



BANK OF ENGLAND

Speech

Stress tests and the countercyclical capital buffer: the U.K. experience

Speech given by

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London School of Economics, Money Macro and Finance 50th Anniversary Conference

Wednesday 4 September 2019

I would like to thank the following for their contributions: Analise Mercieca, Stephen Burgess, Matthieu Chavaz, Paul Nahai-Williamson, Dan Beale, Catherine Shaw, Stephen Fishbourne and Andy Walters. The views expressed are my own and do not necessarily reflect those of the Bank of England or other members of the Financial Policy Committee.

Introduction:

I am honoured to be asked to give the Goodhart lecture at this conference. Charles has worked at the intersection of financial markets and institutions, academic research, and central bank policy, advancing our understanding how the world works and how to make policy to promote price and financial stability. I suspect there isn't any one in this room whose research or policy decisions haven't been greatly enriched by their contact with Charles' ideas; I know that's true in my case.

Today I will be taking up a subject at that crossroads of institutions, research and policy: The stress tests of UK banks and their use by the Financial Policy Committee at the Bank of England (FPC) to counter the inherent procyclicality of risk-based bank capital. Charles has frequently voiced concerns about the tendency for bank capital calculations to fail to keep up with rising risks in the expansion phase of cycles and then to exacerbate capital erosion and tightening credit availability in downturns.¹ The FPC has addressed this using the UK countercyclical capital buffer rate (CCyB); and our judgments about the appropriate level of the buffer have been importantly informed by concurrent stress tests of bank capital against a severe recession scenario.

The stress tests were a major innovation growing out of the Global Financial Crisis (GFC). Their objective is to assure that banks have enough capital to allow them to continue to support the economy by making loans to households and businesses even after a severe adverse shock has hit the economy-in marked contrast to the experience of the GFC when sharp restrictions on credit availability through banks and markets made a bad economic situation much worse.

The stress tests do this by subjecting bank loan and market portfolios to a deep recession and sharp declines in the prices of assets owned or used as collateral. Banks are required to have enough capital going into the stress event to meet certain minimums at the low point of the stress, where those minimums are high enough to allow the banks to continue to access funding and make loans on reasonable terms. The tests mitigate procyclicality by stressing bank capital against a scenario that gets more severe as the business and financial cycles move higher. The stress tests have gained force and effect through their transparency, which have subjected both banks and their regulators to public accountability.

In a recent paper, my colleague Nellie Liang and I addressed the effects of the stress tests in the US.² We attempted to answer three questions: First, have the stress tests helped to counter procyclicality of bank capital; our answer was yes, though perhaps more because of the requirement that banks prefund several years of planned dividends and share buybacks than because of the countercyclicality of the scenarios used in the test. Second have the stress tests improved risk management at banks; here the answer also was yes in large part because the Federal Reserve made public its qualitative assessment of the capital

¹ See for example Goodhart & Schoenmaker (2019) "Automatic stabilisers in banking capital", VOX CEPR Political Portal, 11 July.

² Kohn & Liang (2019) "Understanding the Effects of the US Stress Tests", prepared for the Federal Reserve System Conference, 9 July.

planning processes at banks, including their risk management processes. Third, have the stress tests affected the cost and availability of credit from the largest banks; we answered yes to this also, though we noted that this could be considered a feature, not a bug because credit before the GFC was too easily available; we also noted that studies showed that as the stress-tested banks drew back, others-smaller banks and nonbank sources of funds-stepped in to make loans to small and medium businesses, who were often the class of greatest concern.

UK stress tests differ from those in the US in several important ways so I won't be able to address exactly the same set of issues. The Federal Reserve collects microdata from the banks and runs them through its own supervisory models; in the UK banks' models are a vital input to the stress test results, complemented by the Bank of England's modelling that is used to cross check and adjust banks' projections. In the UK, as in the US, stress test results are public, but to date, the insights gained by the Prudential Regulation Authority (PRA), the microprudential regulator, into the modelling and risk-management capabilities of individual banks have been folded into the supervisory process, and not made public. This could be about to change, however.

In 2019 the Bank is undertaking a qualitative review of the effectiveness of the banks' stress testing models; the PRC has said that it is minded to include the reference to qualitative review outcomes in this year's publication of bank-specific assessments.³ And in the UK we don't rely on a prefunding requirement for damping procyclicality; instead we design the scenarios to be actively countercyclical. In the UK our approach to earnings distributions in the stress test is to make it clear that banks will cut dividends, buybacks, and even bonuses, if necessary to zero, in a stress situation. Importantly, unlike in the US, we feed the stress test results into our consideration of the CCyB, which we have adjusted more actively than our US colleagues.

Still, the basic goal of the UK and US stress tests are the same-assurance that banks will be able to access funding and make loans after a severe adverse shock to the economy and markets. And it seems a good time to take stock of the effects of the UK stress tests to date, and their interaction with the CCyB. My focus is on how these help to counter procyclicality of bank capital. The FPC has been using the annual cyclical scenario (ACS) for this purpose since 2016⁴, and the FPC along with the PRC will be discussing and deciding on an update to the Bank's 'Approach to stress testing' document later in the year.⁵

In the remainder of my talk I will [1] take a deeper dive into the causes and consequences of procyclical risk-based bank capital and the role the FPC envisions for the CCyB, informed by stress tests, in countering this tendency; [2] discuss how the FPC has used the CCyB and stress tests in practice; and [3] end with some challenges for the research agenda that would help the FPC be even more efficient and effective.

³ PRA (2018) "Model risk management principles for stress testing", *SS3/18*, April 2018.

⁴ The stress test that informs the setting of the CCyB is the Annual Cyclical Scenario. The FPC and PRC also run Biannual Exploratory Scenarios that look at specific challenges facing the banks. In this talk I will be discussing only the ACS.

⁵ See Bank of England (2019) "The Bank of England's response to the Independent Evaluation Office's evaluation of its approach to concurrent stress testing"

The Bank of England's Framework

The case for countercyclical capital requirements. The Financial Policy Committee, on which I sit, is charged with “the identification of, monitoring of, and taking action to remove or reduce systemic risks with a view to protecting and enhancing the resilience of the UK financial system.”⁶ The systemic risks we focus on manifest themselves when the financial system amplifies shocks to the economy-in the extreme is unable to deliver essential services to households and businesses, including a safe place for saving and credit on reasonable terms, under stress. Shocks are, by definition, unexpected tail events and our job is make sure the financial system is resilient to such shocks-that it doesn't make a bad situation worse and will be able to extend credit to UK households and businesses in bad times as well as good.

Systemic risks tend to build in good times. Extrapolating recent experience, people come to expect asset prices to continue to rise and incomes to continue to increase and support debt repayments. These expectations become embedded in asset prices beyond sustainable levels and credit terms easier than justified by through the cycle risk. Greater credit availability along with borrower optimism leads to growth in credit that exceeds the expansion of incomes. Historically, banks have been major contributors to this cycle.

Easier financial conditions and rapid growth of debt support the expansion of incomes in the short- to intermediate-term, but they leave the economy vulnerable to unexpected developments that can result in outsized declines in GDP down the road when asset prices begin to correct or incomes are hit by a slowdown in growth.⁷

If the resilience of the financial system rose along with the risk, the odds on ending up in a deep recession would be greatly reduced-but it doesn't. The misperception of risk that leads to the overabundance of credit and elevated asset prices also will be reflected in the capital calculations banks make about the risks they face. When the risks crystallize they will find they do not have enough capital to protect them, and they are likely to cut back on credit to protect their capital and market perceptions of their viability-and to cut back far more than is justified by the actual risk level. And they may be forced to sell assets as they downsize, amplifying the fall in asset values already underway.

The countercyclical framework and stress tests. So we need a framework that matches resilience to risk: building capital in good times so that it can be rundown in bad times while still maintaining confidence in the health and viability of the banking system, preserving its ability to perform its essential functions. The Basel Committee on Bank Supervision agreed that authorities should implement a countercyclical capital buffer for this purpose-one that would require increases in bank capital as risks mounted, and then fall as risks

⁶ Her Majesty's Treasury (2018) 'Remit and recommendations for the Financial Policy Committee: Budget 2018', letter sent from the Chancellor to the Governor of the Bank of England.

⁷ 'How do financial vulnerabilities and bank resilience affect medium-term macroeconomic tail risk?', Bank of England Staff Working Paper, forthcoming, David Aikman, Jonathan Bridges, Sinem Hacioglu Hoke, Cian O'Neill and Akash Raja.

materialized. The FPC has adopted the CCyB, using the stress tests as a key input to our decisions on the level of risks and required capital.

The FPC's approach to assessing the threat level on UK bank exposures has three basic elements:

1. FPC assesses the likelihood and severity of potential future adverse 'shocks' to the UK economic outlook; this includes an analysis of domestic and global economic and financial imbalances whose correction could have material adverse consequences for UK economic activity.
2. The FPC monitors characteristics of households' and companies' financial conditions that would determine how macroeconomic and financial shocks could translate into defaults and losses.
3. Finally, the FPC assesses the banks' capacity to absorb losses on their UK exposures.

To assess the risk environment and the likely resilience of the banks to risk events, the FPC considers a wide range of economic and financial indicators as well as supervisory and market intelligence. For example, we look at the evolution of the terms of bank lending to assess a possible shift in the supply of credit, and we pay particular attention to the rate of growth of credit relative to income⁸, which has been a good indicator of potential systemic risks⁹. The prices of assets, like housing and commercial real estate, along with risk spreads relative to history give us clues about risk appetite and the possibility that unexpected shifts in that appetite that might adversely affect bank losses and capital. And of course we have information on measures of bank capital and liquidity to gauge bank resilience to any unexpected developments. The set of indicators evolves in response to conditions and new analysis, and judgment necessarily plays a large role in putting the overall picture together.

Stress testing speaks directly to the issue at hand—is there enough capital in the system to survive a severe stress and continue to lend, or do we need to adjust the CCyB to align capital with risk in the system. Stress tests serve as a check on the FPC's judgement and help it to detect changes in the structure and composition of bank balance sheets that affect their resilience to unexpected developments.

But there is no mechanical link between the outputs of the stress test or the readings from a set of indicators and the setting of the CCyB. The FPC attempts to be systematic about our reactions to readings on risk and resilience, and we are transparent about what we are looking at and why we are or are not concerned about emerging phenomena in financial markets. But we are a ways from having a "Taylor Rule" tied to a few right

⁸ The CCyB rate must be assessed and set in accordance with CRD and Treasury's Regulations, taking into account: (a) the buffer guide calculated by the FPC that reflects the credit cycle and the risks due to excess credit growth in the United Kingdom, taking into account specificities of the UK economy, and based on the deviation of the ratio of credit to GDP from its long-term trend, (b) any current guidance maintained by the ESRB, (c) any recommendations of the ESRB on setting the CCyB rate, and (d) any other variables that the FPC considers relevant for addressing cyclical systemic risk. In practice, the FPC has not given weight to the buffer guide, which, as it has explained, appears to have been distorted by too-rapid growth in credit before the cycle among other things.

⁹ Broadbent, B. (2019) "Debt Dynamics"

hand side variables to give us guidance; indeed one may doubt whether such a rule will ever be possible for as complex a phenomenon as “financial stability”.

In April 2016, FPC set out its preferred setting for the UK CCyB rate to be in the region of 1% when risks to UK financial stability are standard-neither depressed as in the aftermath of financial stress when risk-taking has pulled back, nor elevated after a period of expansion. This was decided following a broader review of the capital requirements framework for UK banks in Dec 2015.¹⁰ In the context of those capital requirements, the FPC judged that the one percent CCyB would provide the banks with enough capital to withstand a severe stress that might occur when risks were in standard range. The FPC agreed to keep this 1% rate under review. But it reflects the a wider strategy to set a positive rate before risks become elevated, in order to be able to vary the CCyB more gradually as risks build. The positive resting place raises the odds on staying up with emerging risks in an uncertain environment.

Activating the buffer before risks become elevated provides the banking system with a positive buffer that can be cut in the event of a material adverse shock. An important advance of the Basel 3 capital structure was the addition of buffers to capital minimums in the capital stack. As the FPC has emphasized, buffers are there to be used when adverse shocks occur; in that event, banks should draw down their capital buffers rather than cut back lending, which would amplify the negative shock. Three buffers are available-the capital conservation buffer, the CCyB and the systemic buffers, including the G-SIB.¹¹ Drawing on the capital conservation and the G-SIB buffer will trigger restrictions on earnings distributions, which will make the banks reluctant to utilize them; no such restrictions would apply to the capital formerly held to meet the CCyB after it was reduced to zero, so banks should be more willing to let that portion of capital run down while continuing to extend credit.

Financial stability requires that banks retain the confidence of investors and funders as they allow capital ratios to fall. The key to this is in the design of the stress scenarios. They must be perceived as severely adverse, testing the banks against a very negative outcome; and they must produce countercyclical results for capital-larger losses as the financial cycle gathers upward momentum and smaller loses when risks crystallize. Investors must be assured that banks will still be quite well capitalized after a severely adverse economic and financial shock and therefore viable.

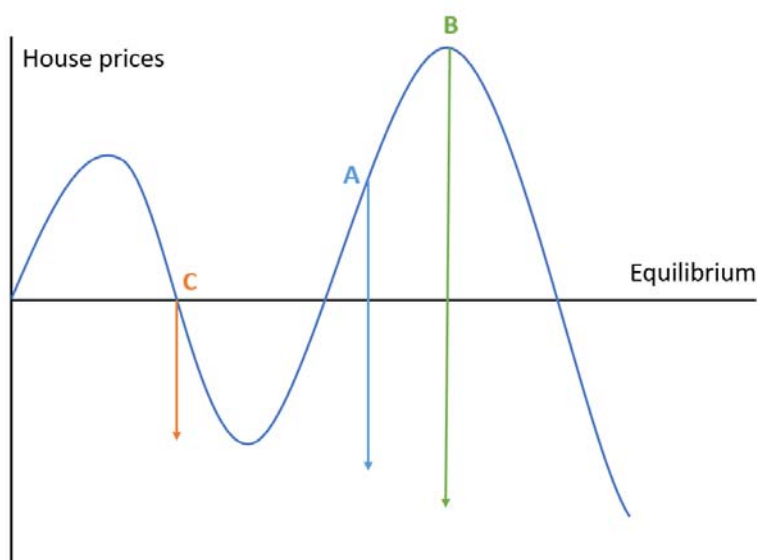
The FPC and PRC have been doing concurrent stress testing since 2014, but an innovation in came in 2016 - when we ran the first annual cyclical scenario. The 2016 scenario was designed under a new framework - one that would vary in severity systematically each year, linked to the FPC’s assessment of risk across various markets and regions. That assessment is informed by the historical distribution of values of key variables, supplemented by judgment about shifts in the risk environment that could affect the future evolution of those variables.

¹⁰ Bank of England (2015) “Supplement to the December 2015 Financial Stability Report: the framework of capital requirements for UK banks”

¹¹ The Bank of England also operates bank-specific buffers: the PRA Buffer.

Our approach to setting the ACS scenario is explicitly countercyclical. This is illustrated in Figure 1 below. When the FPC judge that the risk level has risen - for example house prices increase from point A to point B in the chart - a greater house price fall is assumed in the stress test. Moreover, if the FPC perceives the underlying risk environment has deteriorated in a way that could amplify the adjustment once it was under way-say because leverage among borrowers had increased-it will also lower the trough to which the variable is stressed.

Figure 1: Severity of house price falls across the cycle

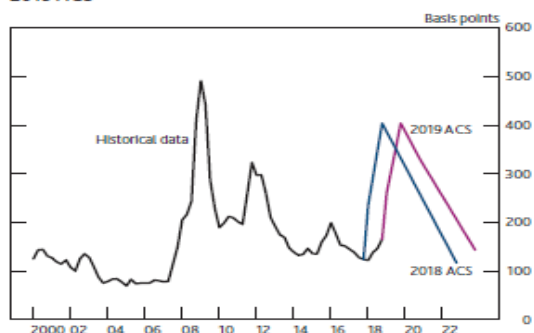


Source: Bank of England (2015) "The Bank of England's approach to stress testing the UK banking system."

One neat example of this approach in operation was shown in the publication of our 2019 scenario earlier this year. Between the 2018 and 2019 scenarios, corporate bond spreads had risen around the world, as some risks in markets had crystallised. In the UK, this meant that the increase in corporate bond spreads in the stress was less in 2019 than in 2018 to the same stressed level (Figure 2, left hand chart). But in the US, because the FPC judged that greater corporate leverage had increased the risks to business lending, we actually increased the stress to corporate bond prices, reflected in the rise in the peak between 2018 and 2019 (Figure 2, right hand chart).

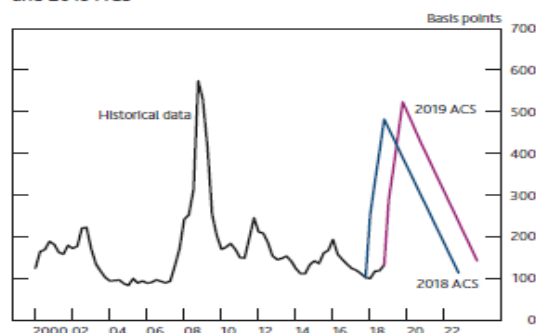
Figure 2: Example of framework in operation in the 2019 ACS

Sterling investment-grade corporate bond spreads in the 2018 and 2019 ACS^(a)



(a) Quarterly average option adjusted spread over maturity-matched government spot curve on GBP denominated investment-grade corporate debt publicly issued in the eurobond or UK domestic market.

US dollar investment-grade corporate bond spreads in the 2018 and 2019 ACS^(a)



(a) Quarterly average option adjusted spread over maturity-matched government spot curve on US dollar denominated investment-grade corporate debt publicly issued in the US market.

Source: Stress testing the UK banking system: key elements of the 2019 annual cyclical scenario

The process I just described is the backbone of stress test scenario construction, but judgment is also employed-beyond adjusting peaks or troughs. The FPC shape the scenarios to test against risks that are judged most important at the time. In 2016 the ACS encompassed a domestic recession, global slowdown and persistent near-zero interest rates; in 2017, after the referendum, the scenario had a domestic recession and global slowdown, but it also encompassed the risk of a flight from UK assets that resulted in a rise in UK inflation and nominal interest rates as sterling fell, along with a spike in risk spreads. We have also focused analysis in the results phase to test resilience to potential problems in consumer and business lending, when indicators suggested special risks in those areas.

The construction of the scenarios to capture changing risks is a necessary condition for the stress tests to be effective macroprudential tools, but it is not the only one. In addition, banks must be able to maintain capital adequacy in a stress while continuing to make credit available to UK households and businesses. Indeed, a requirement of the stress tests submissions by the banks has been no tightening of credit supplies. The FPC recognizes that the growth of loans is likely to be affected by the drop in demand associated with the assumed economic weakness, but supplies must be maintained to avoid having the banks amplify the cycle.

The participating banks model the impact of the annual cyclical scenarios on their portfolios and capital. Having participating banks model the impact of stress scenarios themselves allows the PRA to gain insight into the strengths and weaknesses of banks' models; feedback from the PRA should enhance banks' risk management capabilities, which in turn will improve the quality of their stress testing, both within and outside of the concurrent stress-testing framework.

The Bank of England has developed a suite of internal models covering a range of risk areas used for benchmarking and providing an independent challenge for the stress projections submitted by the banks. Our models on credit risk, for example, include a mix of sectoral loan-level models that shed light on distributional impacts of the stress scenario; portfolio-level models that produce firm-level estimates of credit

losses; and aggregate-level models that provide high-level estimates for expected losses for the entire system. These can also be used to perform sensitivity tests of results to different scenario paths and assumptions.

The final, published, stress test results also draw on peer review, supervisory insights and judgment by experts at the Bank of England.

The Framework in action: how the CCyB and stress tests have been applied to deliver countercyclical capital—and other macroprudential judgments and policies.

The stress tests have been an important element in enabling the FPC to move the CCyB up and down as the risk environment has evolved, but they also have proved invaluable in several other dimensions.

In the aftermath of the GFC, risk taking in the UK banking system was quite constrained for a time as the economy was depressed and banks focused on dealing with the problems uncovered by the financial crisis. By the beginning of 2016, however, the growth of credit and measures of credit availability had returned to more normal levels—risks were in the “standard range” in FPC terminology. At this point, committees set out the expectation to set a UK CCyB of one percent. Consistent with our published approach, the FPC began a process of gradually raising the CCyB to “the region of one” in those circumstances, by announcing in March 2016 that a CCyB of 0.5 would be in effect from March 2017; our intent was to move it up further in the foreseeable future, if nothing intervened to change the risk picture.

But, of course, something did intervene in the form of the Brexit referendum in June and the market reaction to that of a sharp drop in Sterling and UK-focused equity prices and a rise in risk premia on many UK assets. In July 2016 we judged that ‘some of the risks to financial stability from the referendum had begun to crystallise’. The Governor’s opening remarks at the July 2016 FSR press conference mentioned three key risks: the current account deficit and associated vulnerability to sudden shifts in foreign capital and sharp adjustments in sterling; adjustments in CRE and the associated tightening in credit conditions for UK businesses; and the number of households vulnerable to a tougher economic outlook and tighter credit conditions (ref opening remarks).

In that context, cutting the CCyB to 0% with immediate effect would ‘reduce pressure on banks to tighten credit conditions’. This decision was consistent with the FPC’s approach to setting the UK CCyB, which says that: “Should a stress materialise, the FPC may cut the CCyB rate, including where appropriate to 0%. Reducing the CCyB rate pre-emptively before losses have crystallised may reduce banks’ perceived need to hoard capital and restrict lending, with consequent negative impacts for the real economy.”¹²

¹² Bank of England (2016) “The Financial Policy Committee’s approach to setting the countercyclical capital buffer”

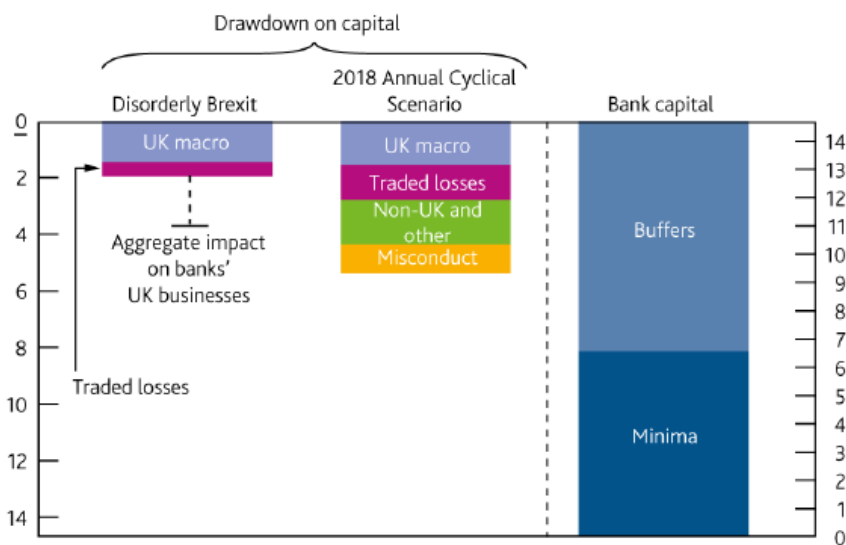
In judging the resilience of the banking system under these circumstances with the CCyB at zero, the FPC looked to the level of capital and liquidity buffers held by banks, and also to the results of the 2014 and 2015 stress tests. These showed that the banks could continue to lend even in “extremely severe economic scenarios”, characterized by a 30 percent drop in Sterling and rise in interest rates in the 2014 test and a global recession and persistent near-zero interest rates in the 2015 scenario.

Aside from risks associated with Brexit, using the stress tests and other indicators, the FPC has judged that underlying domestic vulnerabilities have remained at a standard level overall since the end of 2015. As markets settled after the referendum and credit conditions remained in the standard range, we returned to raising the rate to one percent, where it sits today.

Nonetheless, obviously, the risks from Brexit have been high on our agenda. Rather than include Brexit in the ACS explicitly, the FPC have been able to use the results of the stress tests to gain confidence that the UK financial system would be resilient to a range of adverse Brexit outcomes. We were helped in this judgment because we shaped the UK macro component of the 2017 and 2018 annual cyclical scenarios to have some similarities with a disorderly Brexit scenario; it featured a significant domestic recession, a rise in domestic risk premia, a sharp fall in sterling and a rise in inflation and short-term interest rates.

In November 2018, in response to a request from the Treasury Committee, the Bank of England published a report analysing the effect of various scenarios for EU withdrawal on the ability of the Bank to deliver its objectives for monetary and financial stability. This included two scenarios where the UK left the European Union without a deal. The chart below shows that the severity of the 2018 annual cyclical scenario, which all the major UK banks passed, encompassed the worst case no-deal Brexit scenario the FPC reviewed. Both could be absorbed within banks’ existing capital buffers. The bars in that chart encompass all UK stress tested banks, several of which have considerable overseas activity, which would be less vulnerable to Brexit tail risk. The bracket in the left-hand bar of that chart shows a simple calculation which applies the stress scenario to banks’ UK businesses in isolation.

Figure 3: Comparison of the impact of the disorderly Brexit scenario and 2018 ACS on major UK banks' capital ratios



Source: Bank of England (2018) November 2018 Financial Stability Report

This use of stress test results illustrates a more general point: we stress banks to a generally bad scenario and then when we identify a specific trigger we can assess whether the resulting scenario is encompassed. We have done this for the effects of a global trade war as well as for Brexit scenarios.¹³

Although, aside from Brexit, UK risks have remained in the standard range, that's not true globally. Risks in other countries are judged to have increased, and, consistent with our framework, we have made the global stress progressively more severe over recent years to reflect that. The fall in World GDP in the 2016 test was 1.9%. In 2017 we notched that up to 2.4%. And in 2019 we pushed it to 2.6%. That's the general picture, and we've targeted that increase in severity in the areas where we think risks have increased - namely China, the US, and the Euro Area (Table 1). For China and the US increased risk reflects our judgment that increases in leverage imply the potential for larger corrections; for the Euro area, we saw political developments in Italy reinforcing the vulnerabilities created by high private sector debt and interlinkages between banks and sovereigns in a currency union. Globally, growth is threatened as well by rising trade tensions.

¹³ Bank of England (2019) "July 2019 Financial Stability Report"

Table 1: Peak-to-trough falls in GDP in successive ACSs by country^(a)

Peak-to-trough falls in GDP in successive stress tests	2016 ACS	2017 ACS	2018 ACS	2019 ACS
UK	-4.3	-4.7	-4.7	-4.7
US	-3.0	-3.5	-3.5	-3.7
EA	-3.0	-3.6	-3.6	-4.0
China	-0.5	-1.2	-1.2	-1.2
Hong Kong	-7.4	-7.9	-7.9	-7.9
World (PPP-weighted)	-1.9	-2.4	-2.4	-2.6

(a) The fall in Chinese GDP in the 2019 ACS is the same as in the 2018 ACS, but growth does not recover to the same rate as in the 2018 ACS.

Source: ACS Key Elements Documents 2016-2019

Global risks matter for the UK stress test for two reasons. First, many UK banks have direct exposures to overseas economies through their foreign branches and subsidiaries. Second, global risks can spill over to the UK macroeconomy because of trade and financial interconnections between the UK and other countries. Indeed, in the 2019 ACS scenario, more than half of the UK losses are generated by spill overs from global stress. This means that global risks have an indirect effect on the setting of the UK CCyB, even though the CCyB is only set against UK credit exposures. In contrast, losses on global exposures are covered by the PRA buffer or foreign CCyB rates where applicable. Through both channels then, rising global risks will manifest as larger declines in capital in the stress test.

The stress test also has enabled us to explore specific vulnerabilities that the FPC judged were building up in the system. One key example of this is consumer credit. In 2017, the FPC raised concerns over the rapid growth of consumer credit. We were concerned that lenders might be placing too much weight on the recent benign macroeconomic conditions when underwriting consumer credit and, as a result, underestimating losses under stress. We accepted that there had been some improvement in underlying credit quality since the crisis, but we judged that the improvement had been less material than lenders had assumed. In response, the FPC significantly increased the loss rates applied to consumer credit portfolios in the 2017 annual cyclical scenario.¹⁴ Loss rates were brought broadly in line with the historical relationship between unemployment and write-offs.

The test results in fact indicated that some lenders had not been taking adequate account of the potential for less benign economic conditions to feed back on the performance of their portfolios. We discussed the appropriate policy reaction-should the FPC raise the CCyB or increase capital required by all banks on consumer lending? The lapses varied between institutions, however, and the costs of these more

¹⁴ See Box 4 in Bank of England (2017) "Stress testing the UK banking system: 2017 results".

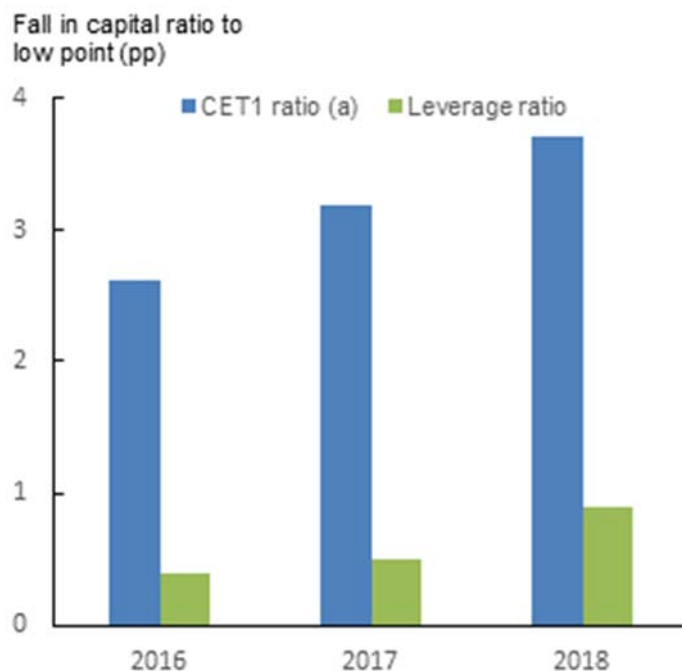
generalized responses were likely to exceed the benefits, especially where a more focused approach could be taken by the PRA. So, where weaknesses were identified, the PRA took micro-prudential actions to address them. Regulatory buffers for individual firms were set so that each bank can absorb these additional losses on consumer credit lending. This was combined with a PRA statement asking firms to respond to questions on their underwriting processes for consumer credit. Close cooperation between the FPC and PRC helped shaped stress tests that met the needs of both bodies and policymaking that addressed a systemic issue with the least possible costs to society.

Stress tests and countercyclicality. As we've discussed, stress test results are a key input to the FPC's decisions on the CCyB. The FPC uses these results together with indicators and judgment to assess the level of risk and of the banking system's resilience to that risk. For the CCyB to be able to counter the inherent procyclicality of bank risk-based capital calculations, the stress test inputs to the FPC's decisions should generate estimates of rising losses as risks increase. As a reminder, the scenario is updated to account for the business cycle (e.g. by first targeting the same level of unemployment) and the financial cycle in asset prices, but our framework goes further than that, ramping up severity when risks are judged to have increased.

As can be seen in Figure 4, this increase in severity shows through in the results.¹⁵ The impact of the credit and market components of the stress test have gradually increased since we started using the ACS framework in 2016. There is an increase in the capital stress impacts from 2016 to 2017, reflecting higher global impairments and traded risk losses. As close followers of the Bank of England's stress tests will know, we kept the UK scenario broadly unchanged between 2017 and 2018. So the higher fall in capital relates more to other factors, including an increase in competitive pressures reducing the net interest margins of banks compared to 2017. Some of it also reflects the introduction of IFRS 9, which required banks to anticipate loan losses in the severely adverse scenario - though we did take account of the available transitional relief and an adjustment to hurdle rates was also made to accommodate this effect.

¹⁵ Figure 4 has been adjusted for the mechanical effect of a higher starting point for capital. See note (a) in Figure 4.

Figure 4: Aggregate stress impact (excluding misconduct)^(a)



(a) The CET1 ratio is defined as CET1 capital resources divided by risk weighted assets (RWAs). A higher starting point capital ratio mechanically increases the percentage point fall in the ratio for a given increase in RWAs. For example, if RWAs double, all else equal a given capital ratio would halve – which would appear as a larger percentage point fall if the starting capital ratio is 20% ratio than if it was 10%. The figures presented in this chart remove this effect for the sake of comparability between years.

Source: ACS results 2016-2018, Bank of England calculations.

The stress test is an important cross-check on whether banks existing buffers are adequate. At the aggregate level those existing buffers comprise of the Capital Conservation Buffer (CCoB), the CCyB and the individual firms' PRA Buffer. For the UK banking system, that adds up to a buffer of around 3%. You can see from the chart that surviving the 2018 stress test, which includes a 4pp fall in capital ratios, would require more than just those buffers. And the decline in capital ratios to the low point was even larger-5 percentage points-when stressed misconduct costs are included. As explained in the 2018 stress test results publication, however, all banks cleared their hurdle rates and none had to strengthen its capital position as a result of the test even as they maintained lending.¹⁶ Banks could draw on the capital buffer they kept in excess of requirements; two of them triggered conversion of AT1 securities from debt to equity; they had to reduce distributions through dividends, share buybacks, and variable compensation; and they benefited from higher earnings as interest rates rose in the severe stress scenario.

¹⁶ Bank of England (2018) "Stress testing the UK banking system: 2018 results"

Research

As this is an academic conference, I thought it might be useful near the end of my remarks to briefly highlight research at the Bank on these topics and urge all of you to think about the opportunities to contribute to what is still a newly developing area of modelling and research in support of macroprudential policy.

I've already noted the importance that Bank of England modelling plays in producing stress test results. Going forward the Bank is investing in more granular models for key UK credit books that will allow it to explore risks that may not have been observed in historical macro-level data. The Bank has also made progress on incorporating feedback and amplification channels into the stress test results. These models allow the Bank to assess the plausibility and potential impact of banks' actions (such as selling assets) on each other and the wider market (for example by reducing market prices), such that potential risks from these channels can be incorporated consistently in the final stress test projections. As well as this 'asset contagion' channel, solvency contagion, risks in the unsecured interbank lending markets, and the feedback between banks' deteriorating solvency and increasing funding costs are also captured. In fact, given the reduction in interbank lending, reliance on wholesale funding, and other improvements in bank resilience since the crisis, to date, the contagion risks and spill overs have been relatively small or already incorporated in the scenarios.

But that might not be the case in all circumstances, and the Bank is developing an infrastructure that can interact its contagion models to support 'what if' analysis. Interacting contagion models will allow Committees to understand whether the outcomes in a stress scenario may differ if firms behaved differently to expected, such as by withdrawing funding from another bank or selling a larger quantity of illiquid assets.

And we have done a good deal of work on indicators of tail risk, including the GDP at risk literature highlighted by Alex Brazier in a recent speech.¹⁷

But there remain challenges and gaps in and research relating to the modelling of the dynamic evolution of financial networks and focus on the interaction of contagion channels. Most of the current literature focuses on a snapshot of the financial network at one point in time and then assesses how a shock propagates within that network. However the defensive reactions are often based on mechanical rules of thumb, and in this sense are limited to the fixed rules. A more realistic way to model shock propagation and more generally network dynamics would be to allow for contagion to happen on a network that is itself evolving, in the sense that financial institutions can react endogenously to the unfolding of the contagion and change their financial relationships dynamically.

In addition key challenges remain for further development and research on further integrating solvency and liquidity stress into a single modelling framework, and more. Areas where we have gaps include extending

¹⁷ See Brazier, A (2019) "Financial resilience and economic earthquakes"

models to the wider global banking system; considering feedback channels between banks and the real economy; considering links to the wider financial system and the impact of banks' actions on other institutions and researching the implications that information contagion plays in financial stability. Beyond banking sector stress tests, a major challenge is the development of a general equilibrium macro-financial framework that can mimic the way that the wider financial system and real economy endogenously generate crises. Such models could be used to find weak points in the financial system, where adding resilience could bring significant benefits for the system as a whole.¹⁸

Conclusion

Concurrent and transparent stress tests have been among the most important and effective reforms to come out of the efforts to build more stable financial systems in the wake of the GFC. In the UK they are a joint effort by both the macroprudential authority-the FPC-and the microprudential authority-the PRC-and have been extensively used by both. The FPC are determined to use the countercyclical capital buffer informed by the stress tests to ensure that bank capital is adequate to the risk environment-increasing it as risks build and releasing it as they crystalize to support continued bank lending to UK households and businesses; importantly owing to discipline in scenario construction, the stress tests have in fact been an effective, countercyclical, input into determining the appropriate level of the CCyB. They have also been used by the microprudential regulator, the PRC, to adjust bank-specific capital ratios to better capture risk. Moreover, the stress test process affords the PRC critical insights into the risk modelling and management practices of banks so it can assess the adequacy of each bank's capital planning.

The stress tests are an important cross check on FPC and PRC judgment and should be helpful to overcome any inaction bias that might creep into capital determination at some later date. In this regard, their transparency-about the scenarios and the results on an institution-by-institution basis--is critical to holding we policymakers accountable in the nascent and evolving area of macroprudential regulation. Transparent tests provide clarity to the market, should enhance market discipline on the banks, and build confidence.

All that said, it's important to keep an important caveat in mind: The CCyB and the stress tests have not been tested in an economic downturn. We need to be sure that capital builds up sufficiently with risks so that when the CCyB is released those who are funding banks have the confidence to support banks' efforts to continue lending to households and businesses even as the economy falls into recession. We need to make sure we do release the CCyB promptly, even proactively as in 2016, to allow banks the scope to make those loans even as losses begin to rise-and we need to assure that the stress test scenarios and results are fully supportive of an appropriate release. As I noted near the beginning of my talk, the Bank of England is expected to release an updated approach to stress testing document later this year. I am looking forward to the discussions I will have with my colleagues about how to further strengthen an already productive and robust system.

¹⁸ See Aikman et al (2019) "System-wide stress simulation" Bank of England Staff Working Paper No.809.

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