MEMORANDUM FOR	MFC Committee
FROM	Macro Financial Policy (Authors: Ashley Dunstan and David Hargreaves)
MEETING DATE	28 August 2017
SUBJECT	Implications of stress tests for calibration of capital requirements
FOR YOUR	Information

Summary

- This paper discusses the implications of stress tests for system resilience. This is partly motivated by the upcoming calibration of the capital review.
- Stress tests have consistently shown major banks falling to around the top of the conservation buffer, suggesting that that the most plausible outcome is that the banks would weather a severe downturn fairly well.
- This robust performance is contingent on underlying earnings remaining strong enough to gradually absorb substantial credit losses. We calibrate alternative scenarios where capital impacts are much more severe than in the stress tests.
- While these scenarios are in no way precise, we argue there is a credible case that banks should hold increased capital to be able to absorb them. 'Normal times' CET1 ratios of roughly 12-13.5 percent would be required to achieve our calibration of the desired trough in stressed capital ratios.
- A supporting MFC paper provides in-depth analysis of risks to profitability and net interest margins during a macroeconomic downturn. We continue to think profitability will tend to be robust in a NZ downturn, but this is not certain enough to rely upon.

1) Introduction

1. Stress testing is a critical component of a sound risk management framework, and is one means to assess individual bank and system resilience. It has been an RBNZ strategic priority for three years or so, and we (together with APRA) have run several tests of major banks since 2014. It is now timely to clarify the lessons from stress tests for system and individual bank resilience, especially given that minimum capital requirements are currently under review.

2. Capital ratios are set to ensure that the system remains solvent with a high degree of confidence. Given the significant uncertainty around how tail risks will affect the capitalisation of banks, and that many stress tests focus on an economic downturn without other tail risks being captured, a mechanical reading of the stress test results is not appropriate. We argue that it is important to understand the sensitivity of the

headline results to the underlying assumptions, and this has been a focus of both the 2016 and 2017 stress test exercises.[1]

3. Section 2 begins by reviewing the baseline view of system resilience from recent stress tests. We then establish that there are plausible alternative scenarios where credit and other losses are higher (section 3) and underlying profitability is impaired (section 4). Section 5 calibrates an alternative view of system capital outcomes under some of these scenarios, and discusses the implications for desirable capital levels.

2) The baseline view

### Capital outcomes during recent tests

4. The major New Zealand banks have been subjected to multiple regulatory stress tests in 2009, 2011, and every year since 2014. The tests have typically featured macroeconomic and asset price outcomes that are comparable to some of the worst financial crises in advanced economies. While results vary bank by bank and depending on the particular scenario, the resilience of capital ratios to stress events has been a common theme across multiple tests (see Dunstan (2016)).

5. For example, the recent results of Phase 1 featured a fall in the system CET1 ratio of 250 basis points, resulting in the system just breaching the top of the capital conservation buffer in year 3 (figure 1A and B). This is despite conservative assumptions on system demand for lending, and before taking into account improved capital positions resulting from mitigating actions.[2] We believe that these outcomes, if taken at face value and seen as accurate by the market, would allow the banking system to continue to provide essential functions and support real economic activity.

6. The significant dispersion in outcomes across banks highlights the uncertainty involved in estimating the impact of tail risk events. These differing outcomes are almost always driven by different modelling assumptions around how the scenario would impact credit losses and underlying profitability. The differences are too large to be fully explained by genuine differences in riskiness.

7. It is worth noting that we have not yet completed Phase 2 of the 2017 stress test. In addition to narrowing the dispersion of results across banks, we believe that Phase 2 is likely to result in the system capital ratio falling materially further than in Phase 1. This reflects more conservative assumptions around operational risk, credit losses (particularly mortgages), and defaults of large exposures. We are still discussing

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[1] The 2016 exercise was a reverse test, where banks had to come up with the most plausible scenario that would cause them to breach a minimum requirement. The 2017 exercise includes a focus on operational risk, which is an element largely missing from typical stress tests, and sensitivity of loss rates to changing assumptions. We draw on the lessons from these exercises throughout the paper.

[2] Common mitigating actions include cost-cutting, re-pricing for higher risk, reducing credit exposures, and tightening origination standards. While there is some uncertainty about the viability and feedback effects associated with some mitigants, they would likely play some role in boosting capital ratios. In the latest stress test, mitigating actions added around 80 basis points to capital ratios for most banks.

appropriate assumptions for Phase 2, both internally and with APRA, and will report on Phase 2 results in detail when they are available in October.[3]

Figure 1 Capital outcomes in recent stress tests

A) Peak impact on CET1 ratio in recent tests (pre-mitigant)
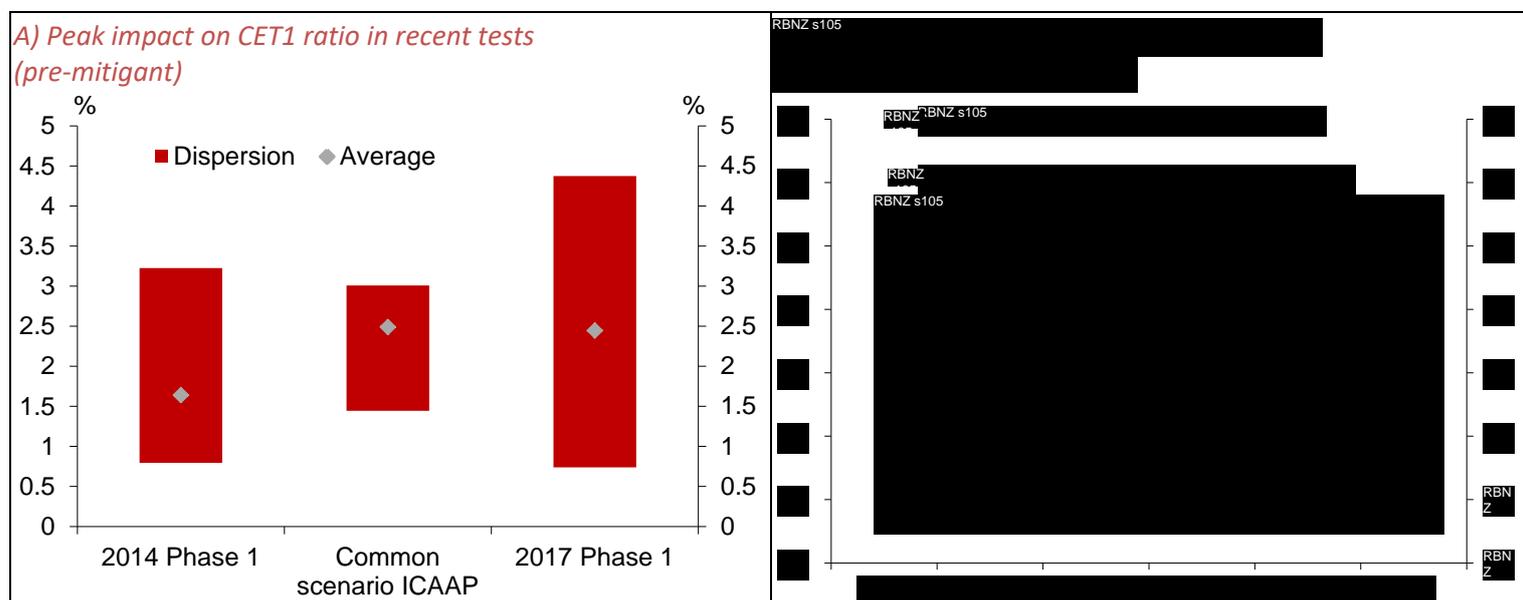
Interpretation of stressed capital ratios

8. At what point would stressed capital ratios raise serious concerns about system capital levels? As capital ratios move nearer to the minimum, it is likely that the scaling up of mitigating actions related to deleveraging, re-pricing, and tightening origination standards could significantly impair economic activity, particularly if it appears difficult to raise fresh capital.[4] This suggests that maintaining a buffer of system capital above the minimum requirement is desirable during a severe downturn.

9. Our paper quantifies the decline in capital ratios under alternative stress scenarios. In order to illustrate the possible implications of this for 'normal times' capital ratios, we assume trough capital well above the CET1 minimum (ie 6-7%) is needed to maintain investor confidence after a severe systemic shock. If the capital review settles on a different level for the 'desired trough' in a severe downturn, the results in this paper can be adjusted accordingly.

10. It is important to note that the desired trough capital ratio (above the minimum) should depend on the severity and nature of the scenario. For example, it seems appropriate that we would tolerate a much lower trough in a scenario featuring

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[3] We could potentially do a 'phase 3' scenario with additional idiosyncratic events striking each bank, similar to the third scenario we model below, or consider doing this in a future stress test.

[4] As bank capital ratios fall, they reach a point where it is unrealistic to expect existing shareholders to negotiate capital injections, as most of the benefit of the fresh capital ends up accruing to creditors of the bank (existing shareholders get severely diluted). If accounting/regulatory rules permit banks to calculate their retained earnings in a way markets don't find credible, that 'crisis point' may be much higher. For example, Lehman Brothers had a tier 1 ratio of 11% five days before bankruptcy (The Economist, 2010).

idiosyncratic risk, as competitors may be able to offset the impact of mitigating actions, and could potentially purchase the stressed bank.

3) Risks to losses

11. Recent stress tests have found that the bad debt charge would cumulate to between 3.6 and 7 percent of starting loans and advances throughout the stress horizon (figure 2A). Most of these losses occur in the first three years of the scenario, so they will contribute to the peak impacts on capital ratios summarised in the previous section.[5]

12. The stress test results are highly sensitive to the scale and timing of credit losses, and how they are realised. All else equal, every 50 basis point increase in the loss rate throughout the first three years of the scenario leads to a similar sized decline in the CET1 ratio trough.

A worse result for the system

13. The stress test loss rates are significantly higher than the 1.5 percent loss rate during the GFC. However, several advanced economies have experienced significantly higher credit losses during severe macroeconomic downturns (figure 2B). For example, system loss rates were approximately:

    o 5.5 percent in New Zealand during the early 90's[6], and 8.5 percent in Australia (Rodgers (2015)).
    o 11-19 percent for Nordic countries during the early 90's (Drees and Pazarbaşioğlu (1998)).
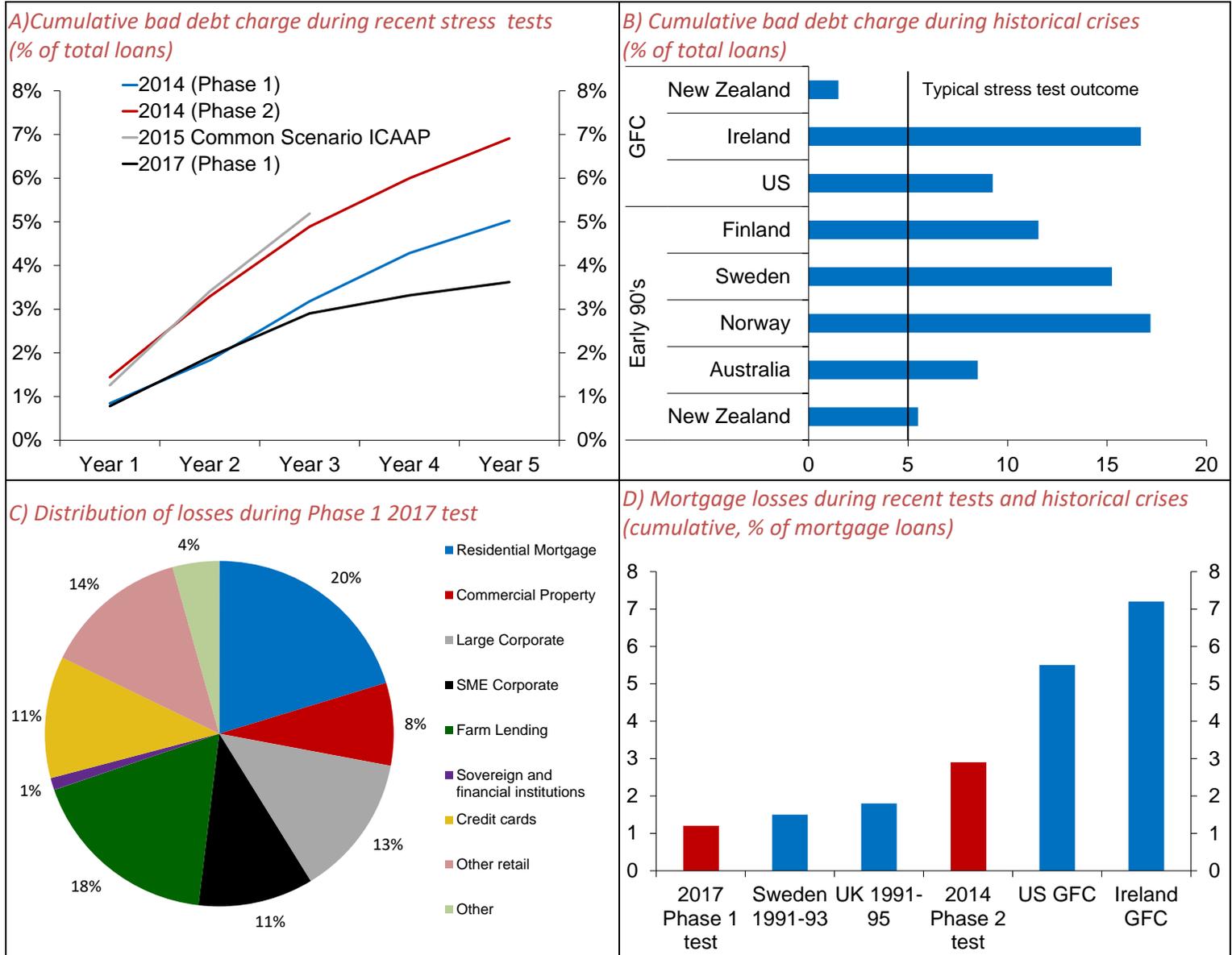   o 9 and 17 percent in the US and Ireland respectively during the GFC.

    While there are many good reasons we expect New Zealand banks to perform better than their overseas counterparts, these historical loss rates serve to highlight the scale of upside risk to system stressed losses, and the relatively mild GFC experience in New Zealand.

14. Loss rates on residential mortgage are a particularly crucial judgement in the stress tests. Despite 60% of bank lending now being residential mortgages, they only account for 20% of system losses (figure 2C). This is consistent with the historical experience that residential mortgage loss rates are typically significantly lower than losses on other bank loans (Kragh-Sorenson and Solheim, 2014). However, debt levels (LVRs and DTIs) have risen substantially over the last 30 years, and some economies did experience substantial mortgage losses during the GFC. Figure 2D shows losses from the US and Ireland against recent stress test results. In Phase 2 of the 2017 test we expect losses to rise from 1.1% to around 2.1%.

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[5] The 2014 test featured continued growth in losses in years 4 and 5, due to a double dip recession in the scenario. This is significantly different to the outcome in 2017. The 2015 Common Scenario ICAAP was a three year scenario.

[6] We have computed this figure based on data from RBNZ bulletin articles in the early 1990's.

Figure 2 Comparison of stress test credit losses and historical downturns

A)Cumulative bad debt charge during recent stress tests (% of total loans)

B) Cumulative bad debt charge during historical crises (% of total loans)

C) Distribution of losses during Phase 1 2017 test

D) Mortgage losses during recent tests and historical crises (cumulative, % of mortgage loans)

Concentrated losses

18. In addition to the scale of losses, their timing throughout the stress horizon has a large impact on capital outcomes. If losses are concentrated within a short period of time, there would not be time for underlying earnings to offset the losses, so that capital ratios would trough much lower. The timing of defaults and losses throughout a downturn scenario is highly uncertain, although the three year peak impact is broadly consistent with historical episodes.

19. One scenario that could lead to concentrated losses is if banks follow an "extend and pretend" strategy to recognising credit losses and continue to pay dividends. For example, borrowers could be provided with interest only or other concessionary restructurings to avoid them being classified as in default and generating a specific

provision.[7] This latent default problem could require a large concentrated provision later in the stress event, once it becomes clear that the loans are not going to recover. The impact would be amplified if banks continue to pay dividends for a period once the downturn begins.[8] Dividend payments in the first six months of the 2017 test reduce the trough CET1 ratio by approximately 70 basis points.

Constraints on ability to work out losses

20. Our stress test results assume, for reasons of tractability and comparability, that banks dispose of all troubled assets at the end of the year they become non-performing. A slower rate of asset disposal would lead to a significantly higher LGD for some loans, and more RWA expansion (as troubled assets remain on balance sheets for longer).

21. Operational risk events have been a key driver of write-off delays in several countries after the GFC, reflecting failures to comply with existing law (e.g. consumer contracts act), or Governments directly legislating to restrict mortgagee sales. For example, there have been foreclosure moratorium (Ireland), compulsory conversion of foreign exchange mortgages into local currency (Hungary), difficulty recovering on some mortgages because of paperwork problems (the United States); and compensation cases due to mis-selling of mortgages (United Kingdom).

22. Operational risk events were a key focus of the 2016 reverse test and Phase 1 of the 2017 test. The operational risk events modelled by banks draw on many of the historical episodes noted above. The individual scenarios tend to focus on one dimension of operational risk, resulting in capital ratios falling by around 50 basis points. In reality the losses could be substantially larger:
    - The compensation packages emphasised by some banks could interact with delays in being able to write-off distressed customers emphasised by others, resulting in larger capital impact. For example, it is plausible that legal cases and compensation take some years to resolve, so that write-offs of disputed loans are not possible.
    - Operational risk events could place additional pressure on bank margins in order to underwrite their reputation and support long-term customer relationships. This reflects the likely negative sentiment towards banks and overhang of distressed customers.

4) Risks to underlying profitability

23. Banks in NZ have generated very strong profits over a number of years. Their central view in the stress tests is that they will largely be able to pass on funding cost

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[7] These events should be classified as a default under BS2B, but in practice banks may be able to get around the rules in a crisis.

[8] US banks paid substantial dividends during 2008, with Lehman brothers increasing its dividend in Q3 of 2008, shortly before failing. Most were then forced to stop dividends during 2009 – see Acharya et al (2012). European banks paid substantial dividends in recent years despite market scepticism about their future health (see the Economist (2017))

increases during a stress scenario, consistent with experience of GFC and current degree of market power. Although there is often substantial variation across banks, it is typical for system margins to decline by 25-50 basis points in the first few years of the scenario before stabilising in subsequent years.

24. It does not take a large change in margins to translate into a substantial impact on capital. A 25 basis point decline in NIM reduces profits by approximately 75 basis points of assets over 3 years. Because risk weighted assets are less than actual assets (even in a downturn scenario), the impact on capital would be approximately 115 basis points.

25. Future profitability is not the same as capital. There are various reasons that profitability could be eroded, as discussed in Bruce's paper. As alluded to above, one possibility is that banks come under pressure to reduce margins to maintain long-term customer relationships (especially if borrowers are struggling and there is strong negative sentiment towards banks). Below we summarise two additional scenarios from Bruce's paper that would be likely result in a more substantial shift in margins.

Name crisis

26. A 'name crisis' for an individual bank is a loss of confidence that forces it to pay more for funding than its peers. This could occur quite suddenly, and would likely be a result of other underlying problems within that particular bank. As the market becomes aware one bank faces much larger losses, it is likely to charge a funding premium to that bank, eroding the banks' ability to trade its way out of difficulty. Any additional funding premium paid by an individual bank will have a substantial impact on profits.

27. A name crisis fits with the pattern of historical crises, where losses have often been very unevenly distributed. For example, the worst affected banks during the early 90's period of distress in Australia (State Banks of Victoria and South Australia) lost more than 300% of starting shareholder's funds, compared to 36% of starting shareholder's funds for the system (Gizycki and Lowe, 2000). While this sort of dispersion is less likely amongst the major NZ banks given their similar business practices and asset composition, it still seems feasible that some banks will be impacted more than peers in a severe downturn.

28. Importantly, this cannot happen to all the key banks simultaneously, in the sense that if they all face rising funding costs, they will be able to pass that on without losing substantial market share. This suggests that the RBNZ may be comfortable with an individual bank's capital falling further than the system due to idiosyncratic events (since competitors could offset the impact of deleveraging by the stressed bank and potentially acquire their book).

New competitor or business model

29. A foreign competitor or new business model (e.g. securitised mortgages being sold to institutional buyers, as in the Netherlands recently) could undercut the big NZ banks

and eat into profit margins. Increased competition from a new entrant or business model would present the most significant challenge if it happened shortly before (or during) a severe downturn. In this situation it would be difficult for banks to raise capital to offset the likely erosion of their future profitability, given the increased likelihood of failure.

30. In the scenario where a foreign competitor or new business model took away the pricing power of the major banks during the upswing of the credit cycle, our analysis suggests we should look to raise system capital ratios. We suggest there would probably be time to do this given the slow moving nature of market share.

31. It is also worth noting that the *prospect* of entry could be one reason why banks to be particularly careful about maintaining long-term customer relationships during a downturn.

5) Calibration of alternative scenarios

32. During the FSAP, we developed a stylised top down stress testing model which used assumptions on key drivers (e.g. net interest margins, RWA expansion, and credit loss assumptions) to forecast bank balance sheets. This model can be used to replicate the 2017 Phase 1 stress test results, and then apply more severe assumptions around loss rates and underlying profitability.

33. We calibrate three alternative scenarios in order to illustrate the sensitivity of stressed capital to underlying assumptions, drawing on the discussion above (figure 3). These scenarios are in no way precise and judgement is required to interpret their implications for 'normal times' capital ratios. Our interpretation is that CET1 ratios of the order of 12-13.5 percent would be required to weather the more severe outcomes.

High system loss

   a. This scenario assumes a loss rate for the system of almost 6 percent, with most of the losses concentrated in the first three years of the stress scenario (figure 3B). The loss rate is based on the 2015 Common Scenario ICAAP test, which featured a more severe macroeconomic scenario than the 2017 test. (This results in significantly more severe outcomes than in 2015, due to the other assumptions from 2017 being more stringent, eg asset growth).
   b. The system CET1 ratio declines by approximately 550 basis points (figure 3A), enough to touch the bottom of the buffer ratio under current requirements. This could impair the recovery, and we suggest starting with CET1 ratios around 12 percent (so that the CET1 trough is around 6.5 percent) would lead to a better economic outcome.

Operational risk

   a. This scenario overlays the previous one with a much larger operational risk event. We assume a compensation case related to mis-selling of mortgages, which
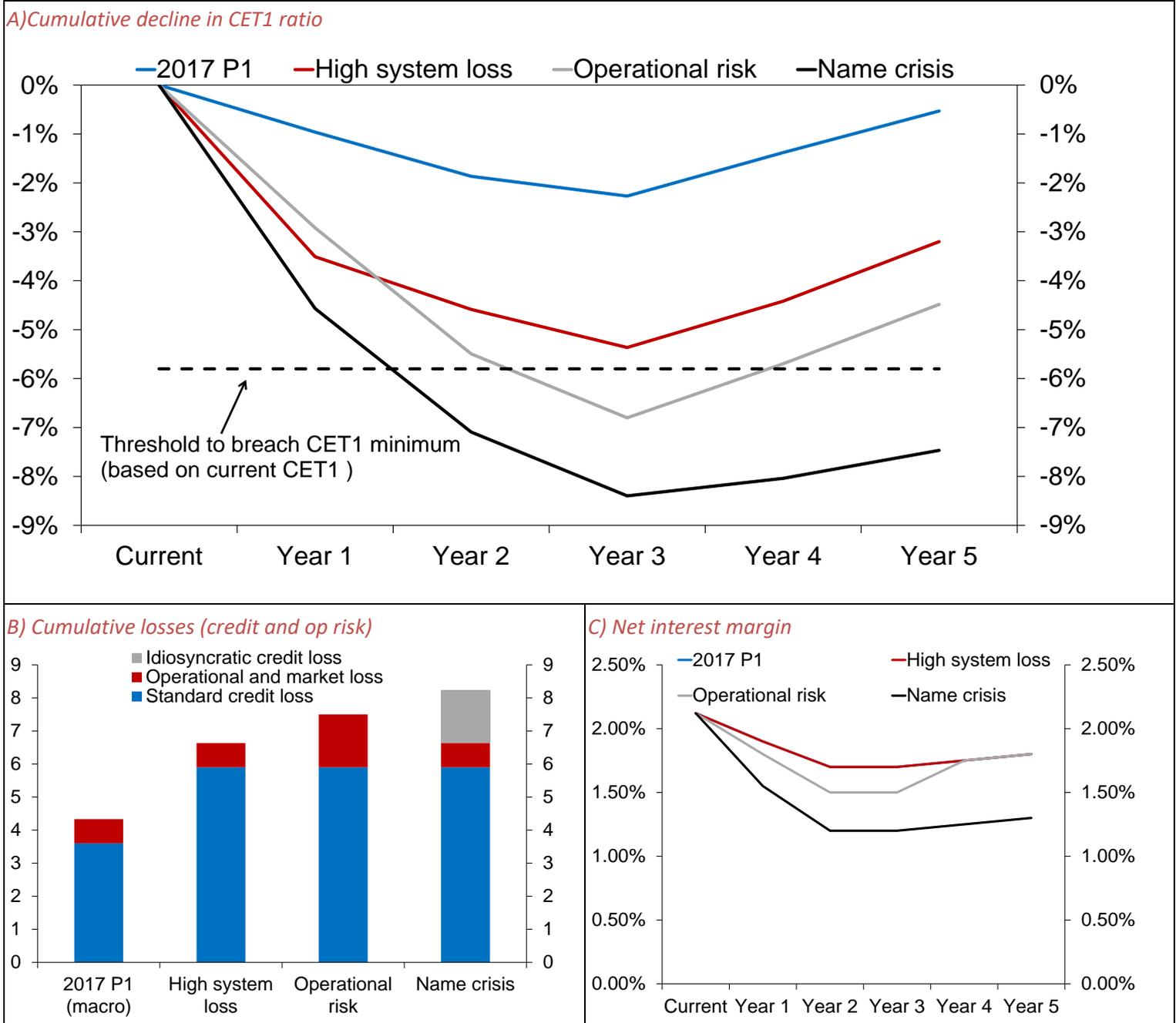
takes until year 3 to reach a ruling, combining the worst elements of the banks' 2017 scenarios.

b. Total losses are around 90 basis points higher (figure 3B), with the impact evenly split between compensation to affected customers and higher LGD due to delays foreclosing. In line with the discussion above, we also assume there is a further 15 percent RWA growth as defaulted customers stay on the book longer, and an additional 20 basis point fall in NIM (figure 3C).

c. The CET1 ratio declines by approximately 700 basis points (figure 3A). This suggests that the CET1 ratio would need to start around 13 percent to trough around 6 percent.

Name crisis

d. This scenario assumes that credit losses increase by a further 160 basis points for the worst affected bank (figure 3B, this is over and above the 2015 system result). ██

e. As the higher losses are assumed to be idiosyncratic to this bank, they are likely to face a significantly higher cost of funding than peers. It is assumed that their NIM reduces by 50 basis points (figure 3C, note this is similar to the name crisis modelled in ████ reverse test).

f. The name crisis has potentially severe implications for an individual bank (figure 3A). An initial capital ratio of 13.5 percent would be required in order to keep the bank 50 basis points above the current minimum CET1 requirement (ie around 5%). However, their peer banks would still be around 8%. This would probably allow those banks to either take over the weakest bank or gain market share as it deleverages.

34. It is important to note that the system may still have trouble continuing to lend if their capital ratios are not credible to markets (they don't believe it reflects the risk position of the banks). As stated above, the level of capital that keeps the system functional depends on how vigilantly the regulators ensure that banks are provisioning sufficiently for likely losses as the loan portfolio deteriorates. This is likely to be challenging when parent banks may be putting subsidiaries under pressure to upstream profits, and auditors have tended at times to be sceptical about raising collective provisions (as this reduces taxable profits).

35. Finally, the idea that banks may sometimes need to reduce capital well below the starting level seems consistent with making more of the normal times requirement a buffer (e.g. a conservation buffer, or a countercyclical buffer) so markets don't panic when capital ratios fall.

Figure 3 Alternative stress test calibrations

A)Cumulative decline in CET1 ratio

B) Cumulative losses (credit and op risk)

C) Net interest margin

Conclusions and next steps

34. Stress test results are broadly sensible as a base case estimate of a severe but plausible scenario. But outcomes are highly sensitive to changes in assumptions around credit losses and underlying profitability. A system CET1 ratio of approximately 12-13.5 percent (normal times) seems appropriate if we want banks to be capitalised to absorb a range of possible outcomes during a severe downturn.

35. We suggest that the ideas in this article could be used to write a bulletin article (and/or perhaps a section in a capital consultation paper) explaining our view on how stress tests inform aggregate capital setting. Some submissions for the initial capital consultation have suggested that passing stress tests mean current capital requirements are sufficient, making this communication important.

36. This paper has focussed on the implications of the stress tests for system capital requirements. To date, we have not used stress tests very actively as an input to individual bank capital requirements, unlike some other regulators. For example, the US approach aims to provide a market signal about the relative strength of individual banks, and to effectively create 'add-on' capital requirements for banks where stress test results seem to imply a need for it.

37. Our approach has been to focus on what results tell us about the risks facing the overall system and particular loan portfolios. While we think the results we are getting from banks are more credible than 3 years ago, substantially more resources would be needed in order to use them in the US way. This reflects that we would need a greater degree of confidence that the stressed capital outcomes reflected genuine differences in risk across banks. It is also important to note that the application of individual Pillar 2 capital is not currently part of the Bank's supervisory approach.

38. This would likely entail investing in getting better harmonised data about loan portfolios, and undertaking more in-depth monitoring of banks results, to mitigate the incentive for banks to understate the risks they face. The Federal Reserve collects a lot more useful credit quality data and devotes a lot of resource to analysing it.[10] The Federal Reserve uses this data, along with an in-depth understanding of the credit models used by banks, to provide a comprehensive cross-check on bank results

39. An easier next step would be to re-calibrate risk weights based on stress test results. For example, banks consistently tell us their losses on consumer and SME lending would be disproportionate to their starting capital for those loans.

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[10] For example, the IRB banks give us their corporate portfolio by PD grade (e.g. AA-), but we don't get objective measures of the health of that loan book such as interest coverage ratio.

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