bank calculations.
Chart 25: Household debt-to-income ratios around major crises\(^{(a)}\)

Sources: ONS, OECD, Bank of Korea, the Riksbank, Bank of Finland, Statistics Finland, Bank of Japan, Economic and Social Research Institute (Japan) and Bank of England calculations.

(a) The ratio of the stock of household debt to household income. The definition of debt and income varies slightly from country to country, depending on data availability. The years beside the country names give the dates of the first year of a banking crisis, based on Reinhart and Rogoff (2009).
SCR: Conditions and terms in markets

Sources: ONS, Nationwide, Halifax, Investment Property Databank (IPD), CML, FSA Product Sales Database and Bank calculations.
Chart 28: House price-to-rent ratios around major crises (a)

Source: OECD Economic Outlook database, ONS, Nationwide, Halifax and Bank calculations.

(a) The years beside the country names give the dates of the first year of a banking crisis, based on Reinhart and Rogoff (2009).
## CCB: Market-based banking system indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Average, 1987-2006</th>
<th>Average 2006</th>
<th>Max since 1987</th>
<th>Min since 1987</th>
<th>Latest value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7 Bank debt measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDS premia</td>
<td>12 bps</td>
<td>8 bps</td>
<td>298 bps</td>
<td>6 bps</td>
<td>168 bps (Nov 2012)</td>
</tr>
<tr>
<td>Subordinated spreads</td>
<td>29 bps</td>
<td>10 bps</td>
<td>967 bps</td>
<td>4 bps</td>
<td>354 bps (Nov 2012)</td>
</tr>
<tr>
<td><strong>8 Bank equity measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price-to-book ratio</td>
<td>2.14</td>
<td>1.97</td>
<td>2.83</td>
<td>0.52</td>
<td>0.76 (Nov 2012)</td>
</tr>
<tr>
<td>Market-based leverage ratio</td>
<td>9.6%</td>
<td>7.8%</td>
<td>14.8%</td>
<td>1.9%</td>
<td>3.9% (Nov 2012)</td>
</tr>
</tbody>
</table>
## SCR: Bank balance sheet stretch

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Average, 1987-2006</th>
<th>Average 2006</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Bank balance sheet stretch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1 Core Tier 1 capital ratio</strong></td>
<td>6.6%</td>
<td>6.3%</td>
<td>10.8%</td>
<td>6.1%</td>
<td>10.8% (2012 H1)</td>
</tr>
<tr>
<td><strong>2 Leverage ratio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>4.7%</td>
<td>4.1%</td>
<td>5.4%</td>
<td>2.9%</td>
<td>5.1% (2011)</td>
</tr>
<tr>
<td>Basel III</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>4.2% (Oct 2012)</td>
</tr>
<tr>
<td><strong>3 Average mortgage risk weights</strong></td>
<td>n.a.</td>
<td>n.a.</td>
<td>22.5%</td>
<td>18.9%</td>
<td>22.5% (2012 H1)</td>
</tr>
<tr>
<td><strong>4 Balance sheet interconnectedness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intra-financial lending growth</td>
<td>13.9%</td>
<td>12.9%</td>
<td>78.7%</td>
<td>-15.0%</td>
<td>11.5% (2012 H1)</td>
</tr>
<tr>
<td>Intra-financial borrowing growth</td>
<td>14.6%</td>
<td>14.0%</td>
<td>37.3%</td>
<td>-18.4%</td>
<td>-4.9% (2012 H1)</td>
</tr>
<tr>
<td>Derivatives growth (notional)</td>
<td>37.7%</td>
<td>34.2%</td>
<td>67.5%</td>
<td>-18.0%</td>
<td>-5.3% (2011)</td>
</tr>
</tbody>
</table>
## CCB: Non-bank balance sheet stretch

<table>
<thead>
<tr>
<th></th>
<th>Average, 1987-2006</th>
<th>Average 2006</th>
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<tbody>
<tr>
<td>Non-bank balance sheet stretch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>9 Credit-to-GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>131.8%</td>
<td>179.1%</td>
<td>198.4%</td>
<td>93.8%</td>
<td>183.7% (2012 Q2)</td>
</tr>
<tr>
<td>Gap</td>
<td>4.2%</td>
<td>13.0%</td>
<td>21.4%</td>
<td>-16.3%</td>
<td>-13.3% (2012 Q2)</td>
</tr>
<tr>
<td><strong>10 Private non-financial sector credit growth</strong></td>
<td>10.8%</td>
<td>10.1%</td>
<td>25.6%</td>
<td>-4.7%</td>
<td>0.4% (2012 Q2)</td>
</tr>
<tr>
<td><strong>11 Net foreign asset position to GDP</strong></td>
<td>-4.7%</td>
<td>-26.4%</td>
<td>21.6%</td>
<td>-28.8%</td>
<td>-22.5% (2012 Q2)</td>
</tr>
<tr>
<td><strong>12 Gross external liabilities to GDP</strong></td>
<td>245.2%</td>
<td>419.6%</td>
<td>513.2%</td>
<td>146.1%</td>
<td>494.8% (2012 Q2)</td>
</tr>
<tr>
<td>of which debt to GDP</td>
<td>205.5%</td>
<td>351.0%</td>
<td>441.2%</td>
<td>130.8%</td>
<td>416.0% (2012 Q2)</td>
</tr>
<tr>
<td>of which bank debt to GDP</td>
<td>134.6%</td>
<td>210.6%</td>
<td>285.8%</td>
<td>90.5%</td>
<td>235.4% (2012 Q2)</td>
</tr>
<tr>
<td><strong>13 Current account balance to GDP</strong></td>
<td>-2.0%</td>
<td>-2.9%</td>
<td>0.6%</td>
<td>-5.4%</td>
<td>-5.4% (2012 Q2)</td>
</tr>
</tbody>
</table>
## SCR: Non-bank balance sheet stretch

<table>
<thead>
<tr>
<th></th>
<th>Average, 1987-2006</th>
<th>Average 2006</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-bank balance sheet stretch</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6 Credit growth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household</td>
<td>10.1%</td>
<td>11.6%</td>
<td>19.9%</td>
<td>0.0%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Commercial real estate</td>
<td>15.3%</td>
<td>18.4%</td>
<td>59.8%</td>
<td>-9.7%</td>
<td>-4.8%</td>
</tr>
<tr>
<td><strong>7 Household debt to income ratio</strong></td>
<td>115.1%</td>
<td>160.6%</td>
<td>172.1%</td>
<td>88.0%</td>
<td>144.9%</td>
</tr>
<tr>
<td><strong>8 PNFC debt to profit ratio</strong></td>
<td>285.4%</td>
<td>391.3%</td>
<td>498.6%</td>
<td>189.2%</td>
<td>456.1%</td>
</tr>
<tr>
<td><strong>9 NBFI debt to GDP ratio (excluding insurance companies and pension funds)</strong></td>
<td>64.2%</td>
<td>144.1%</td>
<td>186.5%</td>
<td>15.8%</td>
<td>176.0%</td>
</tr>
<tr>
<td>of which short-term</td>
<td>49.7%</td>
<td>98.6%</td>
<td>125.8%</td>
<td>14.2%</td>
<td>113.3%</td>
</tr>
</tbody>
</table>

(2012 Q2)
## SCR: Conditions and terms in markets

<table>
<thead>
<tr>
<th>Conditions and terms in markets</th>
<th>Average, 1987-2006</th>
<th>Average 2006</th>
<th>Max since 1987</th>
<th>Min since 1987</th>
<th>Latest value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10 Real estate price to rent indices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>100.0</td>
<td>151.0</td>
<td>161.3</td>
<td>66.6</td>
<td>120.6 (2012 Q3)</td>
</tr>
<tr>
<td>Commercial</td>
<td>100.0</td>
<td>128.1</td>
<td>131.6</td>
<td>77.7</td>
<td>92.2 (2012 Q3)</td>
</tr>
<tr>
<td><strong>11 Residential mortgage terms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loan to value ratio</td>
<td>n.a.</td>
<td>89.4%</td>
<td>89.7%</td>
<td>80.4%</td>
<td>82.9% (2012 Q2)</td>
</tr>
<tr>
<td>Loan to income ratio</td>
<td>n.a.</td>
<td>3.9</td>
<td>4.2</td>
<td>3.7</td>
<td>4.0 (2012 Q2)</td>
</tr>
<tr>
<td><strong>12 Spreads on new lending</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortgage lending</td>
<td>81 bps</td>
<td>56 bps</td>
<td>368 bps</td>
<td>42 bps</td>
<td>351 bps (Oct 2012)</td>
</tr>
<tr>
<td>Corporate lending</td>
<td>103 bps</td>
<td>98 bps</td>
<td>389 bps</td>
<td>93 bps</td>
<td>332 bps (2012 Q3)</td>
</tr>
</tbody>
</table>
Implementing FPC decisions

• FPC decisions published in Record
• Countercyclical capital buffer (CCB)
  – 12 months to meet an increase in CCB rate (unless exceptional circumstances)
  – Reduction in CCB rate applies immediately
  – Mandatory distribution restrictions when operating within buffer
  – Firms disclose institution-specific CCB rate
• Sectoral capital requirements (SCRs)
  – Implementation by regulators as soon as reasonably practical
  – PRA communicate separately on implementation approach
  – FPC may Recommend, but not Direct, timetable or method