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Stress testing the UK banking system: key elements of the 2017 stress test

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Executive summary

The 2017 stress test includes two stress scenarios. Alongside the annual cyclical scenario, the Bank is, for the first time, running an additional exploratory scenario. This represents an important step towards achieving the Bank's vision for stress testing, which it set out in 2015.

The annual cyclical scenario incorporates a severe and synchronised UK and global macroeconomic and financial market stress, as well as an independent stress of misconduct costs. The sizes of the shocks to different sectors and economies are adjusted each year to deliver a similar stressed outcome unless the assessment of vulnerabilities warrants a change to that outcome.

The stressed outcome for UK activity and unemployment is the same as in the 2016 annual cyclical scenario. For the global economy, the stressed outcome is worse than in 2016, largely reflecting continued rapid growth of credit in China.

As highlighted in recent *Financial Stability Reports*, the United Kingdom's large current account deficit creates a vulnerability to a reduction in foreign investor appetite for UK assets and increases in funding costs for real-economy borrowers. The 2017 cyclical scenario incorporates a sudden increase in the rate of return investors demand for holding sterling assets and an associated fall in sterling.

The scenario incorporates a rise in Bank Rate, differentiating it from the 2016 exercise, in which Bank Rate was cut to zero. This reflects a challenging trade-off between growth and inflation in the scenario. The higher path for Bank Rate is not designed to change the overall severity of the stress. In aggregate, banks are likely to see higher impairments but also higher interest income. This aspect complements the exploratory scenario, in which interest rates persist at very low levels. Together the two scenarios will allow the impact on banks of both rising and persistently low Bank Rate to be assessed.

The results of the annual cyclical scenario are used to ensure that the banking system as a whole, and individual banks within it, have sufficient capital to absorb losses and maintain the supply of credit to the real economy, even in a severe stress.

The benchmarks — or hurdle rates — above which banks will be expected to maintain their capital positions in the 2017 cyclical scenario have been set on the same basis as in the 2016 test. All participating banks will be expected to meet their minimum CET1 capital requirements, which averaged 6.5% in 2016. Globally systemic banks will be held to a higher standard. Failure to meet these standards in the stress will generally result in banks being required to take action to improve their positions, if they have not already done so.

The aim of the Bank's 2017 exploratory scenario is to consider how the UK banking system might evolve if recent headwinds to bank profitability persist or intensify. It incorporates weak global growth, persistently low interest rates, stagnant world trade and cross-border banking activity, increased competitive pressure on large banks from smaller banks and non-banks, and a continuation of costs related to misconduct. The test will have a seven-year horizon to capture these long-term trends.

The exploratory scenario is not focused on bank capital adequacy. It will focus not on whether, but how, banks would meet regulatory requirements and build sustainable business models in such an environment. Its purpose is to explore the impact of banks' actions on both the real economy and the future resilience of the system to shocks.

Background

The Bank of England's (hereafter 'the Bank') concurrent stress-testing framework is designed to examine the potential impact of hypothetical adverse scenarios on the health of the banking system and individual institutions within it.(1)(2)

In 2017, the Bank's stress test will include two stress scenarios; an annual cyclical scenario (ACS) and a biennial exploratory scenario (BES).

The seven banks and building societies (hereafter 'banks') taking part in both the 2017 ACS and BES exercises account for around 80% of the outstanding stock of Prudential Regulation Authority (PRA)-regulated banks' lending to the UK real economy.(3) These banks have a diverse range of business models and some operate in a broad range of international markets.

The Bank's 2017 stress-test scenarios and guidance have been designed and calibrated by Bank staff, under the guidance of the Financial Policy Committee (FPC) and Prudential Regulation Committee (PRC).

Annexes 1–3 on pages 10–23 provide more detail on the 2017 baseline scenario, ACS and BES. More background on the Bank's approach to stress testing, detailed guidance for stress-test participants, along with the projections data underlying the 2017 ACS, BES and baseline scenario can be found on the Bank of England website.(4)

2017 annual cyclical scenario (ACS)

In common with the 2016 exercise, the ACS contains three types of stress, which are assumed to be synchronised:

- A macroeconomic stress scenario, spanning a five-year period to the end of 2021.
- A traded risk stress scenario, which is consistent with the content and calibration of the macroeconomic stress scenario.
- A misconduct costs stress, which is in addition to the macroeconomic and traded risk stress scenarios.

The stress applied under the ACS is not a forecast. Rather, it is a coherent 'tail-risk' scenario designed to be severe and broad enough to assess the resilience of UK banks to adverse shocks.

The annual cyclical scenario incorporates a severe and synchronised UK and global macroeconomic and financial market stress, as well as an independent stress of misconduct costs. The sizes of the shocks to different sectors and economies are adjusted each year to deliver a similar stressed outcome. However, where imbalances in credit and financial markets have increased (decreased), the stressed outcome may be more (less) severe. And where there are likely spillovers between sectors and economies, these are taken into account.

Adjusting the stress scenario in this systematic way should mean that the impact of the stress on banks' capital and leverage ratios grows in an upswing. This makes the ACS useful for the FPC in assessing the appropriate setting for the UK countercyclical capital buffer (CCyB) rate.

An important macroprudential goal of the ACS is to help assess whether the banking system is sufficiently well capitalised to maintain the supply of credit in the face of adverse shocks. To that end, banks in the ACS are expected to meet the projected demand for credit from UK households and businesses in the stress. Over the five years of the 2017 ACS lending to UK households and businesses is projected to grow by 2%.

Vulnerability assessment and calibration

The calibration of global elements of the 2017 ACS reflects the judgement of the FPC and PRC that global vulnerabilities are elevated and have increased somewhat over the past year. A significant factor driving the assessment of increased vulnerability is the continuation of rapid Chinese credit growth. The stressed outcome for Chinese and global GDP is therefore more severe than in the 2016 ACS.

Underlying domestic vulnerabilities are judged to be broadly unchanged overall. So the stressed outcomes for UK activity and unemployment are the same as in the 2016 ACS.

These judgements mean that:

- **The peak-to-trough fall in global GDP is -2.4% in the 2017 ACS, larger than the -1.9% in the 2016 exercise.**
- **UK GDP falls by 4.7%, as compared to 4.3% in the 2016 ACS. But the stressed outturn for unemployment is the same as in the 2016 exercise at 9.5%.**

Changes in individual asset prices have fed through to the size of shocks in the test.

The shocks to asset prices incorporated in the stress relative to the 2016 ACS largely depend on how these prices have moved over the past year.

(1) Unless otherwise stated, references to the Bank of England throughout this document include the Prudential Regulation Authority.
(2) For more details on the purpose and use of bank stress tests see Dent, K, Westwood, B and Segoviano, M (2016), 'Stress testing of banks: an introduction', *Bank of England Quarterly Bulletin*; www.bankofengland.co.uk/publications/Documents/quarterlybulletin/2016/q3/a1.pdf.
(3) The seven participating banks and building societies are: Barclays, HSBC, Lloyds Banking Group, Nationwide Building Society, The Royal Bank of Scotland Group, Santander UK and Standard Chartered.
(4) These are available at www.bankofengland.co.uk/financialstability/Pages/fpc/stresstest.aspx.

For example, in practice this means that:

- **The shocks applied to US corporate bond spreads are larger because spreads narrowed during 2016. For example, high-yield spreads rise by 1,150 basis points in the 2017 ACS, 100 basis points more than in the 2016 ACS.**

- **The UK residential property price fall is slightly larger in the 2017 ACS than in the 2016 ACS (-33% vs -31%), reflecting the fact that house prices increased faster than household incomes over 2016.**

- **The fall in UK commercial real estate prices in the 2017 ACS is smaller than in the 2016 ACS (-40% vs -42%) reflecting the fall in UK CRE prices relative to nominal GDP during 2016.**

- **The fall in Hong Kong CRE prices is smaller in the 2017 ACS (-56% vs -60% in the 2016 ACS), reflecting a fall in prices during 2016.**

The paths for sterling and UK interest rates differ from the 2016 scenario.

As the FPC has highlighted in recent *Financial Stability Reports*, the United Kingdom's large current account deficit creates a vulnerability to a reduction in foreign investor appetite for UK assets and sharp increases in funding costs for real-economy borrowers.(1) **The 2017 ACS incorporates a sudden increase in the return investors demand for holding sterling assets and an associated fall in sterling. The sterling exchange rate index falls by 27% from its 2016 Q4 level. The sterling/US dollar exchange rate troughs at 0.85 US dollars per pound sterling.**

Bank Rate peaks at 4% in the 2017 ACS, differentiating it from the 2016 exercise, in which Bank Rate was cut to zero. This reflects a challenging trade-off between growth and inflation in the scenario. The higher path for Bank Rate is not designed to change the overall severity of the stress. In aggregate, banks are likely to see higher impairments but also higher interest income. The risk tolerance of the FPC and PRC has not changed.

The rising path for Bank Rate in the 2017 ACS complements the exploratory scenario, in which interest rates persist at very low levels. Together, the two scenarios will allow the impact on banks of both rising and persistently low Bank Rate to be assessed.

There remains a very high degree of uncertainty around any approach to quantifying misconduct cost risks facing UK banks. For the 2017 ACS, the Bank is employing the same methodology as that applied in the 2016 stress test. That means the ACS will incorporate stressed projections for potential misconduct fines and other costs beyond those paid or provided for by the end of 2016. These should relate to known misconduct issues, such as mis-selling of payment protection insurance and misconduct in wholesale markets. Banks are asked to provide stressed projections for misconduct costs which have a low likelihood of being exceeded.

Hurdle rate

The ACS helps examine whether a bank has sufficient capital resources. A key determinant of whether a bank may be required to take action in light of the ACS results is where its capital ratio falls to in the stress, relative to the level of capital that banks are expected to maintain — otherwise known as the hurdle rate. The hurdle rate framework for the 2017 ACS is the same as in 2016.

Under the Bank's stress-test hurdle rate framework, each bank will be expected to meet its minimum risk-based common equity Tier 1 (CET1) capital requirements in the stress scenario. These are comprised of both the internationally agreed minimum ('Pillar 1') and any uplift to that minimum capital requirement set by the PRA (so-called 'Pillar 2A'). As Pillar 2A varies across banks, there is no common CET1 risk-weighted hurdle rate. In the 2016 test, the average CET1 capital hurdle rate across participating banks was 6.5%. It ranged between 8.1% and 6.1%.

Each bank will also be expected to meet a minimum Tier 1 leverage ratio threshold, a maximum of 25% of which may be comprised of additional Tier 1 capital (AT1). For the 2016 ACS, the Tier 1 leverage ratio threshold was set at 3%. In July 2016, the FPC decided to exclude central bank reserves from the leverage ratio exposure measure to ensure that it did not impede monetary policy or UK banks' usage of liquidity facilities. The FPC intends at its next meeting to adjust the UK leverage ratio framework to offset the loosening effect of excluding central bank reserves from the exposure measure. This will ensure that the exclusion of central bank reserves does not mechanically lead to a reduction in the nominal amount of capital needed to meet the UK leverage ratio standard. The leverage ratio threshold and definition used in the 2017 stress test will reflect the adjustment agreed.(2)

The Bank will also judge the results for systemically important banks against a 'systemic reference point'. Barclays, HSBC, RBS and Standard Chartered have been designated as global systemically important banks (G-SIBs), with associated risk-weighted G-SIB capital buffers being phased in between 2016 and 2019 that will eventually range between 1% and 2% of risk-weighted assets, to be met with CET1 capital. Each of these banks will also have an additional

(1) For example, see the Bank's November 2016 *Financial Stability Report*; www.bankofengland.co.uk/publications/Pages/fsr/default.aspx.
(2) For more details see 'Stress testing the UK banking system: 2017 guidance for participating banks and building societies'; www.bankofengland.co.uk/financialstability/Pages/fpc/stresstest.aspx.

leverage buffer to reflect their systemic importance, set at 35% of their corresponding risk-weighted capital buffer, to be met with Tier 1 capital. As in 2016, the Bank will use the sum of the hurdle rate and these G-SIB buffers as they are phased in as an additional systemic reference point against which to assess the impact of the stress scenario on global systemically important banks. In practice, G-SIB capital buffers are able to be drawn on by banks to absorb the impact of a stress. Their inclusion in the systemic reference point acts to reduce the probability that a systemically important bank would be unable to absorb a real stress given that its failure would have a higher impact.

Banks participating in the stress test will be judged against their hurdle rates and, where relevant, systemic reference points based on their capital positions before the conversion of contingent capital instruments such as additional Tier 1 (AT1). This reflects the PRC's policy that capital buffers should be held in CET1 capital, and banks should exceed both their hurdle rates and systemic reference points at the low point of the stress.

The systemic risk buffer (SRB) will be applied to ring-fenced banks and building societies by the PRA, effective from 2019.(1) Its application will have implications for the amount of capital stress-test participants need at group level, if they are subject to the SRB. Banks are still finalising their ring-fence plans, so the precise amounts of capital needed are unknown. But the PRC will take the future implications of the SRB into account when using the 2017 stress test to inform its assessment of the adequacy of banks' capital plans for 2019 and beyond. The Bank intends to take more precise account of the implications of the SRB for group capital in the 2018 stress-test hurdle rate framework.

Policy responses

Banks that fall below their hurdle and, where relevant, systemic reference point, will generally be required to take action to strengthen their capital positions, if they have not already done so.

If a bank's capital ratio was projected to remain above both its hurdle rate, and where relevant, its systemic reference point, the PRA may still require it to take action to strengthen its capital position. Examples of factors the PRA might take into consideration in deciding whether action is needed include, but are not limited to: the bank's Tier 1 and total capital ratios under stress; the extent to which the bank had used up its capital conservation buffer in the stress; and the adequacy and quality of its recovery and resolution plans.

The stress-test results, and other relevant information, are used by the FPC and the PRA to co-ordinate their policy responses to ensure that the banking system as a whole, and individual banks within it, maintain sufficient capital to absorb losses and continue the supply of credit to the real economy even in a stress. They can do so by adjusting a range of regulatory capital buffers, including the system-wide UK countercyclical capital buffer (CCyB) rate, sectoral capital requirements and the bank-specific PRA buffer.

When the FPC sets the UK CCyB rate it takes into account both the results of the ACS and its assessment of prevailing conditions. For example, the 2016 test implied a setting for the system-wide UK CCyB rate in the region of 1%. However, in July 2016, the FPC cut the UK CCyB rate to 0%. It also issued guidance that it would maintain the rate at 0% until at least June 2017, absent any material change in the outlook. The cut was a response to greater uncertainty around the UK economic outlook and an increased possibility that material domestic risks could crystallise in the near term. The FPC's action served to ensure banks did not hoard capital and restrict lending in those conditions. At its next meeting, the FPC will assess whether to return the UK CCyB rate to a more neutral level, consistent with its stated approach to setting the UK CCyB rate in a standard risk environment.

The FPC expects to take the same approach when it considers the results of the 2017 stress test. For example, if, at the time the test is finalised, the environment is judged to be one of heightened risk aversion or in which risks are actually materialising, the FPC will again aim off the test results in its setting of the UK countercyclical buffer rate.

After the FPC has set the UK CCyB rate, the PRA considers the capital adequacy of each individual bank. In making these judgements, the PRA considers all available information, including the results of the ACS. In doing so it takes account of the level of the system-wide UK CCyB rate implied by the results of the test, and where applicable, how that differs from the UK CCyB rate the FPC has decided to set. It does so to avoid introducing a system-wide buffer of capital that overlaps with the role of the UK CCyB.

The PRA also considers any steps banks have taken to strengthen their capital positions since the end of 2016 as well as banks' risk management and governance capabilities.(2) If the exercise reveals a bank's capital position needs to be strengthened further, the PRA will consider the case for adjusting a bank's PRA buffer.

Publication of results

The results of the 2017 ACS will be published in 2017 Q4. The Bank is committed to disclosing the information necessary to explain the results of the ACS, which will entail disclosing at

(1) For more details see www.bankofengland.co.uk/financialstability/Documents/fpc/srbf_cp.pdf. For further explanation of the implications of the SRB at banking group level see also www.bankofengland.co.uk/pra/Pages/publications/ss/2017/ss3115update.aspx.
(2) This is in line with the approach to Pillar 2B set out in the Pillar 2 policy statement. For more details see www.bankofengland.co.uk/pra/Pages/publications/sop/2017/p2methodologiesupdate.aspx.

least as much bank-specific information about the headline impact of the stress on capital adequacy as it did in the 2016 stress-test results publication.

2017 biennial exploratory scenario (BES)

The Bank's first exploratory scenario is designed to **examine banks' strategic responses to a structurally more challenging operating environment.** The macroeconomic scenario incorporated is not a forecast.

Prevailing headwinds and calibration

UK banks have experienced a decline in profitability since the financial crisis. The major UK banks' aggregate return on equity was around zero in 2016, well below recent estimates of banks' cost of equity. UK banks' aggregate return on assets has followed a similar trend. Some of this trend is explained by issues such as misconduct costs and one-off charges like restructuring costs. However, underlying profitability has also declined recently.

Banks are currently expecting a recovery in profitability in the medium term as existing headwinds begin to abate. The exploratory scenario is calibrated to assume that **rather than abating, these headwinds to profitability persist or intensify.** In this environment banks' profitability would be permanently lower unless they were to make changes to their business models.

The 2017 exploratory scenario is not a test of banks' capital positions. It will focus not on whether, but how, banks would meet regulatory requirements and build sustainable business models in the face of these headwinds.

Banks could make changes in response to the scenario that have significant implications for the financial system and macroeconomy over the medium term, including the system's resilience to future shocks. The BES will help the FPC and PRC to understand and anticipate any potential changes in the financial system should the drivers of low profitability persist.

The headwinds incorporated in the scenario reflect developments in the macroeconomy and banking system over recent years. In the BES they continue or intensify.

Global trade has been weak and stagnates in the scenario.

Global trade volumes are around 30% below the level implied by a continuation of their pre-crisis trend. This has been accompanied by a reversal of financial globalisation. In the scenario, **global trade stagnates** and the ratio of world trade to GDP falls to its lowest level since 2003.

The slowdown in productivity growth continues in the scenario, driven by weak trade.

Productivity growth in advanced economies has slowed since the financial crisis. In the scenario, **lower trade harms productivity growth**. Slower productivity growth halves long-term global GDP growth to 1.9%. Permanently lower growth means returns to capital and interest rates remain at very low levels. **The slowdown in productivity growth in emerging markets is more pronounced** in the scenario given their greater vulnerability to slowing trade. Average annual productivity growth in China falls from 5.8% in the baseline to 3.5% in the scenario.

Cross-border banking activity continues to fall in the scenario.

There has been a reduction in cross-border banking since the financial crisis. In the scenario, **cross-border banking activity continues to fall**, consistent with weak global growth and trade prospects. Demand for direct cross-border lending to foreign counterparties remains depressed, while weak trade weighs on the demand for trade finance.

Interest rates have been declining for decades and remain very low in the scenario.

Long-term real interest rates have been declining for several decades, most probably driven by structural shifts in global saving and investment preferences.(1) **In the United Kingdom, Bank Rate is cut to zero** during the first year and stays there for the remainder of the scenario. Long-term interest rates also remain very low; ten-year UK gilt yields are 1.25% by the end of the ten-year horizon.

Recent competition pressures intensify in the scenario.

Competition in the financial sector has created additional challenges for major banks. While much of this has been driven by the larger banks themselves, smaller UK banks have had significant influence on pricing and dynamics in UK retail lending markets. Recent advances in financial technology increase the probability that competitive pressures will persist. In the scenario, **competitive pressures intensify**, resulting in a fall of round 40% in the spread between market retail deposit and lending rates relative to current levels.

Expectations of participants

Some of the factors driving weak profitability in the scenario are likely to play out over a longer term than banks' current planning horizons. So, unlike the ACS which spans a five-year period, the 2017 exploratory scenario has been calibrated for ten years. It begins in 2017 Q1 and extends through to 2026 Q4. Banks are requested to submit results for the first seven years of the scenario. The final three years are provided to help banks produce their results.

(1) For a more detailed explanation of long-term decline in interest rates see Section 1 of the November 2016 *Inflation Report*; www.bankofengland.co.uk/publications/Documents/inflationreport/2016/nov.pdf.

In order to reinforce the competitive pressures incorporated in the scenario, the Bank has specified paths for loan and deposit volumes and average prices in selected markets. Banks are expected to take these into account when forming their projections. This aspect of the test is explained in further detail in Box 2 on pages 22–23.

As in the cyclical scenario, banks will face **stressed misconduct costs** in the exploratory scenario. Banks will also be expected to incorporate increased costs into their projections, relative to the baseline, for systems and business processes in relation to managing cyber risk and preventing misconduct, as well as for overall IT investment.

The Bank expects banks to aim for their overall return on equity to **meet or exceed their estimates of their cost of equity.** It also expects banks' cost of equity to vary according to their riskiness. Further details on how banks should formulate those projections are contained in the 2017 guidance for participating banks and building societies.(1)

Banks will be expected to submit projections in which they meet both their minimum capital requirements and their regulatory buffers by the end of the seven-year test period.

Policy responses

The purpose of the exploratory scenario is to explore strategic changes that large banks might make to their business models in the future, if headwinds to profitability persist. This includes examining their decision-making capabilities and their ability to look ahead and consider a structurally more challenging environment. For this reason, banks are unconstrained in the range of management actions they are permitted to propose in this scenario.

The exercise will allow the FPC and PRC to examine the impact of the decisions banks take, including for the UK financial system and how financial services could be provided to the real economy in the future. The results of the BES will therefore be used by policymakers to understand and anticipate potential future developments in the financial system.

Publication of results

Given the focus of the BES is to examine structural challenges in the market and banks' responses to them, the Bank's analysis will consider the impact of these challenges on the sector. To that end, the results publication will disclose aggregate results, including coverage of the economic impact of any strategic decisions banks make, and analysis on the implications for the future resilience of the banking sector. The Bank does not intend to publish individual bank results under the BES, based on considerations around the possible commercial sensitivity of the projections banks will provide.

(1) See guidance for stress-test participants available at www.bankofengland.co.uk/financialstability/Pages/fpc/stresstest.aspx.

Box 1
The respective roles of the cyclical and exploratory scenarios

Consistent with the Bank's approach to stress testing set out in October 2015, the 2017 stress test for the first time includes two scenarios. This box describes how the 2017 ACS and BES will provide complementary information to the FPC and PRC to inform their respective risk assessments and policy responses.

The ACS is designed to help the FPC and PRC co-ordinate their policy responses to ensure that the banking system as a whole, and individual banks within it, have sufficient capital to absorb losses and maintain the supply of credit to the real economy even in a severe stress. The results of this scenario will help inform the setting of the UK CCyB rate by the FPC, as well as any additional individual bank capital buffers set by the PRA.

Under the ACS framework, the stress being tested against will generally be severe and broad. As such, it is likely to generate significant losses for banks on their banking books and their trading books. The size of the shocks in the ACS varies systematically with FPC and PRC assessments about the vulnerabilities facing UK banks.

The BES is designed to **probe the resilience of the system to risks that may not be neatly linked to the financial cycle**. This scenario will not be used to change the Bank's risk tolerance, but will aim to explore risks that are not captured by the ACS. The results of the BES will add to the information set that the FPC has when considering the setting of its macroprudential policy tools. And the results could help to inform PRC judgements around individual bank capital adequacy.

The 2017 BES will examine the potential implications should recent headwinds to bank profitability persist or intensify. These include persistently low interest rates and an increased competitive pressure on banks. The 2017 BES is not focused on capital adequacy. It will focus not on whether, but how, banks would meet regulatory requirements and build sustainable business models in such an environment. Its purpose is to explore the impact of their actions on the real economy and the future resilience of the system to shocks.

Comparing the 2017 stress scenarios

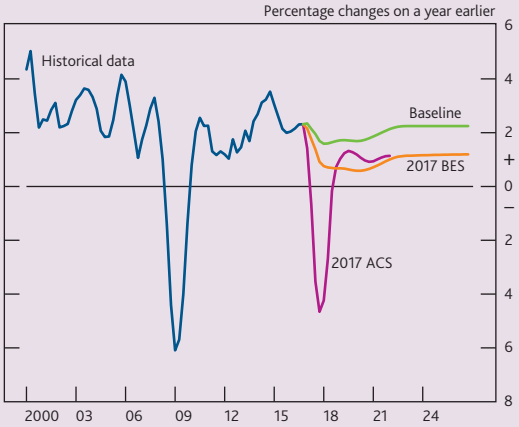
Reflecting the differences in their design and focus, the 2017 ACS and BES will provide complementary information to the FPC and PRC in a number of important ways:

- Together, the 2017 ACS and BES, combined with the 2016 ACS, will provide a rich information set about the potential impacts on major UK banks of both materially higher and persistently low paths for Bank Rate.

- The 2017 BES incorporates a stress which is less concentrated in the early years of the test than the ACS (**Chart A**). In contrast the persistence of headwinds is the main source of severity in the 2017 BES. This means that the ACS is likely to provide more information on the resilience of banks' existing books, while the BES will provide more information on the risks to banks over a longer horizon.

- The focus of the ACS is capital adequacy. The range of strategic decisions banks are permitted to model are constrained in order to help ensure that they are capitalised to maintain the supply of credit in a stress. In contrast, the emphasis of the exploratory scenario will be on banks' strategic reactions and the risks to their execution. Reflecting this, the Bank expects to learn more about banks' reaction functions, strategic decision-making capabilities and processes from the BES. As a result, greater focus will be placed on how the firms have arrived at their decisions. This will be covered in the qualitative review of banks' BES submissions that will be published as part of the results in 2017 Q4.

Chart A UK GDP growth in the ACS and BES[a]



Sources: ONS and Bank calculations.

(a) Annual growth is defined as quarterly GDP relative to the same quarter in the previous year.

Annex 1: 2017 baseline macroeconomic scenario

This annex provides a more detailed description of the Bank's 2017 baseline scenario.

In addition to the stress scenario, the 2017 ACS and BES will assess projections of banks' capital ratios and profitability under a baseline macroeconomic scenario. The baseline scenario will be the same for both the ACS and the BES.

In the ACS the banks will be assessed over a five-year horizon, similar to previous years. This has been extended to seven years for the BES. In order to inform banks' decision-making processes, particularly in the latter part of the BES, the Bank has calibrated a ten-year scenario and baseline.

As in the 2016 stress test, the paths for UK macroeconomic variables in the baseline scenario have been developed by Bank staff and, over the first three years, are broadly consistent with the central projections published in the February 2017 *Inflation Report*. Further out, many of these UK macroeconomic variables grow broadly in line with their average rates over the past fifteen years. Similarly, the international macroeconomic variables are largely consistent with the IMF's October 2016 *World Economic Outlook* (*WEO*) projections. The remainder of this section provides a short summary of the key features of the baseline scenario. Selected features of this baseline are summarised in **Table A1**.

In the United Kingdom, real GDP growth falls to 1.6% in 2018 (compared to 2.2% in 2016) before rising again to 2.0% in 2021 and then to 2.2% for the final five years of the scenario. The near-term outlook for UK growth is slightly lower than in the baseline of the 2016 stress test.

Table A1 Summary of macroeconomic variables in the ten-year baseline scenario

Per cent

	Average over ten-year baseline
Annual UK GDP growth	2.0
Annual global GDP growth[a]	3.7
Annual euro-area GDP growth	1.5
Annual US GDP growth	1.8
Annual Chinese GDP growth	5.9
UK unemployment rate	4.7

Source: Bank calculations.

(a) Purchasing power parity weighted.

The UK unemployment rate increases slightly to 5.0% between the second half of 2017 and 2019 before falling back to 4.5% by the end of the scenario. Inflation increases sharply in 2017 and peaks at 2.7% in 2018 before falling back to the 2% target by 2022. CRE prices continue to fall throughout 2017 and most of 2018 before returning to growth. UK residential property prices continue to rise throughout the baseline scenario.

World GDP has grown at an average rate of around 3.5% a year since its 2009 trough.(1) Having slowed slightly in 2015 and 2016, world GDP growth is projected to rise from 2017 onwards in the baseline, averaging 3.7% in the first five years of the scenario (**Table A1**). This is marginally weaker than the Bank's 2016 stress-test baseline. World growth remains at around 3.7% for the second half of the scenario.

In the United States, growth peaks at 2.5% in 2017 before weakening. It falls to 1.6% by 2021 and remains around there for the rest of the scenario. Euro-area growth peaks at 1.6% in 2018 before stabilising at around 1.5% from 2021 onwards. In China, annual GDP growth averages 5.8% across the scenario.

(1) World GDP is weighted by purchasing power parity.

Annex 2: 2017 annual cyclical scenario

This annex provides a more detailed description of the Bank's 2017 annual cyclical scenario. The annex starts by describing the vulnerability assessment of the FPC and PRC which has informed the calibration of the 2017 ACS before setting out details of the scenario.

Vulnerability assessment

Global vulnerabilities have risen.

The calibration of the global aspects of the 2017 ACS reflects the judgement of the FPC and PRC that global vulnerabilities associated with the level of imbalances in credit markets, asset prices and other economic risks are elevated and have increased since 2016 Q1, when the 2016 ACS was launched. As a result, the stressed outcome for the global economy is more severe than in 2016 (**Table A2**).

One significant factor behind the FPC and PRC's assessment that global vulnerabilities have risen is the continuation of rapid Chinese credit growth. Strong property price growth in China has been associated with an increase in household indebtedness. China has seen a further widening in credit gap measures (**Chart A1**), and signs of increasing overvaluation in a number of sectors.

The stock of indebtedness in Hong Kong remains very high, but in 2016, residential property prices rose only modestly and CRE prices fell. This drop in CRE prices is reflected in a smaller fall in Hong Kong CRE prices than in the 2016 ACS.

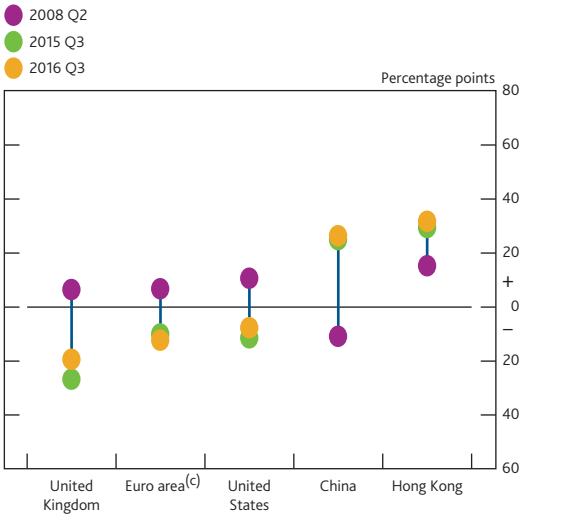
Globally, the risk of a snapback in long-term interest rates persists. These rates remain low in part because of compressed term premia. New York Federal Reserve estimates of term premia on ten-year US government bonds remain close to zero — well below their historical average. A range of asset valuations, including real estate associated with global equities and corporate bonds, would be vulnerable to a rapid rise in term premia, particularly if this was not accompanied by an improvement in growth prospects.

The level of vulnerabilities in the United States and euro area are judged to be around standard. Though it remains relatively subdued, euro-area credit growth has picked up. Real estate prices have also started to rise again but in most euro-area countries, valuations do not appear stretched. Most measures indicate that US credit risk is relatively contained in aggregate, although there are pockets of risk in some areas of the corporate credit and CRE markets.

The domestic risk environment remains around standard.

Overall, domestic vulnerabilities are broadly unchanged. The stressed outcome for UK unemployment is therefore the same as in the 2016 ACS at 9.5%.

Chart A1 Deviation of credit to GDP ratio from long-term trend[(a)(b)]



Sources: BIS total credit statistics and Bank calculations.

(a) Raw data have been adjusted for breaks.
(b) Credit to GDP gaps use a one-sided HP filter with a (BIS-consistent) smoothing parameter of 400,000. Credit by all creditors to domestic private non-financial sector.
(c) Euro-area data take a GDP-weighted average of Member States' credit gaps.

While the level of UK household indebtedness remains high by historical standards, the cost of servicing that debt remains low. Since 2016 Q1, household credit has risen faster than incomes, with consumer credit growing rapidly, but secured lending growth was subdued. On the corporate side, CRE lending terms have tightened slightly.

Since 2016 Q1, UK residential property prices have risen faster than household incomes, and so the shock to UK house prices is a little greater. In contrast CRE prices declined over that period, so the shock to CRE prices is a little smaller than in the 2016 ACS.

High-level description of the 2017 annual cyclical scenario

The stress applied under the ACS is not a forecast. Rather, it is a coherent 'tail-risk' scenario designed to be severe and broad enough to assess the resilience of UK banks to adverse shocks.

The following high-level scenario narrative is intended to help explain the stresses explored in the 2017 ACS. A more detailed description is provided on pages 12–15.

The global stress

Vulnerabilities across financial markets and the global economy crystallise. The stress scenario incorporates a synchronised global downturn in output growth. Relative to the baseline scenario, growth in China, Hong Kong and Singapore is particularly adversely affected.

Investors' risk appetite diminishes and financial market participants attempt to de-risk their portfolios, generating modest safe-haven capital flows and substantial increases in risk premia in financial and property markets. There is

Table A2 Developments since the launch of the 2016 ACS and impact on the calibration of the 2017 ACS

Variable	Developments since 2016 Q1	Stress 2017	Stress 2016
		Per cent start-to-trough fall, unless otherwise stated	
Global activity			
World GDP	Global vulnerabilities have risen, credit growth has continued to pick up	-2.4	-1.9
Chinese GDP	Rapid Chinese credit growth has continued	-1.2	-0.5
Global financial markets			
US equities	Estimates of equity risk premia have fallen, overall US vulnerability level up	-46	-42
US high-yield corporate bond spreads	Spreads have narrowed	1,150 (basis point rise)	1,050 (basis point rise)
Domestic asset prices			
UK residential property prices	Risen relative to household income	-33	-31
UK CRE prices	Fallen relative to CRE rents and nominal GDP	-40	-42
Domestic activity			
UK GDP	Domestic vulnerabilities broadly unchanged. Unemployment has fallen.	-4.7	-4.3
UK unemployment rate	Domestic vulnerabilities broadly unchanged. Unemployment has fallen.	4.7 (percentage point rise)	4.5 (percentage point rise)

volatility in financial markets with emerging market currencies depreciating against the US dollar. The prices of other assets, including property, fall sharply. Falls in Chinese and Hong Kong property prices are particularly pronounced.

Interest rates facing households and businesses increase in the early part of the stress, partly reflecting increases in bank funding costs. Although policymakers pursue additional monetary stimulus, which starts to reduce market interest rates, the overall cost of credit rises in the short term.

The domestic stress

Alongside the crystallisation of vulnerabilities in the global economy, which also impacts the United Kingdom, there is a UK-specific risk premium shock, which is associated with a large depreciation of sterling. Monetary policy responds, as higher import prices feed through to inflation and inflation expectations rise. Long-term gilt yields also rise as a consequence. Related to these rises in interest rates, banks face material increases in their wholesale and retail funding costs.

A sharp fall in UK residential property prices is particularly concentrated in regions which have recently experienced more rapid price increases. Likewise a fall in UK CRE prices is concentrated in the prime sector of the market, where — 2016 aside — prices have risen robustly since the financial crisis.

The combined impact of increases in the cost of credit, the contraction in world demand, falls in asset prices and heightened uncertainty have a pronounced impact on domestic growth and unemployment. UK productivity growth remains weak, limiting the recovery in UK activity through the latter part of the stress horizon.

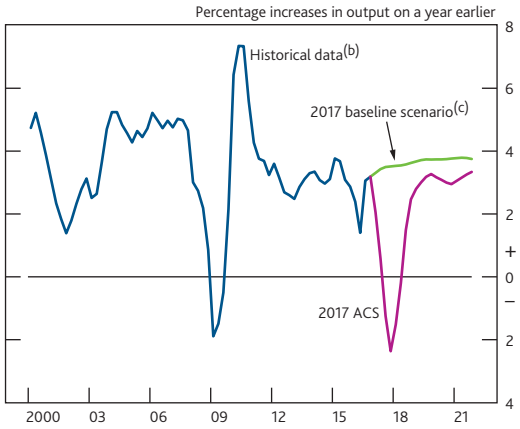
Detailed description of the 2017 annual cyclical scenario

This section describes some of the important aspects of the 2017 ACS macroeconomic stress in more detail. It includes description of some aspects of the scenario not included in the set of published stressed macroeconomic variable paths. In part, this is intended to help guide stress-test participants in generating their own stressed projections for those aspects. As in the 2016 stress test, the 2017 ACS scenario spans a five-year period. It begins in 2017 Q1 and extends through to 2021 Q4.

The global stress

Global output contracts by 2.4% over the first year of the stress scenario as economies around the world experience severe and synchronised slowdowns (**Chart A2**). The trough in global GDP growth is lower than following the financial crisis. The magnitude of this contraction is a little larger than that experienced during the 2008 financial crisis, although the mix of shocks is different, with the Chinese economy, for example, experiencing a larger downturn. Subsequently, growth resumes, averaging around 3.1% per annum over the final three years of the stress, but the level of output remains persistently below baseline.

Chart A2 Annual growth in world real GDP in the ACS[a]



Sources: IMF *International Financial Statistics*, IMF *World Economic Outlook* (*WEO*) October 2016 and Bank calculations.

(a) Annual growth is defined as quarterly GDP relative to the same quarter in the previous year.
(b) Historical data until 2016 Q2 are non seasonally adjusted annual growth rates. The 2016 Q3 and Q4 historical data points are estimated from interpolated annual data.
(c) The baseline projection is consistent with the IMF's projections in the IMF *WEO* October 2016. Bank staff have interpolated the original series from annual to quarterly.

Euro-area GDP contracts by 3.6% in 2017, with moderate growth resuming in 2018. Headline euro-area inflation turns negative in 2017 reflecting weaker demand and lower commodity prices, and does not rise above zero until 2018 H2. Meanwhile, core inflation remains weak throughout the scenario. Aggregate unemployment climbs to over 13% by the end of 2017, before receding to just under 12% by 2021.

Residential property prices fall by 17% across the euro area, while **CRE prices** fall by 27% in the stress. French CRE prices fall by more than that euro-area average, reflecting signs of overvaluation relative to other euro-area economies. Aggregate euro-area property prices recover modestly over the final years of the stress.

The European Central Bank is assumed to pursue significant further monetary stimulus under the stress scenario, putting downward pressure on long-term market interest rates.

US GDP contracts by 3.5% during the first year of the stress scenario while unemployment peaks at just over 9% in 2018. Thereafter, modest output growth resumes and unemployment falls back.

On a peak-to-trough basis, US house prices decrease by around 21% in the stress, while CRE prices fall by 33%. Residential property prices recover somewhat over the final years of the stress horizon ending 13% lower than in 2016 Q4, while CRE prices finish around 23% down.

Overall **US corporate profitability** falls and the cost of corporate credit rises. Highly leveraged corporates and those involved in the oil and gas extraction industry are among those most severely affected, given the weakness of commodity prices in the stress.

Ten-year US government bond yields rise initially as term premia increase, peaking at 3.5%. But as the US Federal Reserve injects monetary stimulus by making further large-scale asset purchases, ten-year government bonds fall back to 2.4% by the end of the stress horizon, only a little higher than their level at the start of the stress.

China's GDP growth falls from just under 7% a year at the end of 2016 to -1.2% by the end of 2017. Thereafter, it recovers gradually, averaging around 5% over the final three years of the stress. This contraction in output is accompanied by a fall in residential property prices of around 45%. Prices recover around a third of that fall by the end of 2021.

The slowdown in Chinese economic activity is associated with a weakening in household income growth. Nominal Chinese household income growth slows from 7.8% in 2016, to an average of 2.8% over the first two years of the stress. It is assumed that the Chinese authorities support China's banking sector throughout the stress, as well as providing additional stimulus to economic activity but that stimulus takes time to boost output.

Hong Kong's output, which has been more volatile than China's over recent decades, contracts by almost 8% over the first year of the stress scenario. Residential property prices and CRE prices are assumed to fall by 50% and 56% respectively from peak to trough (**Chart A3**). These falls are accompanied by a widening of the Hibor-USD Libor spread, as the currency peg to the US dollar comes under pressure, although it is assumed that the currency peg holds in the stress.

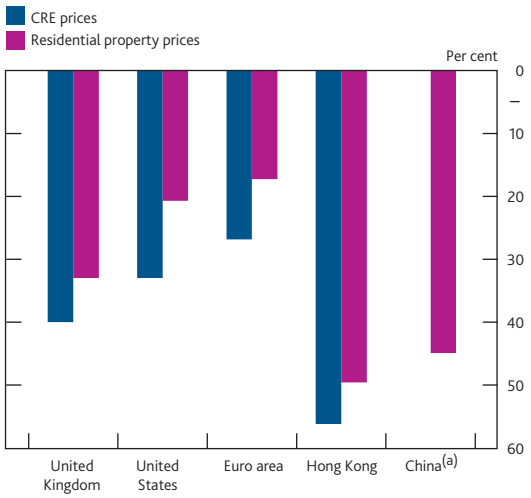
Hibor peaks at around 5% at the start of the stress before falling back to around 1.9% by the end of 2019. Average Hong Kong bank funding costs follow a similar profile to three-month Hibor in the stress.

Economic activity slows similarly in **Singapore** and **India** as part of a broad-based downturn in growth across Asia. Singaporean GDP contracts by 7.2% and Indian GDP slows from 7.2% in 2016 to an annual rate of 2.2% in the first year of the scenario. Actions by authorities support economic recovery from 2018 onwards.

Commodity prices fall in response to the weak global demand conditions. Oil prices fall from US$50 per barrel at the end of 2016 to US$24 per barrel in the stress, and remain around this level until 2019, before rising back to around US$45 per barrel by the end of the five-year scenario horizon. Other commodity prices also fall and remain weak throughout the scenario.

Falling commodity prices particularly affect economic activity in South Africa. South African GDP contracts by 3.8% over

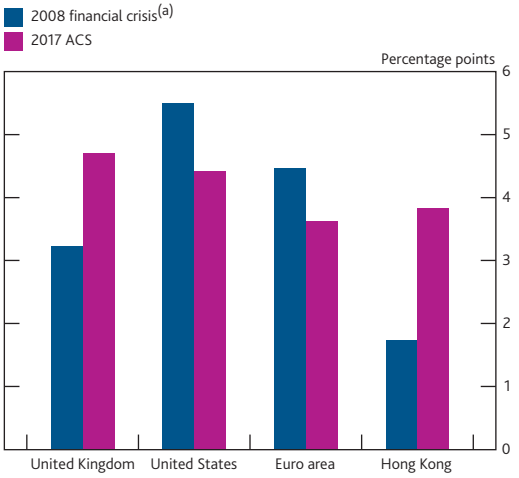
Chart A3 Peak-to-trough fall in commercial real estate and residential property prices in the 2017 ACS



Source: Bank calculations.

(a) Due to a lack of reliable historical data, the Bank does not publish a projection for Chinese CRE prices.

Chart A4 Peak rise in unemployment in the 2017 ACS compared to the 2008 financial crisis



Sources: OECD Employment and Labour Market Statistics Database, ONS, Thomson Reuters Datastream and Bank calculations.

(a) Calculated as the difference between the minimum unemployment rate 2006–07 and the maximum rate 2008–12.

2017. The South African rand depreciates by 15% against the US dollar, and this particularly affects companies that have dollar-denominated debt, and are not fully hedged financially or do not match their liabilities with dollar assets or revenues.

Financial market participants' perceptions of risk increase, and their risk appetite diminishes. Risk premia rise in a number of markets. Investment-grade US corporate bond spreads increase from around 135 basis points in 2016 Q4 to 515 basis points by 2017 Q4, while high-yield US corporate bond spreads rise from around 465 basis points to around 1,615 basis points over the same period. Liquidity conditions deteriorate and liquidity risk premia rise across a number of financial markets.

Term premia on long-term government debt rise over the first year of the stress before falling back. For example term premia on ten-year US government debt rise by over 200 basis points.

The US dollar appreciates as some capital is withdrawn from emerging market economies. The US dollar appreciates by 11% against the Chinese renminbi. The dollar also appreciates by more than 10% against EMEs.

Measures of market volatility also rise, with the VIX index averaging 38 during 2017 in the stress. That compares to a quarterly average of around 40 between 2008 H2 and 2009 H1, during the financial crisis.

The domestic stress

UK output contracts by 4.7% over the first year of the scenario. Reflecting that fall in output, unemployment rises by 4.7 percentage points to peak at 9.5% — a greater rise than that observed following the 2008 financial crisis (**Chart A4**). Although growth returns and unemployment falls back, the level of output remains persistently below the baseline path. That reflects a weakening of potential supply through the course of the stress.

There is a UK-specific risk premium shock, which is associated with a large depreciation of sterling. The sterling exchange rate index (ERI) falls by 27%, with sterling depreciating by 32% against the US dollar. The exchange rate troughs around the end of 2017.

UK inflation rises to 5% by the end of 2018, pushed up by higher import prices and elevated inflation expectations. Monetary Policy Committee (MPC) action to tighten policy helps to bring inflation back to target in the final two years of the scenario. Nominal household income and corporate profits contract by around 2.4% and 6.8%, respectively, over the first year of the scenario.

Bank Rate is assumed to rise to 4% by the end of 2017. After inflation starts falling back towards target over the final two years of the stress, the MPC then reduce Bank Rate, which reaches around 3% by the end of 2021.

Longer-term interest rates are pushed up by an increase in term premia, as well as a higher expected path for Bank Rate. The ten-year gilt yield peaks at 6.9% in 2018 Q1, before falling back over the final three years of the scenario.

Banks' wholesale funding spreads also rise materially. For example, five-year senior unsecured bond yields rise by more than 2 percentage points relative to five-year OIS rates over the first year of the stress, before falling back. The rise in banks' wholesale funding costs spills over to retail funding costs.

As the economy weakens, and interest rates rise, property prices fall. A withdrawal of buy-to-let investors exacerbates the sharp fall in UK residential property prices, which decrease by 33% from peak to trough on an aggregate basis — a 40% fall in real terms (that is, accounting for the rise in UK inflation). Falls are more pronounced in areas of the United Kingdom in which house prices have risen most over recent years and appear most elevated. Similarly, a pull back by overseas investors contributes to the pronounced fall in CRE prices in the scenario. In aggregate, UK CRE prices fall by 40% from peak to trough, though the fall is greater in the prime CRE sector, where prices remain close to their pre-financial crisis peak.

UK lending in the stress

An important macroprudential goal of stress testing is to help the FPC assess whether the banking system is sufficiently well capitalised to support the real economy in the face of severe adverse shocks.

To that end, and in line with the approach taken for the Bank's 2016 ACS, the Bank has calibrated its 2017 ACS on the assumption that banks satisfy the demand for credit from the UK real economy throughout the stress scenario. That is, banks are assumed not to reduce the supply of credit, although rises in bank funding costs are passed through to borrowers.

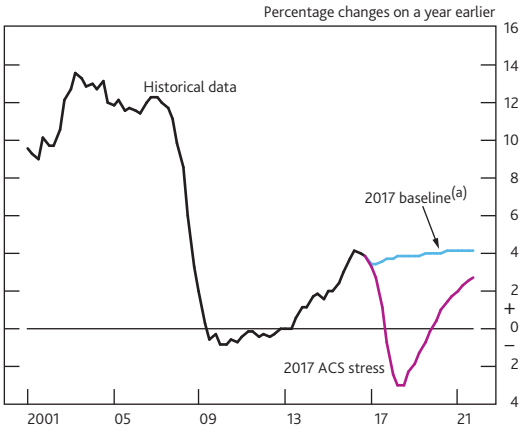
The Bank has published paths for aggregate lending to UK households and private non-financial corporations (PNFCs) based on that assumption. Stress-test participants will be expected to submit projections for lending under the stress which are consistent with those aggregate paths.

Over the five years of the stress scenario, lending to the UK real economy increases by around 2% in total (**Chart A5**). That reflects projected UK credit demand in the stress scenario. Over the first two years of the stress scenario, the demand for credit falls as Bank Rate rises, asset prices fall, investment growth declines, and as the rise in bank funding costs incorporated in the stress is passed through to lending rates. The demand for credit rises thereafter as economic activity increases and Bank Rate and funding costs decline somewhat towards the end of the scenario.

Traded risk stress scenario

The 2017 ACS includes a traded risk scenario that has been designed to be consistent with the macroeconomic scenario — both in terms of the broad movements in market prices and the types and locations of counterparties affected — and to take account of the liquidity of trading book positions. This element of the ACS will principally examine the resilience of the investment banking operations of UK banks to a severe financial market shock.

Chart A5 Lending to UK individuals and PNFCs in the 2017 ACS



Sources: Bank of England and Bank calculations.

(a) The baseline projection is designed to be broadly consistent with the forecasts published in the February 2017 *Inflation Report*.

The traded risk component of the 2017 ACS requires banks to apply a price shock to their market risk positions as of 25 January 2017.(1) The Bank's approach to traded risk takes account of different liquidity horizons of banks' traded risk positions by imposing larger shocks on positions that banks would take longer to close out, and smaller shocks for those positions that could be sold or hedged within shorter time frames.

Taking the shock to UK equity prices as an example, banks should apply a price shock of -11% to their most liquid UK equities positions, whereas banks should apply a -45% price shock to their least liquid positions. The maximum size of the shock, -45%, corresponds to the UK equity price trough in the macroeconomic ACS scenario.

Besides equities, the scenario includes sharp movements in several market prices and volatility measures, including those associated with interest rates, exchange rates and credit spreads.

The value of banks' available-for-sale (AFS) and fair value option (FVO) positions (for example bonds held as part of their liquid asset buffers and certain legacy loan portfolios) are also subject to a market price stress. These positions are stressed over a five-year horizon, however, in common with

(1) For more details see 'Guidance for participating banks and building societies'; www.bankofengland.co.uk/financialstability/Pages/fpc/stresstest.aspx.

the rest of the banks' balance sheets outside their trading books.

Consistent with the macroeconomic scenario, the 2017 ACS will examine the ability of banks to withstand the default of seven counterparties that would be vulnerable to the macroeconomic scenario — five uncollateralised and two collateralised.(1) In determining the counterparties to default, banks are instructed to consider both the current creditworthiness of their counterparties, and how that creditworthiness might deteriorate under the stress scenario.

In addition to examining the impact of the default of specific counterparties, the scenario will also test the broader portfolio impact from the default of a portion of counterparties that are below a certain rating, and that are vulnerable under the scenario.

Banks are also expected to calculate stress scenario revenue and cost projections for their Investment Banking Divisions or activities where relevant. In the stress scenario, banks should assume that market volumes fall as a result of reduced economic activity. Banks should not assume an increase in revenues, as was observed in some business lines in the years following the Lehman default, or any reduction in the aggregate investment banking sector capacity as a consequence of the stress.

Misconduct cost stress

In addition to the macroeconomic and traded risk elements of the stress, the 2017 stress test also incorporates stressed projections for potential misconduct fines and other costs beyond those paid or provided for by the end of 2016 — the start point of the scenario.

There remains a very high degree of uncertainty around any approach to quantifying misconduct cost risks facing UK banks. For the 2017 ACS the Bank is employing the same methodology as that applied in the 2016 stress test. Banks should submit stressed projections for misconduct costs over and above those incurred or provided for at end-2016. These should relate to known misconduct issues, such as mis-selling of payment protection insurance and misconduct in wholesale markets, and will be in addition to the macroeconomic element of the test.

Banks are asked to provide stressed projections for misconduct costs which have a low likelihood of being exceeded. Partly because they relate only to known issues, however, they cannot be considered a 'worst case' scenario.

(1) Banks should select two uncollateralised counterparties to default of their top 10 Asia and emerging-economy exposures, and one from each of their top 10 UK, US and euro-area uncollateralised exposures. Banks should default two of their top 30 collateralised global counterparties.

Annex 3: The 2017 exploratory scenario

This annex provides a more detailed description of the Bank's first biennial exploratory scenario.

The annex begins by outlining the reasons why the Bank has chosen this scenario before explaining some of the recent headwinds to bank profitability. It then sets out the narrative around the scenario as well as some of the key variables in it. As with the ACS, the exploratory scenario is not a forecast.

The 2017 exploratory scenario will consider the impact of a continuation and intensification of trends which have been observed in recent years, and which have contributed to weak bank profitability.

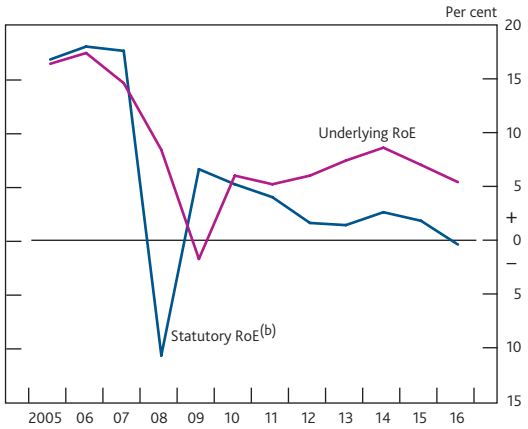
The test will focus on the impact on the macroeconomy of any actions banks would take in the scenario and the resilience of the financial system to shocks in the future. The test will have a seven-year horizon to capture these longer-term trends.

Risk assessment

Bank profitability

The November 2016 *Financial Stability Report* describes how some major UK banks continue to face the challenge of weak profitability driven by a range of factors (**Chart A6**).(1) These include particularly high misconduct costs as well as weak investment banking returns following the financial crisis. More recently, banks have faced increasing competition in retail lending. These forces have occurred against the backdrop of a low interest rate environment. A prolonged period of low returns could impact financial stability through a number of channels.

Chart A6 UK banks' statutory and underlying return on equity (RoE)(a)



Sources: Published accounts and Bank calculations.

(a) Weighted by average shareholders' equity including Barclays, HSBC, Lloyds Banking Group, The Royal Bank of Scotland Group, Santander UK and Standard Chartered.
(b) Statutory RoE is defined as net income attributable to shareholders divided by average shareholders' equity. Average shareholders' equity is calculated as a two-year moving average, and excludes additional Tier 1 capital. Underlying RoE strips out conduct costs as well as other one-time charges.

The level of profitability that banks target affects their risk appetite. The BES will explore how investors' and banks' reactions to an environment with persistent headwinds to profitability could affect risk-taking and the resilience of the financial system.

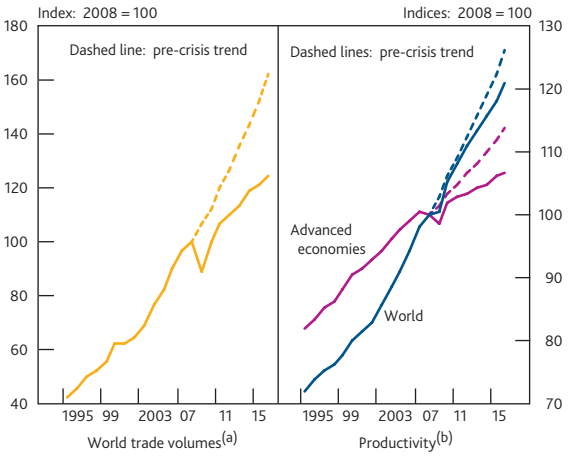
Some reactions could be positive for financial stability, while others could be negative. For example, the range of responses might include reducing the size of their balance sheets, investing in technologies to reduce their cost base and improve their competitiveness, or taking greater risks.

While some of the recent weakness in profitability is due to legacy issues, such as past misconduct, or cyclical factors, there is a risk that some of the pressures weighing on profitability may prove to be longer lasting. The remainder of this section describes in greater detail the macroeconomic and competitive headwinds that are currently weighing on bank profitability, and which are assumed to persist or intensify in the scenario.

Macroeconomic headwinds

Productivity growth has been weak in all advanced economies and emerging markets since the financial crisis. There are likely to have been a number of contributing factors. Among these, weaker trade reduces firms' incentives to innovate as well as the potential size of their markets. Having grown more than twice as fast as world GDP over the pre-crisis decade, global trade volumes are now around 30% below the level implied by a continuation of its pre-crisis trend (**Chart A7**). Weak investment in both advanced economies and emerging markets has provided an additional headwind to productivity growth.

Chart A7 World trade and advanced-economy productivity since the financial crisis



Sources: IMF *World Economic Outlook*, International Labour Organization and Bank calculations.

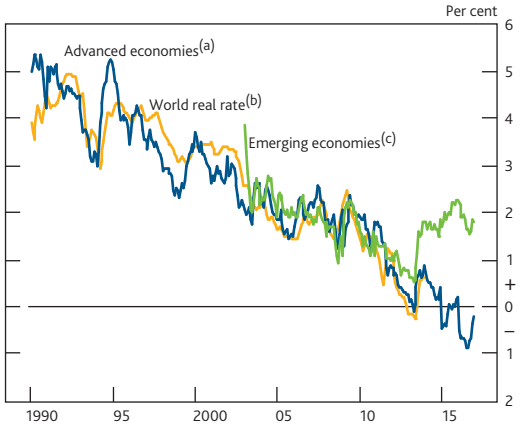
(a) Trade is measured as the volume of total imports of goods and services.
(b) Productivity is measured as real output per employee.

(1) Bank of England *Financial Stability Report*, November 2016; www.bankofengland.co.uk/publications/Pages/fsr/2016/nov.aspx.

This weak productivity growth has, in turn, contributed to the global low growth environment which has been observed in recent years. Global growth has disappointed since the financial crisis with overall activity around 9% below a continuation of its pre-crisis trend.

Long-term interest rates have been declining in recent decades (**Chart A8**). There are several possible drivers of this trend. Shifts in savings and investment preferences, including those driven by demographic changes are likely to have depressed the trend real interest rate. The slowdown in productivity growth since the financial crisis and the expectation that global growth will be lower in the future is also likely to have contributed to this trend over recent years.

Chart A8 Long-run real interest rates



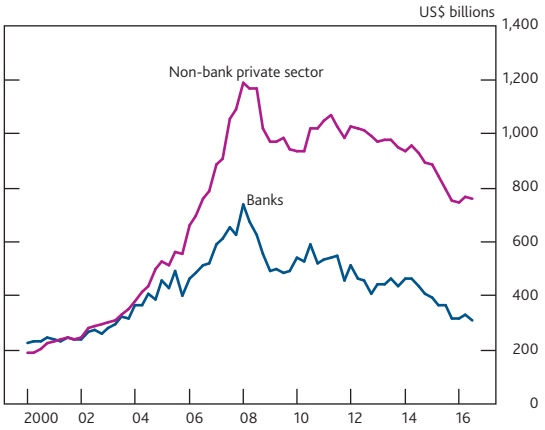
Sources: Consensus Economics, IMF *World Economic Outlook* (*WEO*), King, M and Low, D (2014), 'Measuring the 'world' real interest rate' – www.nber.org/papers/w19887.pdf, Rachel, L and Smith, T D (2015), 'Secular drivers of the global real interest rate' – www.bankofengland.co.uk/research/Documents/workingpapers/2015/swp571.pdf and Thomson Reuters Datastream.

(a) Ten-year sovereign bonds minus one year ahead inflation expectations, weighted by GDP across 20 advanced economies.
(b) The 'World real rate' is taken from King and Low (2014) and shows the average ten-year yield of inflation-linked bonds in the G7 countries (excluding Italy) over the period 1990–2013.
(c) Ten-year sovereign bonds minus one year ahead inflation expectations, weighted by GDP-weighted across 17 emerging market economies.

Alongside these developments, the long-term trend towards greater global financial integration has slowed. Global capital flows appear to have stabilised at materially lower levels, falling from a peak of 44% of global GDP in 2007 to around 12% in recent years. A substantial portion of the reduction can be accounted for by lower cross-border banking flows. This slowdown in cross-border activity has been driven by reduced risk appetite and weaker balance sheets post-crisis on one hand and tighter regulatory and supervisory requirements for banks on the other.

Consistent with global trends, UK banks' cross-border business has contracted both in terms of investment banking and lending activities. UK banks' foreign claims have fallen by over 40% compared to their pre-crisis peak (**Chart A9**).

Chart A9 UK banks' cross-border claims(a)



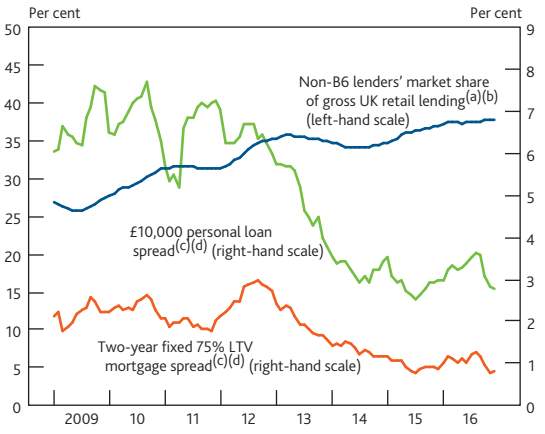
Source: BIS consolidated banking statistics.

(a) For more information on the definitions used in this chart see www.bis.org/statistics/consstats.htm.

Competitive pressures

Since the start of 2013, spreads on new mortgage and personal loan lending have fallen by nearly 200 basis points and nearly 300 basis points respectively (**Chart A10**). While much of this has been driven by the strengthening of major banks' balance sheets following the financial crisis, restoring their capacity to supply credit, small lenders' share of gross UK retail lending has risen by 10 percentage points since the start of 2010, from 28% to 38%. Their presence has contributed to both a loss of market share for the major banks and competition in pricing and other terms and conditions in these markets.

Chart A10 Recent trends in UK retail lending quoted rates and market share



Sources: Bank of England, Bloomberg and Bank calculations.

(a) B6 refers to the six largest lenders to UK households and businesses, comprising Barclays, HSBC, Lloyds, Nationwide, RBS and Santander UK. Non-B6 lenders refer to non-B6 UK-resident monetary financial institutions and non-bank lenders.
(b) Retail lending includes mortgage, credit card and other unsecured lending.
(c) Rates are taken from the Bank of England's quoted household interest rates data set.
(d) Spreads are relative to maturity-matched sterling swap rates.

On the corporate side, there has been a migration of larger companies in particular towards market-based finance and away from bank credit.

Looking ahead, additional competitive pressures may come from developments in regulation and financial technology. Initiatives from the Competition and Markets Authority and the Financial Conduct Authority to increase transparency on fees and current accounts could boost competition, as could greater use of mobile banking applications. Innovation in financial technology has significant potential for making the financial system more inclusive, efficient, effective and resilient, but could also lead to new systemic risks.(1) Together, these developments could make it easier for customers to more easily switch their deposits, leading to a reduction in major banks' brand power, and a rise in the deposit rates paid by these banks.

High-level description of the biennial exploratory scenario

The following high-level scenario narrative is intended to help explain the stresses explored in the 2017 BES.

The exploratory scenario is characterised by a prolonged period of low growth and low interest rates across all world economies. Specifically, it considers a continuation, and in some cases intensification, of recent macroeconomic headwinds and competitive pressures that have weighed on bank profitability.

In the scenario, global trade stagnates. This weighs on productivity somewhat and, in turn, contributes to lower long-term global GDP growth. While growth is weak in advanced economies the slowdown in emerging markets is more pronounced as these economies are particularly vulnerable to slowing trade.

In part as a result of persistently lower growth, returns to capital and interest rates remain at very low levels throughout the scenario. Interest rates remain low, in part due to weak productivity and in part due to demographic trends, which increase global savings.

Consistent with weak global growth prospects and persistently low interest rates, the scenario sees cross-border banking activity remain weak as profitable investment opportunities decrease.

Unemployment and inflation follow the same path as in the baseline scenario. Asset prices continue to grow in the scenario but at a slower rate than in the baseline. There are no large falls because agents gradually adjust their expectations to lower trend growth.

At the same time, competitive pressures intensify. While recent competition from smaller banks and non-banks in domestic lending markets continues, the retail deposit market also begins to see greater competition. This is driven by developments in financial technology which lead customers to become increasingly willing and able to switch products. For further details see Box 2.

The combination of these factors puts significant pressure on banks' profitability. Pressures on margins as well as depressed credit demand limit net interest income. Weak trade and cross-border banking business depresses non-interest income and investment banking revenues.

Throughout the test horizon the prudential standards implemented for the UK financial system remain at least as robust as those currently planned.

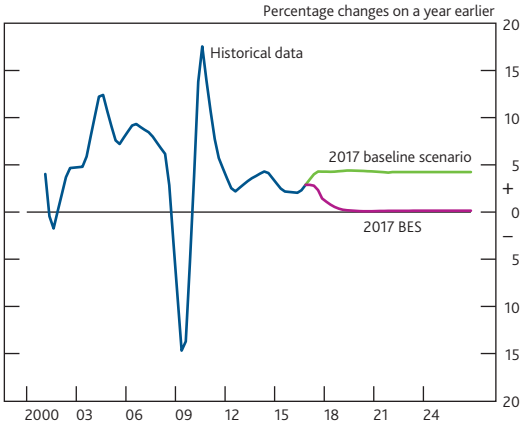
Detailed description of the 2017 exploratory scenario

This section describes some of the important aspects of the 2017 exploratory scenario in more detail. As with the ACS, it includes a description of some aspects of the scenario not included in the set of stressed macroeconomic variable paths, which can be found on the Bank's website. This is intended to help guide stress-test participants in generating their own projections for the exploratory scenario.

Macroeconomic scenario

Global trade stagnates. Real world trade to GDP falls to its lowest level since 2003 as annual growth in trade volumes falls to, and remains at, just 0.1% (**Chart A11**).

Chart A11 World trade volumes(a)



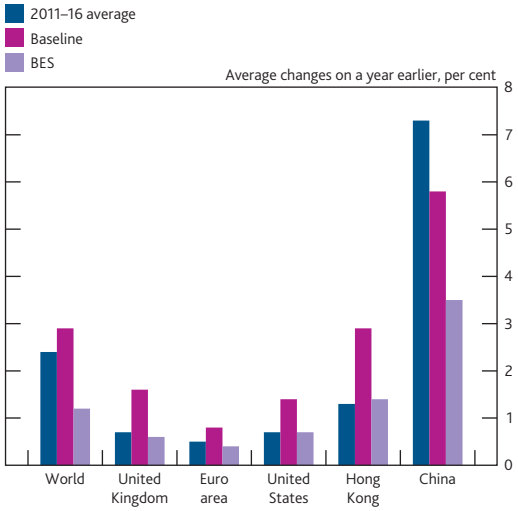
Sources: IMF *World Economic Outlook* and Bank calculations.

(a) Volume of world imports. Regional import volumes aggregated using the dollar value of imports as a share of world total.

Annual **productivity** growth falls to 1.2% at a global level, half the annual average growth rate over the period 2011–16 (**Chart A12**). In advanced economies, productivity growth is similar to recent trends. Weaker productivity, relative to recent trends, is more pronounced in emerging economies.

(1) For further discussion of the future of FinTech, see 'The promise of FinTech — something new under the sun?', speech by Mark Carney, 25 January 2017; www.bankofengland.co.uk/publications/Documents/speeches/2017/speech956.pdf.

Chart A12 Productivity in the BES[a]



Sources: IMF *World Economic Outlook* and Bank calculations.

(a) Output per worker.

Trend world **GDP growth** falls to 1.9%, around half its level in the baseline. UK trend GDP growth falls from 2.2% in the baseline to 1.2% in the exploratory scenario. All emerging economies experience an even larger fall in trend growth, reflecting their greater vulnerability to weaker trade growth (**Table A3**). For example, Chinese GDP trend growth falls from 5.8% in the baseline to 3.5% in the stress.

Table A3 Comparison of trend GDP growth rates and cumulative residential property price growth in the BES and baseline scenario

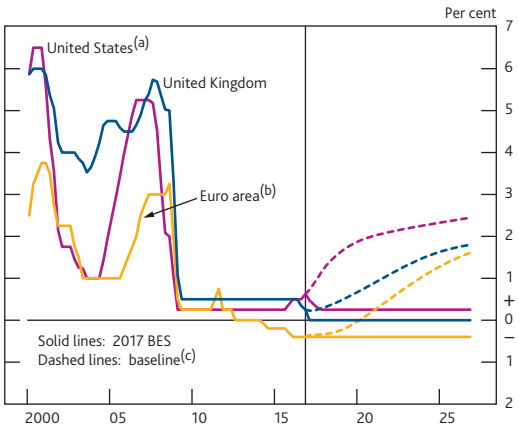
	Trend GDP[a]		Residential property prices[b]	
	Baseline	BES	Baseline	BES
United Kingdom	2.2	1.2	45	16
World	3.7	1.9	n.a.	n.a.
United States	1.6	0.9	48	18
Euro area	1.5	0.7	34	7
Hong Kong	2.9	1.5	54	15
China	5.8	3.5	110	45
India	8.1	4.6	n.a.	n.a.

(a) Trend growth rate measured as the year-on-year per cent growth rate at the end of the scenario.
(b) Cumulative per cent growth rate from the beginning of the scenario to the ten-year point.

Policy rates are low throughout the scenario. In the United Kingdom, Bank Rate is cut to 0%, where it remains. Policy rates also remain low in the United States and euro area. In the United States policy rates fall to 0.25% and in the euro area they remain at -0.40% throughout the scenario (**Chart A13**).

Consistent with this loosening in monetary policy **long-term government bond yields** fall slightly from current levels and remain low throughout the scenario. For example, nominal ten-year UK gilt yields are at 1.25% by the end of the ten-year horizon, compared with 1.31% in 2016 Q4.

Chart A13 Policy rates in the BES



Sources: Bank of England, Bloomberg, ECB, Federal Reserve and Bank calculations.

(a) US policy rate back data is the federal funds target rate.
(b) ECB policy rate back data is the ECB deposit facility rate.
(c) Baseline projections are the fifteen-day average of OIS forward curves as of 25 February 2017.

Reflecting the low interest rate environment, **volatility in all markets** is compressed globally. While the VIX index rises slightly early on in the scenario in response to the change in global monetary policy, it settles under its long-term average.

Investors' risk appetite remains at current levels and, as a result, risk premia do not fall. UK equities grow by 31% in the scenario, compared with 45% in the baseline.

Relative risk premia across advanced economies are unchanged. Advanced-economy bilateral **exchange rates** remain the same as in the baseline. In the United States, equities grow by 34% in the scenario, rather than the 48% growth in the baseline.

Reduced incomes weigh on **asset prices** across all economies (**Table A3**). Investors gradually adjust their expectations to lower incomes with the result that asset prices also adjust smoothly. For example, house prices in the United Kingdom increase slowly, rising by 16% over the ten years of the scenario, compared with 45% in the baseline.

The post-financial crisis downward trend in **cross-border banking** continues. This particularly impacts emerging markets as capital flows fall.

Consistent with post-crisis trends, demand for direct cross-border lending to foreign counterparties remains depressed while weak trade weighs on the demand for trade finance.

Lower returns on capital in the stress push down on the demand for credit from corporates. **Capital market issuance**, and **mergers and acquisitions** activity are depressed. In addition, low volatility in conjunction with persistently low interest rates depresses banks' investment banking revenues through reduced client activity, lower trading volumes and

margins, and the fees investment banks are able to charge for services.

Competition

An intensification of competitive pressures adds to the strain on major banks in the scenario. The net impact of increased competition in lending and deposit markets is a fall of around 40% in the spread between market retail deposit and lending rates relative to current levels, a reduction in the share of household savings held as retail deposits, and a reduction in demand for bank credit from UK corporates. These pressures are facilitated by innovations in financial technology which are observed in both the UK and other foreign markets. Further details of these competitive pressures can be found in Box 2.

Approach to traded risk

Consistent with the design of the macroeconomic scenario there is no severe market shock applied to trading positions. Rather than the sharp declines seen in the ACS, market prices adjust slowly in the exploratory scenario because agents gradually adjust their expectations to lower trend growth.

In the BES, the stress to banks' trading operations instead comes through in the form of depressed investment banking revenues. Low volatility, in conjunction with persistently low and flat interest rate curves, is expected to depress fixed-income trading revenues through reduced client activity. Equity markets are depressed relative to the baseline although still growing slowly, with volatility subdued. Global foreign exchange markets exhibit low volatility and no significant price movements.

Lower returns on capital due to weak productivity push down on the demand for credit and capital issuance from corporates. Corporate investment activity also slows and decreases mergers and acquisitions activity.

Costs

The 2017 BES also incorporates stressed projections for potential misconduct fines and other costs beyond those paid or provided for by the end of 2016 — the start point of both scenarios.

Banks are asked to replicate their ACS misconduct costs in the first five years of the BES. They are not expected to project additional costs relating to misconduct risks beyond the ACS horizon.

Banks should also gradually increase their costs for systems and business processes in relation to managing cyber risk and preventing future misconduct, as well as for overall IT investment. Banks should ensure that from the third year of the test these costs reach a level that is unlikely to be exceeded in practice so as to deliver the necessary protection against operational risks. Further details on costs can be found in the 2017 guidance for participating banks and building societies.

Box 2
Competition in the biennial exploratory scenario

The Bank welcomes and encourages greater, and sustainable, competition in banking. The PRC has a secondary objective to act, so far as is reasonably possible, in a way that facilitates effective competition in the markets for PRA-authorised firms carrying out regulated activities.

One of the key features of the 2017 exploratory scenario is an intensification of competitive pressure from smaller banks and non-bank businesses. In recent years, smaller lenders have had significant influence on pricing and dynamics in UK retail lending markets.

In the exploratory scenario banks are subject to competitive pressures in both the UK retail deposit market, and UK household and corporate lending markets. These pressures are facilitated by innovations in financial technology which are observed in both the UK and other foreign markets. As a result banks face a trade-off between maintaining margins and retaining market shares.

In particular:

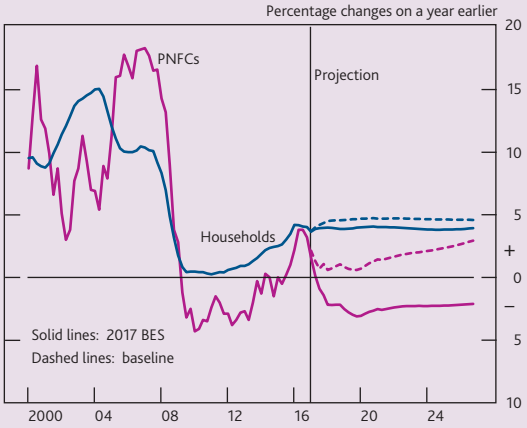
- In the UK **retail deposit market**, households move their savings between banks and different products more frequently than in the past. This is facilitated by greater use of mobile banking applications, as well as households increasingly investing in products offered by non-banks, such as money market funds and peer-to-peer lending platforms. Customers become increasingly willing and able to switch their accounts and the brand power of major UK banks diminishes. This leads to a migration of some household savings to non-banks. Towards the end of the scenario aggregate retail deposits begin to fall. Moreover, by 2022 the major UK banks must price their deposits in line with smaller lenders in order to maintain market share. The average rate on an instant access savings account rises by 21 basis points between 2017 and 2022.

- In the UK **retail lending market**, market-wide lending spreads fall. For example, the average two-year fixed 75% LTV mortgage spread (to two-year sterling swap rates) falls by 41 basis points from its level of 84 basis points in 2016 Q4. This is indicative of trends across the market.

- The net impact of increased competition in retail lending and deposit markets is around a 40% fall in the spread between banks' retail deposit and lending rates relative to current levels.

- In the **corporate lending market**, in addition to the demand for credit being subdued, private non-financial corporations (PNFCs) increasingly opt to issue market debt rather than borrow directly from banks. Bank lending to corporates turns negative in the second half of 2017 and remains that way for the rest of the scenario (**Chart A**). As a result, the aggregate stock of corporate loans on banks' balance sheets falls significantly (by 21% from 2016 Q4) leading to a loss in fees and cross-selling revenues associated with these loans as well.

Chart A Lending to UK households and PNFCs in the 2017 exploratory scenario



Sources: Bank of England, ONS and Bank calculations .

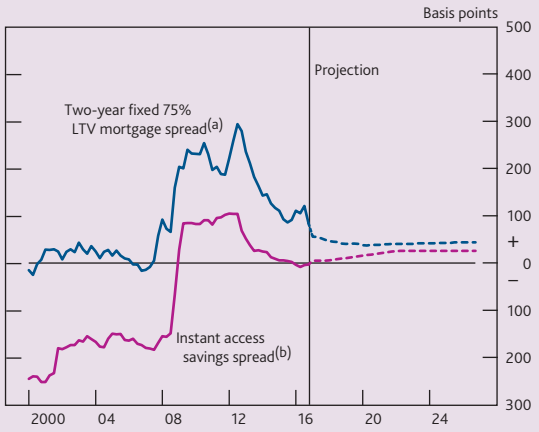
As part of the exploratory scenario banks are expected to model the impact of competition and consider how they might respond, taking into account all relevant published scenario profiles. These profiles include the average product rates on two-year fixed 75% LTV mortgages and instant access savings (**Chart B**), which are indicative of broader market trends, as well as volumes of UK real-economy lending markets and retail deposits. In particular:

- In the retail mortgage market, banks should assume that their market share will fall if they price above the average quoted rate, unless explained by other product features or credit terms. This applies throughout the scenario.

- Similarly, banks should assume that their share of the retail deposit market falls if they price below the average quoted deposit rate. This constraint on deposits is binding from 2022, and banks are expected to assume convergence in market pricing leading up to this date.

- Banks should also assume current levels of competition persist in the personal loan, credit card and auto-lending markets, and this should be reflected in banks' assumed market shares and product terms.

Chart B Illustrative UK retail lending and deposit rate spreads in the 2017 exploratory scenario



Sources: Bank of England, Bloomberg and Bank calculations.

(a) Spreads are relative to two-year sterling swap rates.
(b) Spreads are relative to Bank Rate. Instant access savings spread series before 2011 is estimated due to data availability.

- In the corporate lending and non-UK lending markets banks should explain any assumed increase in market share by pricing, other product features or credit terms. Banks should take into account economic prospects in local markets when considering non-UK lending.

In no market in which they currently operate should banks assume any increase in brand power.

Further details on how banks should approach this aspect of the scenario can be found in the 2017 guidance for participating banks and building societies.

Glossary

ACS – annual cyclical scenario.
AFS – available for sale.
AT1 – additional Tier 1.
BES – biennial exploratory scenario.
BIS – Bank for International Settlements.
CCyB – countercyclical capital buffer.
CET1 – common equity Tier 1.
CRE – commercial real estate.
ECB – European Central Bank.
EME – emerging market economy.
ERI – exchange rate index.
FPC – Financial Policy Committee.
FVO – fair value option.
GDP – gross domestic product.
G-SIBs – global systemically important banks.
Hibor – Hong Kong interbank offered rate.
IMF – International Monetary Fund.
Libor – London interbank offered rate.
LTV – loan to value.
MPC – Monetary Policy Committee.
OECD – Organisation for Economic Co-operation and Development.
OIS – overnight index swap.
ONS – Office for National Statistics.
PNFCs – private non-financial corporations.
PRA – Prudential Regulation Authority.
PRC – Prudential Regulation Committee.
RoE – return on equity.
SRB – systemic risk buffer.
VIX – CBOE Volatility Index.
WEO – IMF *World Economic Outlook*.