NO STRESS

The flaws in the Bank of England's stress testing programme

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1. Executive summary

In 2014 the Bank of England carried out the first stress tests of the capital adequacy of the major UK banks, and its subsequent report claimed that the results demonstrated the resilience of the banking system.

This study challenges this conclusion: it suggests that the Bank's stress tests are methodologically flawed, and that that Bank's own results properly interpreted indicate that the UK banking system is actually very weak.

Methodological flaws include the dependence on (1) a single questionable stress scenario, (2) inadequate data, (3) poor metrics and (4) unreliable models, especially risk models. The stress tests also (5) create systemic instability by forcing banks to standardise towards

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the Bank's models, and lack credibility (6) because the Bank cannot be expected to say that the banking system is in anything other than good shape and (7) because of the Bank's own dismal forecasting record since the onset of the Global Financial Crisis.

The minimum capital requirement in the Bank's stress test is a 4.5% ratio of Common Equity Tier 1 (CET1) capital to Risk-Weighted Assets (RWAs). However, the CET1 capital measure is unreliably soft, and the RWA measure is undesirable because it is easily gamed and increasingly blind to the risks taken. A 4.5% CET1/RWA ratio is also below the minimum requirements to be implemented under Basel III, and alternative stress tests based on the Bank's exercise but using higher hurdle ratios or a minimum leverage (capital) ratio indicate that the UK banking system is in very poor shape.

Concerns about the reliability of regulatory stress tests are confirmed by the abysmal track records of similar exercises overseas: these indicate that such exercises are highly counterproductive and failed to detect the risk build-ups they were meant to spot – including three cases where whole banking systems collapsed unexpectedly.

The Bank's stress tests are highly unreliable and worse than useless because of their tendency to provide false risk comfort. The Bank asks us to believe that there are no icebergs out there merely because the Bank's own radar fails to detect them – essentially the same radar that completely missed the last iceberg that sank the banking system in 2007-2009.

The Bank's stress testing programme should be aborted forthwith, and reformers should focus on the restoration of sound accountancy standards, an end to regulatory risk modelling and the re-establishment of strong bank governance systems that make decision-makers personally liable for the risks they take.

2. Introduction

In 2014 the Bank of England initiated the first of what it anticipated would be an annual programme of stress testing the capital adequacy of the UK banking system. This programme is significant because its results will help the Bank to come to a view regarding the financial health of individual banks and of the banking system as a whole. Reassuringly, the 2014 stress testing exercise led the Bank to conclude that the UK banking system was robust enough to withstand another severe downturn.

But how reliable is the programme and can we be confident that the banking system is as strong as the Bank suggests?

The policy analysis presented here suggests that the programme is seriously flawed and the Bank's confidence unwarranted. To start, it violates some of the principles of good stress testing methodology, including most basically the need to consider a range of alternative scenarios and not just the one scenario considered by the Bank. Bank control over the banks' modelling has the capacity to create systemic instability by forcing the banks to use risk models that incorporate the weaknesses of the Bank's own models, and the Bank's modelling is compromised by political factors that undermine any credibility that the exercise might have had. The exercise relies on flawed data and flawed capital-ratio metrics – most notably, an insufficiently

conservative capital measure in the numerator and the use of an unreliable (because easily gameable) 'risk-weighted' asset measure in the denominator. The Bank also uses an insufficiently high hurdle ratio – the specified minimum post-stress capital ratio – and the same exercise based on a higher hurdle ratio in line with the minimum international requirements to be implemented under Basel III would have suggested that the UK banking system was actually in very poor shape. So would an analysis based on the use of a minimum leverage ratio capital requirement, which is also to be implemented under Basel III. The single scenario considered is also highly questionable and the Bank's credibility to carry out such exercises is undermined further by its own dismal forecasting record since the onset of the Global Financial Crisis (GFC). Finally, concerns about the reliability of regulatory stress tests are confirmed by the very poor track records of similar exercises overseas.

The Bank's stress tests are therefore highly unreliable and the UK banking system is much weaker and more vulnerable than the Bank of England would have us believe.

This study is organised as follows. Section 3 outlines the programme itself: its background, and the objectives and results of the 2014 stress testing exercise. Section 4 provides an assessment of the 2014 exercise: it sets out the principles of good practice in this area and compares the 2014 exercise against them. Section 5 carries out some stress tests of the Bank's own stress test – it varies the hurdle ratio and capital ratios used in line with accepted best practice – and concludes that any reasonable exercise would have confirmed that the U.K. banking system was in very poor shape. Section 6 examines the experiences of regulatory stress tests overseas and the lessons to be drawn from them, and section 7 concludes.

3. The Bank's stress testing programme

In March 2013 the Financial Policy Committee recommended that the Bank and the Prudential Regulatory Authority (PRA) should develop proposals for regular stress testing of the UK banking system. The Bank's proposals were subsequently published in October that year in a Discussion Paper, "A framework for stress testing the UK banking system"[2], which proposed an annual programme of concurrent stress tests involving the bigger UK financial institutions. As it explained, the "main purpose of the stress-testing framework is to provide a quantitative, forward-looking assessment of the capital adequacy of the UK banking system and [of] individual institutions within it" (p. 7).

Amongst various secondary objectives, it was hoped that the programme would "provide a device through which the Bank can be held accountable to Parliament and the wider public, on its financial stability objective, by allowing the FPC and the PRA Board to

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

articulate the resilience standard against which they hold the banking system" (loc. cit).

A further secondary objective was to "bolster public confidence in the stability of the system, by demonstrating the range of severe, but plausible [stress scenarios, note the plural] that authorities expect the banks to be able to withstand" (loc. cit). How much capital constitutes adequacy is, however, a difficult question and would be a policy decision for the FPC and the PRA, but "[a]t the very least, banks would need to maintain sufficient capital to be able to absorb losses in the stress scenario and not fall below internationally agreed minimum standards" (p. 8).

Further details of the stress testing programme for 2014 were published in a subsequent Bank Discussion Paper in April that year.[3] This document identified the banks to be included in the 2014 stress tests: Barclays, the Co-operative Bank, HSBC, Lloyds Banking Group, Nationwide, Royal Bank of Scotland, Standard Chartered Plc and Santander UK. As of end-2012, the combined capital of these banks amounted to over 95% of the capital of the 30 significant banks comprising the UK banking industry.[4] It also set the out the capital ratio to be used – common equity Tier 1 (CET1) as a ratio of risk-weighted assets (RWAs) – and the minimum threshold for this ratio, 4.5%, which is currently the minimum Tier 1 regulatory capital requirement for UK banks.

The Bank's Discussion Paper also set out the Bank's scenario – note the singular: the Bank quietly drops its earlier emphasis on multiple scenarios with no explanation offered: there was now only going to

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3 "Stress testing the UK banking system: key elements of the 2014 stress test," Bank of England Discussion Paper, April 2014.

4 Bank of England, 2013, p. 17, Table A.

be one. The scenario to be modelled consisted of a series of mainly domestic shocks – a major housing downturn and major increases in interest and inflation – over the 3-year period to the last quarter of 2016. The Bank's scenario produces the impacts on key macroeconomic variables illustrated in Figure 1, in which the stress scenarios for real GDP growth, unemployment and CPI inflation are superimposed on the Bank's 'fan chart' probability projections of those same variables: in these scenarios we have a severe fall in output with year-on-year real GDP growth falling to -3.2% before bouncing back to 1.2%; a near doubling of the unemployment rate from 6.6% to 11.8%; and a sharp upturn in annual CPI inflation which rises from 1.8% to peak at nearly 7% before falling back to 6%.

FIGURE 1A: GDP GROWTH IN THE STRESS SCENARIO RELATIVE TO THE FEBRUARY 2014 INFLATION REPORT PROJECTION

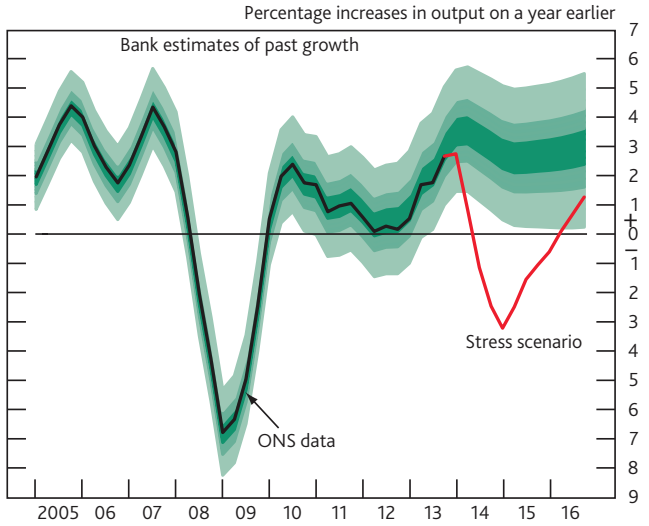


FIGURE 1B: UNEMPLOYMENT IN THE STRESS SCENARIO RELATIVE TO THE FEBRUARY 2014 INFLATION REPORT PROJECTION

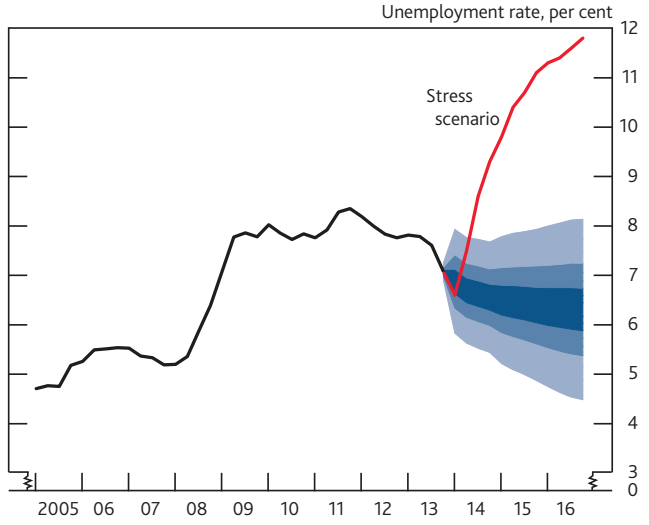
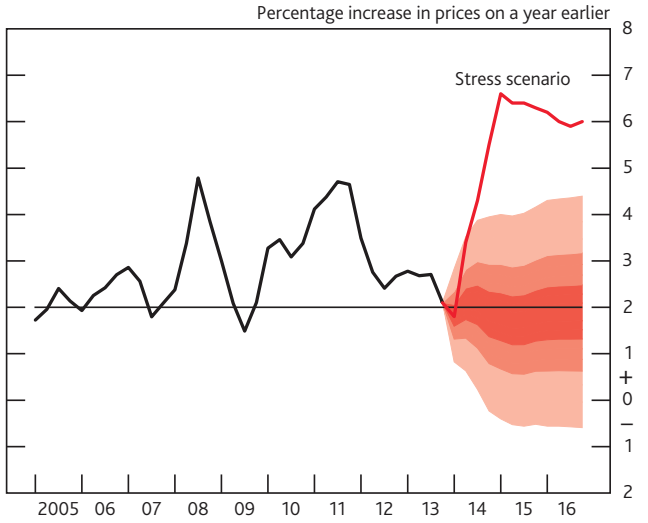


FIGURE 1C: CPI INFLATION IN THE STRESS SCENARIO RELATIVE TO THE FEBRUARY 2014 INFLATION REPORT PROJECTION[5]



The results of the stress test were announced in December 2014. In terms of the Bank's headline CET1 capital ratio, the main results were as follows:

- Barclays: capital ratio down from 9.1% at the end of 2013 to 7.5% after the scenario and post the assumed remedial management action.
- Co-op: down from 7.2% at end-2013 to -2.6% after scenario and post remedial action etc.
- HSBC: down from 10.8% to 8.7%
- Lloyds: down from 10.1% to 5.3%
- Nationwide: down from 14.3% to 6.7%

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5 Figures 1A-C reproduced from Bank of England "Stress testing the UK banking system: key elements of the 2014 stress test," (April 2014), p. 7. Available at http://www.bankofengland.co.uk/financialstability/Documents/fpc/keyelements.pdf.

- RBS: down from 8.6% to 5.2%
- Santander: down from 11.6% to 7.9% and
- Standard Chartered: down from 10.5% to 8.1.

On the basis of these results, the Bank rejected the Co-op's capital plan and concluded that the Co-op, Lloyds and RBS needed to strengthen their capital positions further.

The poor performance of the Co-op was no surprise, even to its own management, but it is interesting that Lloyds and RBS were still judged to be in need of further strengthening 7 years after being bailed out at enormous expense by the taxpayer.

However, most banks came out looking fairly well and the aggregate capital ratio post the stress scenario was a supposedly healthy 7.5%. The take-home conclusion offered by the Bank was that the *banking system as a whole was sound*: as Governor Carney stated at the December 16 press conference, the results show "that the [UK banking system] has the strength to continue to serve the real economy even in a severe shock."

But not everyone shared Carney's optimism – not even his predecessor. As Mervyn King told the *Today Programme* on December 29 last year, less than two weeks after the publication of the Bank's stress tests: "I don't think we're yet at the point where we can be confident that the banking system would be entirely safe," he said with classic understatement – and as if to emphasise his reservations, he pointedly failed to endorse his successor's interpretation of the stress test results.

4. Methodological issues

4.1 PRINCIPLES OF GOOD STRESS TESTING METHODOLOGY

Before examining the Bank's stress testing exercise, it is useful to go back to basics and set out the core principles of good stress testing. Let us suppose that we are interested in stress-testing a particular portfolio held by a particular bank. We build the model, the calculation engine, which generates outputs from inputs: this will typically be built using a spreadsheet. We then calibrate the model to approximate the size and composition of our portfolio. The output of the model would be expressed in terms of a metric such as the loss on the portfolio or a capital ratio. We then posit a number of stress scenarios – we more or less pull these out of thin air – and we use the calibrated model to 'project' the loss or capital ratio that would occur under each scenario.

In commercial practice, the results of such an exercise would inform the bank's risk management strategy. When carried out by a central bank or financial regulator, stress tests would be applied to a model of

a bank's total portfolio, the results would be used to assess the bank's capital adequacy over the near future, and the bank's proposed capital plan would be approved or rejected depending (primarily) on whether the post-stress capital ratio exceeded the specified minimum hurdle ratio in each of the scenarios considered.

Perhaps the most difficult task in stress testing is the selection of scenarios. Since the future is (highly) uncertain, we want a range of substantially different scenarios that we hope might approximate the main risks that the banks face, as best we can perceive them. However, there is no magic formula to tell us how many scenarios we should consider, other than that we shouldn't put all our eggs in too few baskets, i.e., we have to make a judgment about how many to use. There is also the problem of choosing the severity of each scenario: if the stress scenario is too mild, then the stress isn't really much of a stress and the outcome of the exercise is of little use for practical risk management; on the other hand, if the scenario is too extreme, then it becomes extremely improbable and is again of little use. So we need the stress scenario to be severe but not too severe – there is a Goldilocks balance: not too hot, but not too cold – and we have to use judgment to try to get the balance 'right'.

The key issues are therefore: (a) the model itself, which connects the inputs to the projected outputs, (b) the data used to calibrate the model, (c) the metrics in terms of which the model's outputs are expressed, including the pass/fail hurdle ratio, and (d) the scenario(s) considered. Let us consider each of these in turn as they apply to the Bank's stress tests:

4.2 MODELLING ISSUES

The Bank's approach makes use of a suite of models, some its own, others the models of the individual banks involved – though in using the banks' own models, the Bank has to take into account an important moral hazard involved: the incentive that banks face to underestimate the impact of adverse scenarios to improve their final score. Leaving aside how it would address this moral hazard problem, the Bank would carry out partial-equilibrium analysis of each model on a stand-alone basis to gauge first-round effects. This analysis would then be supplemented by system-wide analysis that attempts to capture feedback, interaction or amplification effects across institutions and markets – these might include effects on market interest rates, liquidity, credit or confidence, as well as interactions between the real and financial sectors of the economy – in an attempt to model the resulting general equilibria (GE); these effects would primarily be modelled by the Bank itself.[6] However, the Bank acknowledges that research in this latter area is still at an early stage and the systemic GE effects of scenario modelling are far from well understood.

I would say that these latter claims are understatements. GE modelling in this area is little more than educated guesswork but more worrying is that GE models can easily be manipulated to generate almost any system-wide effects one thinks there should be. So if the Bank view is that systemic effects are important, then the GE modelling will show that these effects are important. However, such results would be far from scientifically demonstrated: instead, they would merely reflect the subjective judgments fed into the models in the first place.

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6 For more on the Bank's scenario modelling, see Bank of England "A framework for stress testing the UK banking system"(2013, Box 4, pp. 26-27).

The Bank discusses these issues as if they were simply technocratic problems that could be resolved by further academic research and by the Bank assuming greater control and throwing more resources at them. In fact, nothing could be further from the truth: these modelling problems are not only unresolvable in principle, but a concerted effort to resolve them has the potential to be highly counterproductive.

Consider the modelling moral hazard problems between the banks and the Bank. At first sight, the Bank's solution of taking control over the banks' stress modelling might seem a reasonable one: the Bank has more expertise, a wider view and a wider remit, etc.

However, increasing Bank control exacerbates the problems of genuine risk management. Model-based risk control is problematic even in the best-case scenario when you have local risk management. Risk takers such as traders will always respond to any risk management system by exploiting its blind spots – exploiting under-estimated risks – and no risk model can take into account how it will be gamed by those whose behaviour it attempts to model: there is a Goodhart's Law at work by which any risk model has a tendency to break down when used for risk management purposes. My point is these control problems tend to worsen as risk control becomes more centralised and more divorced from actual risk-taking decisions: the control system becomes more complicated, more standardised, more porous, and therefore more gameable. The natural response from the central bank is then to become more prescriptive about the banks' risk-taking as well, and the banking system moves further and further towards central planning – a process we can already observe well under way in the United States (of which more below).

Another problem is that the Bank standardising banks' stress practices destabilises the banking system by exposing the whole system

to the weaknesses in the Bank's own models. It also destabilises the system by suppressing the innovation and diversity in the bank risk management practices on which the stability of the system depends: we cannot achieve systemic stability if institutions all follow the same risk management strategy, e.g., by all attempting to sell in a crisis; instead, systemic stability requires differential responses, i.e., contrarianism, whereby some institutions buy in a crisis when others sell.

There is also another moral hazard problem – that between the Bank and its stakeholders, i.e., Parliament and the public – and giving the Bank greater responsibility makes this moral hazard worse. To illustrate, consider what would happen if the Bank were to publish results that suggested that the banking system was in bad shape. Such results would immediately undermine the Bank by highlighting that it had failed to restore the health of the banking system despite all its past promises and the massive public expenditures devoted to doing so. Publication of the results would also have the potential in itself to shatter public confidence in the banking system and trigger a renewed banking crisis. Remember, too, that promoting public confidence in the banking system is not only one of the purposes of the stress tests, but also one of the core duties of the central bank. It follows, then, that we cannot realistically expect the Bank to publish results that are too negative: even if the Bank had severe doubts about the strength of the banking system, it cannot admit to them – and everyone knows this. The stress tests cannot then be credible, because only a reassuring answer can ever be allowed.

It is therefore naïve to assume that the Bank is some disinterested public servant committed to pursuing the 'public interest' whilst the lesser players selfishly pursue their own interests. Instead, we should see the Bank for what Public Choice economics tells us that it is – a

public agency with its own self-interest and agenda.[7] Public Choice also tells us to expect the same self-serving party line: lessons learned so don't bother us with past mistakes, you can trust us in the future, give us more power and more resources, etc. – which, by a curious coincidence, is what the Bank always says.

4.3 RELIANCE ON FLAWED DATA

There is also the problem that no model is of any use if poor data are fed into it. Most stress test exercises involve stresses to a spreadsheet-based valuation model, and these are prone to a number of problems, including a tendency to under-estimate the risks of complicated positions such as those involving options; they are also unable to account for unquantifiable factors – an example is a bank's exposure to litigation and especially misconduct risk. There is also the problem that a bank is likely to have thousands of different spreadsheet models and there will be no straightforward way of combining or standardising the information they provide across the institution as a whole. For all these reasons, and others, the data fed into any models will vary in quality and be prone to error: indeed, the Bank itself acknowledged these issues and reported that there was considerable variability in data quality across banks. Moreover, because of the asymmetric incentives involved, the tendency will be for problems to be underestimated or hidden outright until the miscreants involved get discovered and the problems unexpectedly come to light.

Traditionally the main defence against data problems was to work with audited data constructed using generally accepted accounting

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7 John Allison provides a compelling public choice analysis of the Federal Reserve along just these lines: see J. A. Allison, The Financial Crisis and the Free Market Cure: How Destructive Banking Reform is Killing the Economy. New York: McGraw Hill, 2013.

principles (GAAP). A trained accountant could then interpret the accounting data and make judgments accordingly. Under the rules regarding 'true and fair view', the primary consideration was prudent capital maintenance, i.e., prohibitions against overstating capital and reserves. Accordingly, under traditional UK GAAP, a position was to be valued at the lower of cost or net realisable value, i.e., the recoverable amount of the asset whether it is held to maturity or sold, and not based on potentially over-optimistic valuation approaches such as 'mark to market'.

Unfortunately, this critically important requirement was done away with when the UK adopted International Financial Reporting Standards (IFRS); these accounting standards allow various valuation fudges that have the effect of rendering accounts unreliable, especially for banks. To quote Tim Bush, IFRS rules

> *require holding loans at their cost, less an amount called "impairment". However, the method in the standards to determine "impairment", rather than looking at factors before the event to reflect the value of the loan (its recoverable amount), was instead looking at factors after the event, thus not taking into account the risk of the borrower not paying, due to his income status or lack of asset cover. Instead of building [this] risk into the value of the loan, the IFRS model waited until the customer stopped paying, i.e. bad loans are structurally overvalued and the higher the risk the higher the overvaluation.*
>
> *Put another way, accounts can be signed off, in accordance with IFRS, despite there being a fundamental uncertainty whether the balance sheet can, in fact, be realised at the stated amount. Given that a bank that will not recover its balance sheet at the stated amount is likely to become insolvent, this is a significant hazard. Prudent accounting is in a sense a "stress test", it is reducing the*

> *value of loans for the non-collection risk inherent in a loan. IFRS required leaving this risk out. In doing so it closes down lines of inquiry that should be hard-wired into the systems of a bank in order to get the audited numbers right. …*
>
> ***The IFRS model is inconsistent with the going concern basis of preparing accounts as it can be impossible with a set of IFRS compliant accounts to determine whether the drivers of being a going concern, capital and profits, are in fact real or not.*** (LAPFF, 2011, pp. 6-7, my emphasis)[8]

A now notorious example was RBS' use of IFRS to inflate its 2010 profits and capital by somewhere between £19bn and £25bn (see, e.g., Kerr 2011, pp. 44-45, 78-80[9]): this problem only became apparent when Steve Baker MP, Tim Bush, David Davies MP and Gordon Kerr compared the different valuations of the same loan assets prepared by RBS, which owned them, and the UK's Asset Protection Scheme (APS), which insured them. It turned out that RBS used the relevant accounting standard, IAS 39, as a lender and only recognised losses when they occurred, whereas the APS used IAS 39 as an insurer, and 'fair valued' the assets taking into account expected loan losses.

When confronted with this discrepancy, RBS initially denied any problem, but later switched to the line that it was within its rights under IFRS rules. This latter claim is quite untrue, however: the UK Companies Act requires that accounts be materially correct and take into account unrealised as well as realised losses. To compound its

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8 Local Authority Pension Fund Forum (2011) UK and Irish Banks Capital Losses – Post Mortem. London: Local Authority Pension Fund Forum.

9 Gordon Kerr, (2011) The Law of Opposites: Illusory Profits in the Financial Sector. London: Adam Smith Institute.

malfeasance, RBS's accounts also 'fair valued' the APS insurance on its assets and then showed this latter figure as an additional asset, despite the fact that it could only be realized if losses were so high that they wiped out the bank's capital. As Kerr explains:

> *This accounting treatment may be [IFRS] rule-compliant but is clearly wrong. Imagine that two schoolboys board a train. One has £10 in his wallet and is concerned about losing it. The other has £5 and feels the train to be safe from robbers. In exchange for a sweetie the second schoolboy offers to hand over his £5 if the first schoolboy loses his £10. Under RBS' interpretation of IFRS accounts, the first schoolboy would record his assets as £14.* (Kerr, 2011, p. 80)

My main point, however, is simply this: even the audited accounts, the best data available, can no longer be trusted.

A second example is provided by recently come-to-light transactions between Monte dei Paschi Bank (MDP), the world's oldest bank, and Deutsche and Nomura.[10] MDP's counterparties gamed weaknesses in the IFRS accounting architecture to transaction Credit Default Swaps (CDS) designed in such a way – and this is the clever bit – that the transactions did not appear on the balance sheets of either party. The origins of this deal go back to the height of the crisis in December 2008, when MDP management was looking to hide some €557 million in losses. Revealing those losses would have been inopportune as MDP was negotiating a state rescue at the time. The CDS transactions enabled MDP to roll over the position, hiding its insolvency until details began to emerge in early 2013, by which point

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10 See Elisa Martinuzzi, "Monte Paschi Says Nomura, Deutsche Bank Helped Mask Losses," Bloomberg April 2, 2013, and Gordon Kerr, "How Deutsche Bank (and others?) trade credit default swaps without accounting entries,' Paper presented to the Ravda Conference on International Economics, Ravda, Bulgaria, May 2014.

the bank had accumulated a loss of €730 million and was seeking a second state bailout whilst Deutsche and Nomura had earned over €180 million in profits at MDP's expense. This type of transaction is hugely significant because it renders published accounts potentially useless as a means of revealing banks' true positions – and one presumes that there must be (many?) similar transactions out there that have yet to be come to light. We therefore have little solid idea of how strong any of the banks really are: again, the accounts cannot be trusted.

4.4 OUTPUT METRICS UNDERMINED BY UNRELIABLE RISK METRICS

Returning to the Bank's stress tests, I noted earlier that the output metric used is the ratio of CET1 capital to RWAs, and the minimum required such ratio, the hurdle ratio, is 4.5%. Leaving aside the hurdle ratio for the moment, there are major problems with the metrics to which it is applied.

The ideal metrics would be capital ratios that are both conservative and difficult to game, and these properties are especially important when we are dealing with a severe stress scenario in which it is important that the results have maximum credibility. The ideal capital ratio would then be the ratio of tangible common equity capital – equity plus disclosed reserves, the most conservative capital definition – to some comprehensive, un-risk-adjusted conservatively estimated measure of the total amount at risk.

In its stress tests, however, the Bank uses as its headline ratio the CET1 (Common Equity Tier 1) ratio post the stress scenario (or more precisely, the minimum CET1 ratio before and after the assumed impact of strategic management actions). The Bank's capital ratio

differs from the ideal in both the numerator term (capital) and the denominator term (total assets or amount at risk).

The numerator used by the Bank is common equity. Unfortunately, this measure of capital includes various soft assets including goodwill, intangible assets and Deferred Tax Assets (DTAs) that are of no use as capital when they are most needed. Remember that the whole point of capital is that it functions as a buffer to protect the bank in a crisis. So how do goodwill and intangibles get deployed in such circumstances The answer is that they can't be. Similarly with DTAs, which can only be used when a bank is making a profit to offset against past losses. The only core capital that can be deployed as a cushion in a crisis is tangible common equity plus disclosed reserves. The inclusion of goodwill, intangibles and DTAs in the numerator capital measure is therefore misleading because it makes the banks appear stronger than they would be.

The denominator of the Bank capital ratio is the sum of Risk-Weighted Assets (RWAs) rather than total assets. At first sight, it seems to make sense to have risk-adjusted capital requirements but in practice the adjustments create many more problems than they solve.

The simpler adjustments involve fixed 'risk-weight' multipliers ranging from zero to 100% depending on the class of asset. In the most egregious case, OECD government debt is assumed to be riskless and therefore attracts a risk weight of zero; bank holdings of such debt then attract a zero risk capital charge. Unfortunately, these positions are not riskless and treating them as if they were encourages banks to load up on such debt and was in fact a key aggravating factor in the European banking crisis.

The more sophisticated adjustments involve the use of risk models. These however pose a host of problems:

- They are based on unreasonable assumptions (such as Gaussianity) and unreasonable risk measures (such as Value-at-Risk) that give enormous scope for creative traders and financial engineers to hide risks: traders can stuff risk into the tails and so on.
- They are based on huge numbers of parameters, many of which cannot be estimated with any reasonable precision, and involve a great deal of model risk, both of which give plenty of further scope for creative game-playing to drive the risk numbers down.
- There is an abundance of evidence from recent empirical studies to suggest that simpler models out-perform more complex models.[11] A good example is provided by Haldane (2013): in the period up from 1994 up to the crisis, average risk weights fell from 70% to 40%, whilst average leverage rose from about 20 to well over 30.[12] The leverage picked up the growing riskiness of the banking system, but the average RWA was a contrarian indicator of banking risk: it indicated that risk was falling when it was in fact rising! The explanation is that the risk weights do not reflect true riskiness, but instead reflect the increasing ability of bankers to game

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11 These include: Asli Demirgüç-Kunt, Enrica Detragiache, and Ouarda Merrouche, "Bank Capital: Lessons from the Financial Crisis," World Bank Policy Research Working Paper Series No. 5473 2010); David G. Mayes and Hanno Stremmel, "The Effectiveness of Capital Adequacy Measures in Predicting Bank Distress," mimeo (2012); Allen N. Berger and Christa H. S. Bouwman, "How Does Capital Affect Bank Performance during Financial Crises?" Journal of Financial Economics 109 (2013): 146–76; Adrian Blundell-Wignall and Caroline Roulet, "Business Models of Banks, Leverage and the Distance-to-Default," OECD Journal: Financial Market Trends 2012, no. 2 (2014); Thomas L. Hogan, Neil Meredith and Xuhao Pan, "Evaluating Risk-Based Capital Regulation," Mercatus Center Working Paper Series No. 13-02 (2013); and V. V. Acharya and S. Steffen, "Falling short of expectation – stress testing the Eurozone banking system," CEPS Policy Brief No. 315, January 2014.

12 See Andrew Haldane, "Containing Discretion in Bank Regulation," speech given at the Atlanta Fed conference, "Maintaining Financial Stability: Holding a Tiger by the Tail(s)," April 9, 2013), p. 10.

the risk-weighting system and so hide the risks they are really taking.

It is difficult to over-emphasise this latter point: zero or low RWAs do not mean that the assets involved are actually zero or low risk; instead, they merely mean that Basel assigns zero or low risk status to the positions so designated, which is an altogether different matter. Examples include Greek government debt and carry-trade positions, which have zero risk weights, and many credit derivatives and securitizations, which have very low risk weights. What these low risk positions have in common is that they are all in fact highly risky, but the Basel system operates like an invisibility cloak to makes those risks all but unseeable.

One could give many other examples of the inadequate performance of risk models during the crisis but two in particular are positively stunning:

- Calculations performed by the Bank of England showed that for the four biggest UK banks, cumulative trading losses over the height of the crisis were up to six times the value of the model-determined capital set aside to cover against such losses (Haldane, 2011, chart 3).[13]
- UK bank losses – and these were primarily banking book losses – over 2007-2010 were nearly £100 billion or 183% of the banks' combined capital and reserves (LAPFF, 2011, p. 3).

In each case, the risk models and resulting capital charges were signed off as compliant by regulators, but subsequent losses greatly exceeded the risk capital set aside to cover against them: the banks

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13 Andrew Haldane, "Capital Discipline," speech given to the American Economic Association, Denver, Colorado, January 9, 2011), chart 3.

appeared to be capital adequate, but the model-based risk-weighted metrics merely disguised how weak the banks really were.

4.5 SCENARIO CONSIDERED

Yet even if the calculation methodology and the metrics and calibration data were sound, all of which are either doubtful or demonstrably false, the Bank's approach to stress testing would still be fatally flawed because it relies on a single stress scenario. At best, the exercise can only give us a reliable assessment of the robustness of the banking system in the face of that particular scenario and cannot by definition tell us what might happen in the face of substantially different scenarios. At the risk of belabouring the obvious:

- The impact of any scenario on a bank depends on both the severity of the scenario and the extent to which the scenario captures the bank's particular vulnerabilities – banks have different business models and different sectoral and geographical footprints.
- If we rely on just one scenario we could easily have a situation where a weak bank performs well in a stress test only because the scenario misses its main risk exposures. It is precisely to reduce this danger that the stress testing literature advises that, if we are to do stress testing at all, we should rely on multiple and substantially different scenarios in the hope that if a bank has a major vulnerability, then at least one of the scenario analyses will flag that up.
- Scenarios differ greatly in their systemic implications: a bank might perform well in a scenario that assumed limited systemic effects, but perform catastrophically in a scenario that emphasised such effects.

The Bank's scenario highlighted the housing risks that were a particularly noticeable issue for the Co-op, the Nationwide and RBS; at the same time, it downplayed the risks of the overseas exposures of banks such as Barclays, HSBC and Standard Chartered. An alternative scenario that downplayed the former risks but highlighted the latter would likely have had quite a different impact across the banks.

We also have to consider that neither scenario gives us much guidance on how the banking system would respond to any of a large range of other plausible adverse scenarios such as those from emerging market shocks (e.g., a collapse in China, Japan, etc.), geopolitical shocks (e.g., from the Middle East, Russia, etc.), a worldwide liquidity shock (e.g., in the US Treasuries market), a renewed Eurozone crisis (e.g., a Greek default, the impact of Eurozone deflation or the failure of a big European bank) or a junk bond collapse (e.g., triggered by a collapse of the shale oil sector). If we wish to know how the banking system might respond to any of these scenarios, we actually have to carry out the scenario analyses for them.

To repeat: we cannot draw general inferences about the robustness of the banking system to a range of possible future shocks from any exercise based on a single scenario about what might happen. Yet this is exactly what the Bank's stress testing programme is attempting to do.[14]

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14 Even the Bank itself stressed this very point in its 2013 Discussion Paper. To quote from p. 19: "A key principle underlying the Bank's approach to stress testing is to explore a range of scenarios. Any single scenario is almost certain not to materialise. And it is not desirable from a regulatory perspective that the banking system as a whole is only assessed against a single 'bad state of the world'. Moreover, from a practical perspective, differences in banks' business models imply that scenarios that might be stressful for one bank might be much less so for another. To make the framework useful for policymakers, stress tests should explore different vulnerabilities and manifestations of possible future stresses." It is unfortunate that this 'key principle' seems to have got lost somewhere along the way.

There are also concerns about the Bank's chosen scenario. The gist of the scenario is that a loss of confidence in UK economic prospects leads to a major fall in sterling; inflationary pressures then rise and the Bank reacts with a sharp rise in interest rates. In the process, the economy goes into recession, house and real estate prices fall, unemployment rises, the banks suffer losses and so on. Yet despite its severity from the perspective of the macroeconomic variables shown in Figure 1, the scenario itself leads only to a mild dip in the CET1 capital ratio which falls from 10% to a low of 7.3% before recovering, and to a similarly mild impact on aggregate profits.[15]

I would have expected the rise in interest rates to inflict large losses on banks' fixed-income positions and on interest-sensitive collateral and loan positions – such is the usual consequence of sharp rises in interest rates – and I am surprised that the Bank's modellers envisage a supposedly severe scenario in which a large interest rate hike does not produce a major casualty (and associated systemic knock-on effects) somewhere in the financial system. These considerations suggest to me that some parts of the stress test modelling exercise might not have been as stressful as others.

In short, the Bank is attempting to gauge the general robustness of the banking system from a single scenario – and a questionable one at that. Moreover, the results reported in Box 1 indicate that it is trying to do so from a macroeconomic scenario to which its own risk models attach a zero probability.

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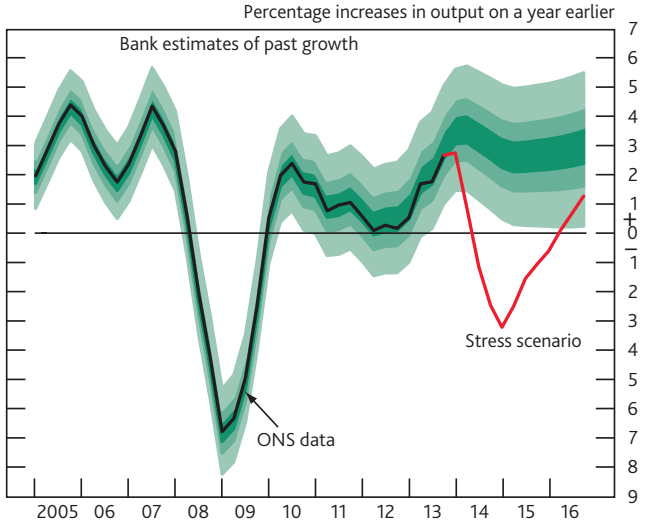
15 See Bank of England "Stress testing the UK banking system," charts 2 and 5 respectively.

4.5.1 The Bank's Stress Tests vs. its Fan Charts

Since the Bank publishes probability forecasts of near-term outcomes for chosen economic variables – its famous macroeconomic fan charts – it is tempting to ask: how likely is the Bank's stress scenario according to its own fan chart models? We can answer this question using Monte Carlo simulation.

In such an exercise, we reconstruct the Bank's fan chart forecasts using information provided by the Bank on its website – information about the density model used (a two-piece normal, a form of asymmetric Gaussian) and the (mode, uncertainty and skewness) parameters on which it is calibrated for each period concerned. For each of the three macroeconomic variables involved (GDP growth, unemployment and CPI inflation, see Figure 1) we conduct a large number m of simulation trials in each of which we use the density forecasts, the fan chart model, to project a random outcome path over the 3-year horizon period. We then count the number of such outcome paths that are at least as severe as the outcomes in the relevant Bank sub-scenario: in the case of the GDP growth sub-scenario, we are interested in the outcomes on or below the red line in Figure 1(a) which is reproduced below. If we find n outcomes on or beyond this line, then the probability of an outcome at least as severe as that posited in the relevant sub-scenario is approximately n/m.

FIGURE 1A: GDP GROWTH IN THE STRESS SCENARIO RELATIVE TO THE FEBRUARY 2014 INFLATION REPORT PROJECTION[16]



The results were striking: in the case of the GDP sub-scenario, out of m=1 billion simulation trials, I found exactly n=0 paths on or beyond the red line: the probability of this sub-scenario is therefore under 1 divided by 1 billion, i.e., less than 0.0000001%. Put differently, the expected waiting time to observe such an outcome would be more than 3 billion years – and 3 billions years from now, life on our planet would have ceased to exist.

I got comparable results for the other two variables. The probability of all three variables falling on or beyond their red paths is therefore even lower – indeed, much lower.

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16 Reproduced from Bank of England "Stress testing the UK banking system: key elements of the 2014 stress test," (April 2014), p. 7, chart 4. Available on the web at http://www.bankofengland.co.uk/financialstability/Documents/fpc/keyelements.pdf

We can safely conclude that the probability of a scenario at least as severe as the Bank's scenario is – according to the Bank's own risk models – not so much small as zero.

We then have to ask: what is the point of making decisions about financial policy against the contingency of a single event that its own risk models indicate will not transpire? Conversely, if we wish to take the Bank's scenario seriously as a contingency to plan against, then it is hard to see how can we give its fan chart models much credence.

4.6 THE BANK'S FORECASTING TRACK RECORD

The Bank often talks of its stress tests as being 'forward looking' projections, and such claims naturally raise the issue of its own past forecasting record. So how good was the Bank's forecasting performance since the onset of the GFC?

Recent revelations from the publication of the minutes of the Bank of England's court – its board of directors – reveal that on the eve of the crisis and even afterwards the Bank had no idea of the scale of the impending meltdown in 2007/8:

- As late as July 2007, the court had no idea of any impending trouble. There were some liquidity problems in the markets, they were told, but these were not sufficiently serious to warrant action. The crisis started the next month.
- September 12th, 2007: the court was told that despite some market turmoil, the tripartite regulatory system was working well and the banking system was sound. The very next day, they were called to an emergency meeting as the BBC announced that

Northern Rock had applied for a rescue. The day after that, there was the run on the Rock – the first English bank run since 1866.

- Even after that, the Bank continued to downplay the scale of the crisis: it maintained that there was only a liquidity problem and that the banking system was adequately capitalised. "I do not believe that in a year's time people will look back and say there was any lasting damage to the British banking system. It is very well capitalised, it is very strong", even though it did have a little bit of a liquidity problem, King confidently told the Treasury Committee in January 2008.[17] In fact neither claim was true: the Government was then to intervene to put much of the banking system on life support to prevent a systemic collapse, and the big banks made losses that more than wiped out their capital.
- By October 2008, after the Lehman crisis, the Bank felt that it had solved the crisis: "there was now a real sense that a corner had been turned and the Bank could be proud of its work", the minutes reveal. Some success: the UK went on to experience the longest recession since WWII and seven years later the banking system is *still* on state support.

The Bank forecasting failures are also clear from Figure 3. This Figure shows the MPC's mode projections – its forecasts of the outcomes it considered most likely – for year-on-year real economic growth at various points in time: the blue line gives the mode projections made in 07q3 for the 13-quarter period starting then, the blue dash-dot line gives the 13-month mode forecasts starting in 08q4, and so on. The chart also shows the subsequently realised real economic growth rates in black. The latter series shows a sharp fall to -6.9% in 08q4 before recovering to 2.3% in 10q3 and then falling back again.

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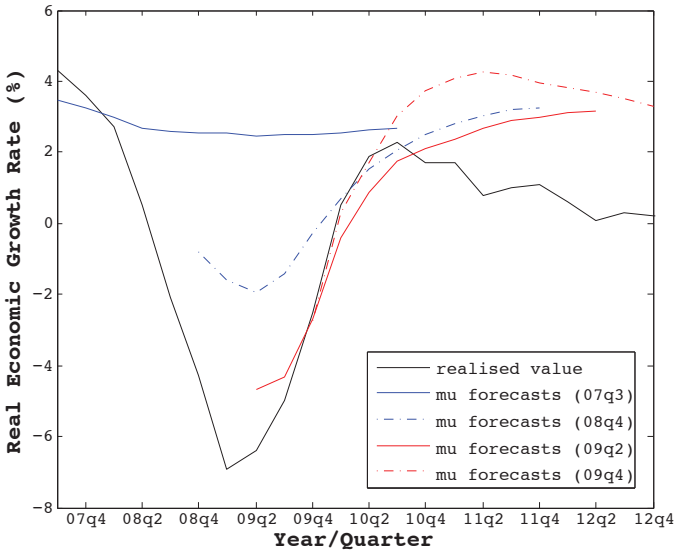
17 Quoted in http://www.publications.parliament.uk/pa/cm200708/cmselect/cmtreasy/56/5610.htm

FIGURE 3: THE MPC'S MODE PROJECTIONS OF REAL GDP GROWTH AGAINST SUBSEQUENTLY REALISED OUTCOMES[18]



So how well did the MPC's forecasts anticipate these outcomes? The answer is not very well:

- In 07q3, on the onset of the crisis, the MPC was forecasting a very modest dip in the economic growth rate and was oblivious to the large fall that was about to occur.
- Even by 08q4, the MPC was still under-estimating the fall in growth by about 50%, and it took another two quarters before it

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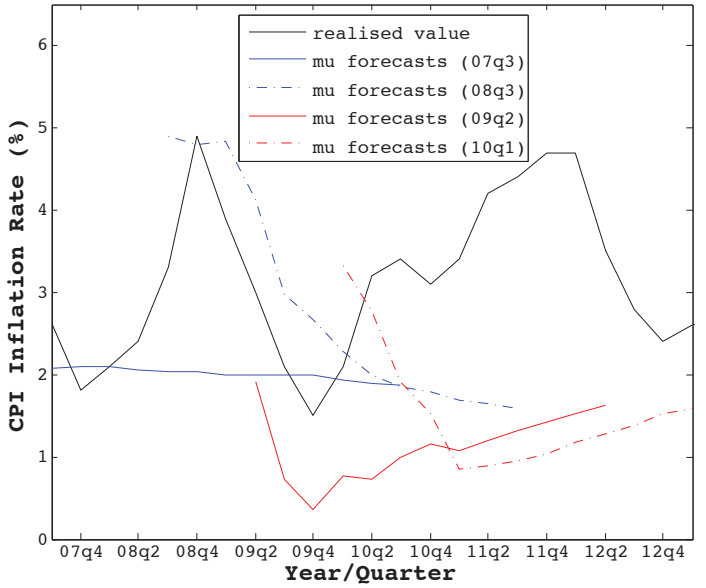
18 Realised values span 07q3 to 12q4 and are based on those from the spreadsheet 'ukvariant2014.xlxs',(http://www.bankofengland.co.uk/financialstability/Pages/fpc/stresstest.aspx,), mode forecasts are taken from the spreadsheet 'Parameters for MPC GDP Growth Projections based on Bank Estimates of Past Growth from August 2007.xls' (http://www.bankofengland.co.uk/publications/Pages/inflationreport/irprobab.aspx). Spreadsheets accessed Jan 30 2015).

got the magnitude of the fall anyway near right, by which time the lowest point had already passed.
- The MPC's projections for the period after 10q3 considerably overestimated the strength of the recovery, and by and large missed the subsequent dip after that.

Figure 4 shows that the Bank's corresponding CPI inflation mode projections did not perform any better:

- As of 07q3, the MPC was forecasting a barely notably decline in inflation and had no clue about the impending spike that was to take inflation up to almost 5%.
- A year later, it had got on to the inflation spike, correctly if tardily predicted the subsequent decline, but missed the second spike that was to peak in 12q1.
- By 09q2, it was back to underpredicting inflation by a considerable margin, again; and even by 10q1 it still had no idea of the second spike that was already under way.

FIGURE 4: THE MPC'S MODE PROJECTIONS OF CPI INFLATION AGAINST SUBSEQUENTLY REALISED OUTCOMES[19]



In short, the Bank's forecasting record makes Mystic Meg look quite respectable.

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19 Realised values span 07q3 to 13q1 and are taken from the spreadsheet 'ukvariant2014.xlxs'(http://www.bankofengland.co.uk/financialstability/Pages/fpc/stresstest.aspx,), mode forecasts are taken from the spreadsheet 'cpiinternet.xls' (http://www.bankofengland.co.uk/publications/Pages/inflationreport/irprobab.aspx). Spreadsheets accessed Jan 30 2015.

4.7 CONCLUSIONS

So can we agree with the Bank that its stress tests show that the banking system is strong enough to withstand a renewed severe shock? Certainly not. On the contrary, the Bank's risk modelling – its stress tests and its celebrated fan charts – are utterly lacking in credibility.

Does this failure imply that the Bank's risk modelling is useless? No. It suggests that the Bank's risk models are worse than useless because they give false risk comfort. The Bank asks us to believe that there are no icebergs out there merely because the Bank's own radar – and a demonstrably faulty radar at that – fails to detect them: essentially the same radar that completely missed the last iceberg that sank the banking system in 2007-2009

It is surely better to have no radar at all than a blind one that no-one can rely upon.

APPENDIX TO SECTION 4: STRESS TESTING JARGON – A DEVIL'S DICTIONARY

The jargon used in the Bank's stress-testing literature is often confusing. This Appendix provides a lighthearted guide to common expressions and what the BankSpeak really means:

> *A stress test provides a quantitative forward-looking assessment of the capital adequacy of the banks.*

'Quantitative' in this context means that someone in the Bank has a model that spews out numbers; whether the model is any good is another matter. 'Forward-looking' means that the Bank looks into

the future even though it has the same forecasting abilities as the most of the rest of us, i.e., none.

> *Analysis of the impact of scenarios would be undertaken by Bank staff. The scenarios would also be modelled by banks themselves. The ultimate output would be a synthesised view …*

Banks would work with central bank staff to ensure that they reach the same conclusions as the Superior Beings in the Central Bank. This is already standard practice in the United States and only an idiot could confuse such guidance with central planning.

> *We should guard against the risk that the stress test becomes excessively exposed to the unavoidable weaknesses of any single model.*

Another reason why the banks should use their own models and make sure they come to the same answers as the Bank's model.

> *The Bank's stress tests seek to mitigate the risk associated with banks' own modelling: banks may face incentives to be overly optimistic about the impact of stress scenarios to achieve a more favourable result.*

Heaven forbid that the banks might wish to game the stress test regime that the Bank imposes on them! It is just as well that the Bank as a public agency, and its employees as public servants, are above any self-interest of their own.

> *Stress tests should bolster public confidence in the stability of the system, by demonstrating the range of severe but plausible, scenarios that authorities expect the banks to be able to withstand.*

The Bank will promote public confidence in its stress-test results by avoiding any results that it fears might be detrimental to such confidence. In this context the phrase "range … of scenarios" actually means just one scenario, and the word "plausible" should not be construed too tightly either: it refers to any scenario that the Bank chooses, regardless of any non-Bank meaning of the term, even a scenario that its own risk models regard as impossible.

> *Over time, stress testing will seek to capture the effects of various feedbacks and amplification mechanisms. These are likely to have a crucial bearing on system-wide resilience.*

The Bank believes that feedback and amplification mechanisms are important, but it hasn't got a clue about how to model them. Nonetheless, it intends to add more of them to its stress test models to ensure that the models show why they are needed to model amplified systemic instability, regardless of whether the system really works that way or not.

> *It is important that credible policy actions are taken in response to the results of the stress tests.*

… unlike the case of the Northern Rock 'war games' of a decade ago, where a major vulnerability was correctly identified before the event and then nothing was done about it.

5. Stressing the stress tests

Leaving aside the problems discussed earlier, if the Bank's stress test exercise is to be credible, then the results should be robust to reasonable alternative ways in which it could have been implemented: we should be able to stress test the stress tests and get results that reinforce the Bank's own conclusions.

Two such exercises come readily to mind:

- Stressing the 'headline' 4.5% CET1/RWA hurdle ratio emphasised in the Bank stress test.
- Carrying out a stress test using a leverage ratio instead of a CET1/RWA ratio.

To carry these out, I take as given the Bank's own results as reported in Table 1 of the Annex to its December 2014 Financial Stability Report, but vary the criterion used to determine pass or fail.

In each case, the underlying issue is this: what is, or should, or might reasonably be, the criterion to be used to determine pass or fail?

In attempting to answer this question, we can draw on the Basel III rules and practice overseas – not to mention the Bank's own promise that minimum capital standards should "not fall below internationally agreed minimum standards".

5.1 STRESSING THE 4.5% CET1/RWA HURDLE RATIO

The first point to note is that the Basel regulations do not simply state that the minimum CET1/RWA ratio is 4.5%. Instead, the rules are much (much) more complicated. In fact, they stipulate that the minimum CET1/RWA ratio is (or eventually will be, once the system is fully implemented) the sum of the following four elements:

1. A base minimum of 4.5% plus
2. A 2.5% 'point buffer' plus
3. A Counter Cyclical Buffer (CCB) plus
4. A buffer for Globally Systemically Important Institutions (G-SIIs).[20]

The CCB is set at between 0% and 2.5% at the discretion of the relevant regulatory authority, in this case, the FPC. To quote the FPC, the CCB

> *is currently set at zero, and this is intended to be its default setting when the FPC judges that threats to financial stability are low. When the FPC judges that system-wide risk is rising … the FPC will raise the CCB. If and when these risks crystallise, the FPC*

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20 For a good overview of this highly complicated subject, see R. Raman (undated), Basel III – An Easy to Understand Summary (iCreate Software, Bangalore), p. 6.

> *intends to release the CCB so banks can use their previously accumulated buffers to absorb losses and continue lending.*[21]

Just in case you missed that point, let me spell it out again: the CCB is set at zero reflecting the FPC's party line *that threats to financial stability are currently low.*

One wonders whether anyone at the Bank actually looks out of the window to see what is going on out there. The FPC's optimistic assessment of the threats to financial stability is well out of line with the views of a host of informed observers, including, most notably, the BIS in a well publicized report that was published whilst the Bank was working through its stress test exercise and which they could hardly have failed to notice.[22] Section 5.1.1 gives a selection of quotes from that report, and these paint a very different picture.[23]

The G-SII buffer is an additional requirement imposed on G-SII-designated banks. In February 2015, the FPC identified 4 of the 8 banks as G-SIIs and gave them the following G-SII buffer

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21 Bank of England, "The Financial Policy Committee's review of the leverage ratio,"(October 2014), p. 18.

22 84th Annual Report, Bank for International Settlements, Basel, June 29 2014.

23 One has to ask how the FPC could have persuaded itself that the threats to financial stability are low. A partial answer is that it carried out a modelling exercise from which it concluded that it could rely on the credit to GDP gap as a core indicator of the vulnerability of the financial system, and by this criterion the banking system is as safe as it has ever been since at least the late 1960s. (See "The Financial Policy Committee's review of the leverage ratio," p. 18.) I would say that the large fall in the credit to GDP gap since 2008 is in large part a reflection of the unprecedented stagnation in bank lending and the large fall in household debt over the last 8 years, and as such tells us nothing about the threats to the financial system. Yet the Bank prefers to believe a model rather than informed outside views.

requirements: Barclays 2%, HSBC 2.5%, RBS 1.5% and Standard Chartered 1%.[24]

The implied minimum capital requirements are shown in Table 1. Depending on the size of the CCB, these total combined minimum capital requirements vary from 7% to 9.5% for the smaller banks up to 9.5% to 12% for HSBC.

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24 http://www.bankofengland.co.uk/pra/Pages/crdiv/updates.aspx.

TABLE 1: ELEMENTS OF THE BASEL CET1/RWA MINIMUM REGULATORY CAPITAL RATIO[25]

BANK	BASIC MINIMUM (A)	POINT BUFFER (B)	CCB (B)	G-SII BUFFER	SUM (A)-(D)
	(A)	(B)	(C)	(D)	
Barclays	4.5%	2.5%	0-2.5%	2.0%	9-11.5%
Co-op	4.5%	2.5%	0-2.5%	0	7-9.5%
HSBS	4.5%	2.5%	0-2.5%	2.5%	9.5-12%
Lloyds	4.5%	2.5%	0-2.5%	0	7-9.5%
Nationwide	4.5%	2.5%	0-2.5%	0	7-9.5%
RBS	4.5%	2.5%	0-2.5%	1.5%	8.5-11%
Santander	4.5%	2.5%	0-2.5%	0	7-9.5%
St. Chartered	4.5%	2.5%	0-2.5%	1.0%	8-10.5%

Had the Bank implemented these minimum capital requirements and failed any bank that fell below them post the stress and post management actions – which, presumably, is the natural way to implement the test exercise – we would get the results summarized in Table 2:

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25 'CET1' = Common equity Tier 1, 'RWA' = Risk-weighted assets, 'CCB' = Counter Cyclical Buffer, 'G-SII' = Globally Systemically Important Institutions. Based on the results in Table 1 of Annex to the December 2014 Financial Stability Report.

- With a zero CCB, every bank but Santander and Standard Chartered would have failed, and latter would have passed by a whisker (8.1% against a minimum hurdle of 8%).
- With the CCB set to its potential maximum (2.5%) to produce a more rigorous and more credible test, then every single bank would have easily failed.

TABLE 2: RESULTS OF THE STRESS TEST AGAINST THE BASEL CET1/RWA HURDLE RATIO

BANK	PROJECTED CET1/RWA	HURDLE RATIO		PROJECTED MINUS HURDLE	
		CCB=0	CCB=2.5%	CCB=0	CCB=2.5%
Barclays	7.5%	9%	11.5%	-1.5%	-4%
Co-op	-2.6%	7%	9.5%	-9.6%	-12.1%
HSBS	8.7%	9.5%	12.0%	-0.8%	-3.3%
Lloyds	5.3%	7%	9.5%	-1.7%	-4.2%
Nationwide	6.7%	7%	9.5%	-0.3%	-2.8%
RBS	5.2%	8.5%	11.0%	-3.3%	-5.8%
Santander	7.9%	7%	9.5%	0.9%	-1.6%
St. Chartered	8.1%	8%	10.5%	0.1%	-2.4%

The first bullet point tells us that even if we grant the Bank's party line that the banking system is safe – to justify the zero CCB – the outcome of the stress test still disconfirms that party line and suggests that the banking system is actually anything but. Oh dear!

The second bullet point tells us that if the Bank had implemented the capital rules in a more rigorous way (with a higher CCB to reassure credibility), then every single bank would have failed the stress test – and this is the case even if we accept on trust everything else in the Bank's stress test: the Bank's preferred scenario, the models and data used, everything.

Instead, the Bank chose the only the bare 4.5% minimum, element (A), ignoring the other elements of the minimum capital requirement, leading to a hurdle ratio that falls below the standards to which Basel aspires over the next few years – and coincidentally producing the best possible set of results for anyone with a vested interest in trying to show that the banking system is in good shape.

In doing so, the Bank undermined the credibility of the whole exercise.

It is also interesting to note that the Bank's 4.5% hurdle fell below the low standards of even the ECB, which used a 5.5% hurdle in its (widely discredited) 2014 stress test exercise, of which more below. By the ECB's hurdle ratio, Lloyds and RBS would have failed as well.

One is then tempted to suggest that the Bank of England was caught in a bind: however much it may have wanted to, it had very little room to raise the hurdle ratio without producing headline results that would have contradicted its core message that the banking system was sound – and that might have led people to raise awkward

questions about the success of the Bank's policies towards the banking system.

Take-home: had the Bank implemented the Basel rules prudently, using its preferred flawed CET1/RWA hurdle metric but with a higher hurdle, its own stress test exercise would have produced a startlingly bleaker result.[26]

5.1.1 The Bank of England vs. the Bank for International Settlements

In its 2014 Annual Report, the BIS describes a world so different to that in the Bank's stress test report that it may as well be another planet. Here is a sample collection of quotes:

"Overall, it is hard to avoid the sense of a puzzling disconnect between the markets' buoyancy and underlying economic developments globally." (p. 3)

"… despite an improvement in aggregate profitability, many banks face lingering balance sheet weaknesses from direct exposure to overindebted borrowers, the drag of debt overhang on economic recovery and the risk of a slowdown in those countries that are at late stages of financial booms." (p. 5)

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26 Perhaps the most demanding test that would have been to implement the hurdle ratios that are anticipated to be in force in the United States in January 2019: recent Federal Reserve Board estimates suggested that the G-SII buffer might need to be as high as 4.5% rather than the headline Basel maximum 2.5% usually cited. Combined with 4.5% bare minimum and the capital conservation and countercyclical buffers of 2.5% each, we would then have a minimum CET1/RWA requirement of up to 14%. See PwC, "G-SIB capital: A look to 2015," Regulatory Brief, December 2014, p. 1.

"Financial markets have been exuberant over the past year [...] dancing mainly to the tune of central bank decisions. Volatility in equity, fixed income and foreign exchange markets has sagged to historical lows. Obviously, market participants are pricing in hardly any risks." (p. 15)

"Debt burdens have increased, as has the economy's vulnerability to higher policy rates. After rates have stayed so low for so long, the room for manoeuvre has narrowed. Particularly for countries in the late stages of financial booms, the trade-off is now between the risk of bringing forward the downward leg of the cycle and that of suffering a bigger bust later on." (p. 17)

"… long-term prospects are not that bright. Financial markets are euphoric, but progress in strengthening banks' balance sheets has been uneven and private debt keeps growing. Macroeconomic policy has little room for manoeuvre to deal with any untoward surprises that might be sprung, including a normal recession." (p. 19)

"There is a common element in all this. In no small measure, the causes of the post-crisis malaise are those of the crisis itself – they lie in a collective failure to get to grips with the financial cycle. Addressing this failure calls for adjustments to policy frameworks – fiscal, monetary and prudential – to ensure a more symmetrical response across booms and busts. And it calls for moving away from debt as the main engine of growth. Otherwise, the risk is that instability will entrench itself in the global economy and the room for policy manoeuvre will run out." (p. 8)

The BIS report repeatedly puts much of the blame on central banks' monetary policies:

"Accommodative monetary conditions and low benchmark yields – reinforced by subdued volatility – motivated investors to take on more risk and leverage in their search for yield." (p. 38)

Forward guidance "could encourage excessive risk-taking and foster up a build-up of financial vulnerabilities." (p. 90)

"Never before have central banks tried to push so hard." (p. 9)

"As history reminds us, there is little appetite for taking the long-term view. Few are ready to curb financial booms that make everyone feel illusively richer. Or to hold back on quick fixes for output slowdowns, even if such measures threaten to add fuel to unsustainable financial booms. Or to address balance sheet problems head-on during a bust when seemingly easier policies are on offer. The temptation to go for shortcuts is simply too strong ..." (p. 21).

5.2 A STRESS TEST USING THE LEVERAGE RATIO

The leverage ratio is the ratio of a core capital measure to an exposure measure, where the latter is the total exposure to both on-balance-sheet and off-balance-sheet items, and where the off-balance-sheet items would be measured using straightforward but conservative assumptions to bolster credibility. The (big) advantage of the leverage ratio is, of course, that it avoids the weaknesses of RWAs, especially their vulnerability to gaming.

A leverage ratio stress test is also highly appropriate because a key feature of Basel III is the introduction of a minimum regulatory leverage ratio to sit along other minimum regulatory capital ratios. The

absolute minimum leverage ratio requirement is to be 3% and this requirement is due to come into force by January 2018.

I would add, too, that a 3% leverage ratio is actually a very low standard: a bank with such a leverage ratio only needs to lose 3% of its measured exposure to be insolvent.

Now suppose that we implement a stress test with a 3% minimum leverage ratio and pass/fail the banks depending on whether their projected post-stress post-management actions leverage ratios meet this minimum or not. The results of such an exercise are shown in Table 3.

TABLE 3: RESULTS OF THE STRESS TEST AGAINST THE 3% LEVERAGE HURDLE RATIO[27]

BANK	ACTUAL (END-2013) LR	LR POST-STRESS	ASSUMED LR HURDLE	LR POST STRESS MINUS HURDLE
Barclays	2.9%	3.1%	3%	0.1%
Co-op	2.4%	-1.2%	3%	-4.2%
HSBC	4.1%	4.1%	3%	1.1%
Lloyds	3.8%	2.6%	3%	-0.4%
Nationwide	3.4%	3.2%	3%	0.2%
RBS	3.4%	2.3%	3%	-0.7%
Santander	3.3%	2.7%	3%	-0.3%
St. Chartered	4.6%	4.9%	3%	1.9%

We see that four of the banks (Co-op, Lloyds, RBS and Santander) fail the test, two (Barclays and Nationwide) pass by the barest of margins (0.1% and 0.2% respectively) and only HSBC and Standard Chartered do any better (passing by unimpressive margins of 1.1%

27 'LR' = leverage ratio, 'LR post stress' = leverage ratio post stress and post management actions. Based on the results in Table 1 of the December 2014 Financial Stability Report.

and 1.9%). Once again, we would have to conclude that the banking system is in poor shape.[28]

In this context, it is interesting to note that on p. 8 of its Stress Test report the Bank explicitly expresses the "PRA's expectation that major UK banks meet a 3% Tier 1 leverage ratio." One can only guess as to why the Bank did not report the results of any such stress tests – they must be able to do the arithmetic at least as well as I can. The Bank's failure to stress test against its own minimum requirements hardly engenders confidence in the exercise, but then neither does the alternative. Imagine the headlines! On this issue, one can truly say that the Bank is damned because it didn't, and would have been damned if it did.

To rub the point in further, even this test is the weakest of leverage ratio stress tests because the 3% hurdle is meant to be a bare minimum and ignores supplementary requirements to be imposed on G-SIIs. It is also less than the 4% minimum leverage ratio that the Federal Reserve already uses for 2015 in its latest Comprehensive Capital Analysis and Review (CCAR) stress tests, and is well below the 5% requirement to be imposed on U.S. G-SIIs in due course.[29]

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28 An unfortunate feature of the Bank's leverage ratio results is that they are based on a CET1 numerator. For reasons already set out on page 33 above, I would have preferred leverage ratios based on a more conservative capital measure such as tangible common equity. Consistent estimates of tangible common equity are however difficult to obtain from the banks' published accounts because of differences in the ways in which they report their capital, but estimates by Lisa Pollack (2012) suggest that subtracting goodwill, intangibles, DTAs and other 'soft' components from CET1 leads to reductions of perhaps one-quarter to one-third in estimates of core capital. Thus, the Bank's 3% leverage ratio might only be 2% when measured properly.

29 See Board of Governors of the Federal Reserve System "Comprehensive Capital Analysis and Review 2015: Assessment Framework and Results," p. 6; and PwC "Basel leverage ratio: no cover for US banks," Regulatory Brief, January 2014.

Had the Bank of England adopted the Fed's minimum leverage ratio of 4% - even ignoring the supplementary charge for bigger banks – then all but two of the UK banks would have failed the stress test. Of the remaining two, HSBC would have barely scraped a pass (outcome 4.1% against a hurdle of 4%) and Standard Chartered would have passed by less than a hundred basis points (4.9% vs. 4%). The UK banking system would then have looked like a basket case.

One might add that even a 4% minimum leverage ratio is well below the minimum recommended by experts, many of whom would suggest a minimum leverage ratio requirement of no less than 15%, i.e., five times larger than the 3% leverage ratio test that the Bank did not conduct.[30] By this standard the whole British banking system would not so much be underwater as sunk at the bottom of the ocean.

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30 See, e.g., Admati, A., F. Allen, R. Brealey, M. Brennan, A. Boot, M. Brunnermeier, J. Cochrane, P. De Marzo, E. Fama, M. Fishman, C. Goodhart, M. Hellwig, H. Leland, S. Myers, P. Pfleiderer, J.-.C. Rochet, S. Ross, W. Sharpe, C. Spatt and A. Thakor, "Healthy banking system is the goal, not profitable banks," Financial Times, November 9, 2010.

6. Lessons from international experience

Overseas experiences of regulatory stress-testing offer some interesting case studies and some object lessons in how (not) to go about such exercises.[31]

6.1 US EXPERIENCE

In 1992 the newly established U.S. Office of Federal Housing Enterprise Oversight (OFHEO) was directed to establish a stress-based capital standard to determine regulatory capital requirements for the giant housing Government Sponsored Enterprises (GSEs), Fannie Mae and Freddie Mac. At face value, the new standard was admirably conservative: the stress scenario envisaged a decade long

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31 Some of these case are covered further in my "Math Gone Mad: Regulatory Risk Modeling by the Federal Reserve", Cato Policy Analysis 754, September 2014.

'nuclear winter' scenario of prolonged stress to mortgage defaults and interest rates. The required level of capital was then set as the amount that would allow them to remain solvent plus an extra 30% for good measure. The risks involved were complicated, however, and it took nearly a decade to build the stress models.

To reinforce confidence in its financial strength, Fannie Mae commissioned a team of distinguished economists led by Joseph Stiglitz to carry out their own analysis, and the Stiglitz team reported in 2002 that the risk of Fannie failing over the scenario decade was "effectively zero". Both GSEs then proceeded to embark on a binge of aggressive risk-taking – most notably, loading up on toxic subprime – and were only saved from looming financial collapse by the government taking them into conservatorship in September 2008: they had both effectively failed.

So what went wrong? Part of the problem was that the capital requirements were very light: for example, Freddie's risk-based capital requirement was below 200 basis points for the entire period 2003-2007 when it was rapidly building up its subprime exposure. The models also ignored the major risks involved: they ignored the venture into subprime, ignored the impact of executive compensation packages that encouraged excessive risk-taking, allowed the GSEs to game the risk models and ignored the impact of the political pressures brought to bear to keep the risk numbers down. The stress test exercise had been undermined from start to finish.

The Federal Reserve then began stress-testing the banks in 2009. The initial exercise – the Supervisory Capital Assessment Program – was a fairly light one involving the 19 biggest bank holding companies. This was followed by the more extensive Comprehensive Capital Assessment and Review (CCAR) in 2011, a program in which the Fed also required banks to demonstrate the adequacy of their own risk

models. The CCAR then became an annual cycle, with each annual exercise more extensive and more demanding than the previous one; in 2013, the CCAR was supplemented by the regulatory stress tests mandated by the Dodd-Frank Act, the so-called DFAST tests, which were to be conducted twice a year; the next year, U.S. banks were also subject to even more stress tests to be carried out under Basel III.

These stress tests were subject to the usual criticisms that they were excessively reliant on the Fed's preferred scenarios which were not particularly stressful, were blind to major risks credibly identified by independent observers, e.g., a Eurozone collapse, which was ignored till the 2012 CCAR, the risks of counterparty defaults or a rise in interest rates, ignored till the 2014 CCAR, or the enormous risks created by off-balance-sheet activities, which have still not been addressed.

The Fed's stress tests were conditioned by political factors (e.g. the Fed's optimistic party line on real estate, its reluctance to face up to the ongoing weakness of the big zombies: Bank of America, Citi, etc.). Critics also pointed out that alternative approaches existed that were much simpler, less costly, less intrusive, more transparent and more accurate than the Fed's stress tests. These alternatives included financial analysis, in which you start with loss assumptions, examine capital, earnings and liquidity and then determine the institution's loss absorbing capacity without the need for any macroeconomic scenarios or risk modelling at all. Another alternative was to use off-the-shelf financial volatility models, such as those promoted by the NYU

Stern's Volatility Institute, which also have a better performance record than the Fed's models.[32]

Another problem is that any system of regulatory capital modelling means that the regulators have a preferred model of their own and then pressure regulated institutions to adopt similar models. The end result is that banks will have much the same models and much the same risk management strategies. They will therefore take much the same risks and make much the same mistakes—dramatically magnifying systemic risk. Indeed, the evidence confirms that U.S. banks soon became focused on trying to mimic the Fed's results to pass the Fed's stress tests rather than projecting the risks they thought most appropriate to their own institutions, so creating new harder-to-detect risks in the process. The result was that innovation and diversity in risk modelling and management were ground down across the system. The risk modelling gene pool then becomes increasingly narrow and more vulnerable to the next unexpected financial virus.

A further consequence is that stress losses become more predictable over time. A recent study by Glasserman and Tangirala (2015) suggests that they are now strikingly predictable and that this predictability would seem to be an artefact of the stress testing process rather than an accurate reflection of the risks actually taken. To quote:

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32 Inevitably, perhaps, the Fed's stress tests also led to some awkward mistakes. To list two: (1) Regions Financial easily passed the 2012 CCAR, despite being GAAP-insolvent and therefore subject to the Prompt Corrective Action statutes that mandated that it should be taken into receivership. The Fed appears not to have noticed its insolvency and illegally passed its capital plan instead. (2) Bank of America passed the 2014 CCAR and had its capital distribution plan passed by the Fed, only to admit a little later that it had overestimated its capital by $4bn. It also turned out that it had been repeating the same mistake since 2009, and neither it nor the Fed had picked up the error till BAC 'fessed up.

> *If a bank's portfolio and the Federal Reserve's scenarios remain reasonably consistent over time, so should the bank's stress test results. In its first year of participation in the stress tests, a bank needs to make major investments in staff and information technology; over time, the process matures and becomes more routine. Indeed, consulting firms and software vendors have made a business of trying to simplify and standardize the stress testing process for banks to make it more routine.*

One might also note here that the banks all use the same consultants to get them through the stress test process, and these consultants are often former Fed officials who used to conduct the stress tests themselves. To continue:

> *The models used by the Federal Reserve to define scenarios and project losses have also been refined and should change less over time. Banks have incentives to avoid investments that will attract high capital requirements through the stress tests. … they also face incentives to align their internal risk assessments with the Federal Reserve's. All of these factors contribute to making outcomes more predictable over time.*
>
> *But whereas the results of stress tests may be predictable, the results of actual shocks to the financial system are not, and herein lies the concern. The process of maturation that makes stress test results more predictable may also make the stress tests less effective.*[33]

It is also important to appreciate the scale of the compliance costs involved in the Fed's stress tests. To quote Whalen and Scott:

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33 P. Glasserman and G. Tangirala, "Are the Federal Reserve's stress test results predictable?" Office of Financial Research Working Paper 15-02, March 3, 2015, p. 2.

> *banks are required to perform an exhaustive self-analysis of financial and operational risks that most closely resembles a full-blown audit. Management and the board of directors are required to comprehensively identify all risks to the enterprise, then model hundreds of variables in response to the subjective criteria provided by the Fed. The banks are required to design their own internal economic scenarios and then stress credit, operational and idiosyncratic risks. Keep in mind that for many banks, there are more people working on DFAST and CCAR than are part of the core credit team.*[34]

This process is to be carried out with virtually no co-operation from the Fed about its evaluation process or its own in-house models. The final output then stretches to many thousands of pages and includes information on capital levels, loss projections on different types of asset, and much else besides, down to an extraordinary level of detail. Once the report is submitted, a bank can expect to undergo a severe interrogation from Fed officials, who will evaluate the bank's results using their own models, which will almost always produce more severe results. Throughout the process, the bank has always to anticipate the Fed's reaction and it has no choice but to manage to what it perceives the Fed's model to be – and the results provided by Glasserman and Tangirala suggest that they have now pretty much mastered the art of doing so. The very process of stress testing has made the stress tests themselves futile.

In researching my Cato policy analysis *Math Gone Mad* on the Fed's stress tests, I interviewed the senior management of one big U.S. bank, whose management were privately scathing. This bank had weathered the crisis very well. Unlike many, it used very little risk

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34 C. Whalen and J. Scott, "For Bond Investors, the Bank Stress Test Process is Beside the Point," Kroll Bond Rating Agency, U.S. Financial Institutes FI Research, March 9, 2015.

modelling: it had little need of models as it chose not to take excessive risks. The risk models it then submitted to the Fed under the risk supervisory process used its own loss experience, which was much lower than the industry average.

Supervisors however rejected their models and demanded that the bank use more sophisticated models and the industry loan loss experience instead of its own. Thus, in the interests of promoting good risk management and discouraging excessive risk-taking, the Federal Reserve forced a well-run bank to adopt highly expensive risk management technology that it neither needed nor wanted, imposed higher regulatory capital requirements that were not justified by the risks the bank wanted to take, and then forced the bank to take extra risks that it *didn't* want to take in order to recoup its higher costs!

However, the damage went further, as much of the bank's normal business activity was stopped by a hugely expensive need to feed the models demanded by the Fed:

- The bank had to stop investing in technological innovation because its IT people were overwhelmed with regulatory reporting, and this despite the bank hiring over a thousand IT modellers over little more than a year.
- The CCAR 2014 alone involved 57 separate models and over 10,000 pages of regulatory documents to be submitted to the Fed.
- The bank could not pursue further acquisitions because its systems were overwhelmed and it was not able to determine the regulatory risk in potential purchases.
- The model upgrade process swallowed up a vast amount of management time. Risk management meetings went from quarterly to monthly, board members might have over 1200 pages of documents to review at a single meeting, and board minutes might run to 1500 pages.

Even worse, the regulatory process warped the bank's core business model, pushing the bank from an old-fashioned decentralized-judgment-plus-incentives business model that had worked well towards an inferior one dominated by models, right down to the level of individual lending decisions.

6.2 ICELANDIC AND EUROPEAN EXPERIENCES

The Icelandic and European experiences are also interesting. These are remarkable in particular for the banking stresses that the stress tests completely failed to detect in advance, including no less than *three* cases where whole national banking systems – not just individual banks – suddenly collapsed shortly after having been signed off as sound by regulatory stress tests.

The first of these was Iceland. By the end of 2007, the assets of the three biggest Icelandic banks – Glitnir, Kaupthing and Landsbanki – had grown to almost 900% of GDP. By this point, there were concerns about the banks' dependence on wholesale markets and CDS spreads were strongly suggesting that the banks were vulnerable. However, in 2008 a variety of stress tests by the IMF, the Icelandic central bank and the Icelandic financial regulator suggested that the system was resilient. The financial sector then unexpectedly collapsed in October.

There are also the stress tests conducted by the Committee of European Banking Supervisors (CEBS) and later by the European Banking Authority (EBA) and the European Central Bank (ECB).

The first of these was conducted by the CEBS in 2009 with results reported in October that year. The results suggested that none of the

22 large banks covered would see their Tier 1 capital/RWA ratios fall below the minimum threshold of 6%, and the accompanying press release proudly talked of how the exercise demonstrated the "resilience" of the banking system after recent difficulties. Critics suspected that the assumed stress was merely too weak to pick up any problems. Subsequent events were to prove them right.

The second exercise was conducted by the CEBS in 2010: this exercise covered 91 biggest European banks and the results reported in July showed that only seven banks failed to meet the 6% minimum capital level and even then their combined shortfall was a mere €3.5bn, about 0.15% of Eurozone GDP. Skeptics noted that this figure was a fraction of any of the estimates of independent analysts and pointed out that the stress test largely ignored the biggest risk of all – the risk of sovereign defaults – apparently because the EU were committed to ensuring that such defaults never happened, a classic case of policy make-believe undermining the credibility of the exercise before it had even started.

Four months later, it was revealed that the Irish banks – which had passed the stress test with flying colours – were in need of massive support to stay afloat and the Irish government was unable to cover their wholesale financing requirements: the eventual cost of the Irish bailout package came to €85bn. The 2010 stress tests were now totally discredited.

About the same time, a new round of stress tests was announced: these were to be carried out the next year by the new European Banking Authority. The EBA promised that lessons had been learned and the new stress tests were to be more rigorous than their predecessors. Using a slightly stronger capital definition (5% core Tier 1 instead of 6% Tier 1) and a slightly smaller but stronger sample of 90 banks, with a much greater awareness of the sovereign debt problem

and its implications for European banks and with a pressing need to prove itself, the EBA then came out with an aggregate shortfall of €2.5bn, even less than it had been the year before!

Three months later, the big Franco-Belgian bank Dexia failed: Dexia had aced the stress test with a top-of-the-class core Tier 1 capital ratio of 10.4%, more than twice that of the 8 banks that failed the test. Meanwhile, in a frantic effort to shore up whatever credibility it imagined it still had, the EBA hurriedly redid its sums and eventually revised its aggregate shortfall to €114.7bn, over 45 times its best estimate of a few months earlier. Even this figure, however, was well below the estimates of €200bn-€300bn that others were getting. Then, the following May, 2012, the big Spanish bank Bankia failed: Bankia had also passed the stress test.

Amongst the banks that did well in the 2011 stress test were the Cypriot banks: the whole Cypriot banking system then collapsed out of the blue in March 2013. None of the agencies monitoring Cyprus – the EU, the EBA, the IMF, the BIS, etc. even had Cyprus on any kind of watch list.

The next major EU stress tests were conducted by the ECB in 2014 as part of its new mandate as Europe's super-regulator. Remember that a key driver behind the establishment of the Eurozone banking union and the Single Supervisory Mechanism to govern it was the argument that national regulators were prone to capture and therefore an independent and more demanding regulator was required: the ECB. The ECB promised that its stress tests really would be credible and it would not repeat the mistakes of the earlier stress test fiascos. The ECB stress test was also to be buttressed by an Asset Quality Review (AQR) to provide assurance that the new stress tests would be based on sound data given the glaring data problems that had plagued earlier stress tests. The new tests were also to have a stronger capital

standard, an 8% CET1/RWA hurdle ratio – the standard minimum of 4.5%, plus a 2.5% CCB plus a 1% G-SII requirement.[35] Unfortunately, the 8% ratio soon attracted a lot of negative lobbying from interested parties – the banks and their national supervisors, who had been captured by them – and the hurdle ratio was eventually knocked down to an easier-to-pass 5.5%.

The 2014 stress test covered 130 Eurozone banks accounting for almost 82% of Eurozone bank assets, and results were published in October that year: 25 banks were failed with a combined shortfall of €25bn.[36] None of the biggest banks failed, and the banks that did fail were concentrated mainly in the southern fringe. For its part, the Asset Quality Review produced asset quality adjustments of an additional €48bn. The severity of the stress is apparent when one considers that the combined shortfall plus quality adjustment amounted to only about 0.3% of total bank assets – a number small enough to be rounding error.[37] A chorus of independent experts then pretty much dismissed the results on publication.[38]

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35 S. Riecher and J. Black, "ECB capital definition tougher in stress test than in review," Bloomberg, October 23, 2013.

36 There was also a new set of stress tests carried out by the EBA over a slightly different sample, but I gloss over this exercise because their approach and results were not much different from the ECB's.

37 The fact that the AQR produced a correction of 0.2% of total asset values then tells us one of two things. Either the assets were accurately estimated in the first place, i.e., so those earlier pesky data problems had now been sorted – this happened to be the ECB's interpretation – or the exercise was so weak as to be pointless: take your pick.

38 See, e.g., P. Legrain, "Yet another eurozone whitewash," October 26, 2014; R. I. Meijer, "Europe redefines stress," The Automatic Earth, October 26, 2014; F. Coppola, "European stress tests: not stressful enough," October 28, 2014; M. Goldstein, "The 2014 EU-wide bank stress test lacks credibility," Vox EU, November 18, 2014; and Y. Onaran, "European banks see afflicted by $82 billion capital gap," Bloomberg, December 2, 2014. See also the further references below.

One source of problems was the adverse scenario, which was notable for its mildness: it omitted the possibility of a sovereign default, assumed a fall in real GDP activity of 0.7% over 2014, assumed that unemployment in Cyprus and Greece would fall and assumed bond yield rises that are much smaller than the spikes we saw in recent years. More amusingly, the adverse scenario also assumed that inflation would drop to a low of 1% in 2014. However, by the time the stress test results were released inflation had fallen well below this level to 0.3% and deflation was a distinct possibility that has since come to pass.

Why does this matter? Well, it matters in part because including deflation would have increased bank shortfalls and led to (potentially many) more bank failures. It also matters because the credibility of the ECB is on the line. When challenged at the press conference as to why the ECB had not modelled the possibility of deflation, ECB Vice-President Vitor Constancio's response was admirably to the point: "The scenario of deflation is not there because indeed we don't consider that deflation is going to happen," he said. Even then, much of southern Europe already was in deflation.

If I understand this aright, the ECB was trying to restore credibility by ignoring a possible damaging outcome that was already a reality in much of Europe and that subsequently transpired across Europe on the grounds that it didn't think it would happen. Some things are beyond satire.

A bigger problem is that independent analysts came to very different conclusions to the ECB. For example, studies by Acharya and Steffen (2014a,b) estimated bank shortfalls in the event of a 40% global stock market fall, and they estimated total shortfalls for European banks of €450bn and possibly as much as €767bn, nearly 30 times larger than

the ECB's estimates.[39] Their results suggest that the biggest risks, by far, are in the French and German banking systems, for which they estimate shortfalls of €189bn and €102bn respectively, the first figure being equivalent to about 10% of French GDP. Other estimates they offer are even higher.

Acharya and Steffen demonstrate that the main reason for the discrepancy between their results and the ECB's is that they use leverage ratios rather than the CET1/RWA ratios used by the ECB. They also find that these two measures tend to be negatively correlated, a finding that stems from French and German banks having a greater proportion of zero- and low-RWA assets in their portfolios – in fact, their average RWAs are astonishingly low, at 26% and 23% respectively, compared to the already low Eurozone average of 33%. Thus, the French and German banks only appear as strong as they do because of their superior expertise in gaming the risk weights.

I emphasise that these studies (and others like them[40]) are superior because they use standardized, easily replicable low-cost approaches and are credible because they are independent of the political influences that compromise central bank stress tests.

It is interesting to examine some of the big French and German banks a little more closely, and remember that all these easily passed the ECB's stress test:

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39 V. V. Acharya and S. Steffen, "Falling short of expectation – stress testing the Eurozone banking system," op. cit.; and V. V. Acharya and S. Steffen "Benchmarking the European Central Bank's Asset Quality Review and Stress Test – a tale of two leverage ratios," Vox EU, November 21 2014.

40 I particularly recommend J. Vestergaard and M. Retana, "Behind smoke and mirrors: on the alleged recapitalization of Europe's banks," Danish Institute for International Studies Report 2013:10, Copenhagen: Danish Institute for International Studies.

- Credit Agricole had a CET1/total asset (TA) ratio of 1.81% at the end of 2014 in the adverse scenario, and would have produced a shortfall of €81.6bn or just under 4% of French GDP under a leverage ratio test with a 7% hurdle. Its RWA/TA ratio was just over 18% at the end of 2013.
- BNP Paribas had a CET1/TA ratio of 2.84% at the end of 2014 in the adverse scenario, and would have produced a shortfall of €83.5bn or just over 4% of GDP under a 7% leverage ratio test. Its RWA/TA ratio at the end of 2013 was just over 30%,
- Soc Gen had a CET1/TA ratio of 2.38% at the end of 2014 in the adverse scenario, and would have produced a shortfall of €64bn or 3.11% of GDP under a 7% leverage ratio test.[41] Its RWA/TA ratio at the end of 2013 of just over 25%.

Note, therefore, that each of these banks would easily have failed an undemanding 3% leverage ratio test, would produce enormous shortfalls under a severe leverage ratio test, and had low, even very low RWA/TA ratios that suggest that most of their risks are invisible to the ECB stress test, i.e., so these banks are not less risky, but just better at hiding their risks.

But the star of the class is, without doubt, Deutsche: Deutsche Bank had a CET1/total assets ratio of 1.81% at the end of 2014 in the adverse scenario, and would have produced a shortfall of €91.8bn or 3.35% of German GDP under a 7% leverage ratio test. Its RWA/TA ratio at the end of 2013 was a puny 16.5%. And if this doesn't make your hair stand on end, there are also other problems:

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41 Numbers quoted from the tables in J. Vestergaard, "European banking misery: pretending rather than mending does no favours to lending," GEC Watch, November 4, 2014, and "Unpacking Europe's banking stress-tests: German and French banks at the brink of insolvency," GEC Watch, November 20, 2014.

- Recent investigations by the New York Fed into Deutsche indicate a litany of serious problems in the operation of its US arm, which are presumably indicative of the firm worldwide. These include shoddy reporting, inadequate auditing and oversight, and weak technology systems – not to mention its large and still unquantifiable exposure to misconduct risk. To summarise a recent letter from the New York Fed, these shortcomings amount to a "systemic breakdown" and "expose the firm to significant operational risk and misstated regulatory reports."[42]
- As of last year, Deutsche had a total derivative exposure of €54.7 *trillion*, which was about 100 times greater than its €522bn in deposits, about 5 times greater than Eurozone GDP and about 22 times greater than German GDP: Deutsche is a gigantic hedge fund with a comparatively small bank attached. Of course, this €54.7 trillion is a gross figure and the net figure is much smaller, but much of the valuation involved will be mark-to-model or even mark-to-myth, so no-one knows what they are really worth or how effective the hedges involved might be in a crisis – and therein lie the problems.
- This problem of Deutsche's (over) exposure has also been known about for over two years: back in 2013, FDIC Vice Chairman Tom Hoenig said in an interview, "It's horrible, I mean they're horribly undercapitalized. They have no margin of error."[43] As "Tyler Durden" cheerfully commented, this makes "Deutsche the most systematically important, and undercapitalized, bank in the world ... the slightest systemic shock in Europe and Deutsche Bank gets it. And as Deutsche goes, so does Germany, so does Europe, so

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42 D. Enrich, J. Strasbourg and E. Henning, "Deutsche Bank suffers from a litany of reporting problems, regulators said," Wall Street Journal, July 22, 2014.

43 http://www.reuters.com/article/2013/06/14/us-financial-regulation-deutsche-idUSBRE95D0X620130614

> does the world."[44] One can then imagine more than a little bit of concern emanating from the Bundeskanzleramt to the ECB to ensure that Deutsche comes out well in the stress tests.

It would therefore appear that the stress tests had been driven and hence compromised by the desire not to offend powerful governments – especially Germany and France – who also had their own reasons to want test results suggesting that the problems lay on the fringes of the Eurozone, and not right at its heart. That same message would have also suited the empire-builders at the ECB to reinforce the case for giving them yet more power. In any case, it would have suited no-one for the ECB to suggest that some of Europe's Too-Big-to-Fail banks were, well, on the verge of failure, as that would have put the spotlight on them to come up with a solution to this most vexing of problems. Thus, the

> *suspicion lingers that undertaking the comprehensive assessment on the basis of risk-weighted assets and an only mildly adverse stress scenario were not 'mistakes', after all. More likely, it reflects substantial political pressures. It would have required courage and genuine independence for the ECB to identify several German and French banks as severely undercapitalized just days before it assumes bank supervisory responsibilities for all major Eurozone banks. If anyone believed that there was still such a thing as an 'Independent' ECB, they better think again.*[45]

In short, the ECB had been captured and its stress tests were no more credible than its predecessors' had been.

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44 "T. Durden", "Deutsche Bank "Is Horribly Undercapitalized... It's Ridiculous" Says Former Fed President Hoenig" Zero Hedge, June 15, 2013.

45 J. Vestergaard, "European banking misery: pretending rather than mending does no favours to lending," GEC Watch, November 4, 2014.

7. What should be done?

Given this track record, the obvious question is why would anyone take regulatory stress testing seriously? Given the obvious answer – and given the dangers to those trusting souls who might still be inclined to give such exercises any credence – it is imperative that the Bank of England end its stress test pretensions forthwith: it should abort the entire programme.[46]

Why the urgency? At stake is the question of whether the UK banking system is sound enough to withstand another severe stress. The Bank insists that it is, but its evidence is based on … its stress tests: the same stress tests that are inconsistent with its own fan chart projections, use gameable model metrics based on unsound data, use a

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46 In March 2015, the Bank released details of its planned 2015 stress testing programme, the main innovation of which is a global downturn scenario and its impact on the UK economy. Some such scenario is to be welcome, but the Bank still plans only one scenario and some key parts of the domestic scenario (e.g., regarding the effects on real growth and unemployment) are milder than under the previous stress test, so I do not anticipate any results that will particularly rock the boat. Still, my hopes were not high. For more details, see Bank of England, "Stress testing the UK Banking System: Key Features of the 2015 Stress Test," March 2015.

pass/fail hurdle ratio that is way too low even under the Basel III rules coming into force over the next few years and completely ignore the leverage ratio. These same stress tests also consider a single questionable scenario and are based on a politically compromised methodology that has failed to detect subsequent major stress vulnerabilities anywhere else, not least because it would have been politically inconvenient to have done so.

Indeed, even if we accept the Bank's stress test results at face value, but use a higher pass/fail hurdle ratio or, better still, any reasonable hurdle ratio expressed in terms of the manifestly superior leverage ratio as a measure of capital adequacy, then we would get a rather different and deeply worrying picture of the health of the UK banking system.

There is also the very real danger that if the UK goes further down the stress testing route, it will merely end up repeating the mistakes made elsewhere, turning stress testing into an ever more onerous and deeply counterproductive exercise in compliance, effectively sleepwalking the UK banking system into its next major crisis.

Yet to acknowledge these problems is to admit that public policy towards the banking system has fundamentally failed: it may have propped up the banking system since 2008, but it did not fix the it and it leaves the banking system highly exposed to the next major shock, notwithstanding the vast sums of public money that have been thrown at it to get it on its feet again. The Bank of England's much vaunted 'rebuilding' of the UK banking system is, in fact, nothing of the sort: the Bank has merely papered over the cracks.

So what should be done? The immediately pressing need is for policymakers to wake up from their cryogenic slumber and recognise the need for a radically different approach. Any genuine solution to the

problems facing the banking system then involves concerted action on three fronts: models, metrics and governance.

On the first front, policymakers need to recognise that regulatory risk modelling – both stress testing and Basel risk modelling – has been a failure. So besides ending the Bank's stress test programme, they also need to get away from a capital adequacy regime that relies on any such models – and this means getting out of the Basel system of capital regulation, which is insanely wedded to such models, and which is chronically incapable of meaningful reform because it has long since been captured by the industry it purports to regulate. We should keep in mind that the industry wants capital regulation to be based on models that massively underestimate the risks involved, because they can then reap the short-term profits for themselves and pass on any longer-term losses from their risk taking onto other parties and especially to taxpayers.

On the second front, any system of capital regulation should be based on sound metrics and underlying those, sound data. Sounds metrics means conservatively measured capital ratios, and data means sound *accounting* data, the whole purpose of which is to provide trustworthy numbers for interested parties to work with. Getting sound accounting data means rolling back IFRS to the much better, if far from perfect, GAAP principles on which accounts used to be based. The restoration of sound accounting standards would then enable bank stakeholders to come to their own informed judgments about the soundness or otherwise of their banks – without smoke and mirror gimmicks like stress tests, which merely confuse the issue.

On the third, last and most difficult front, we need to restore strong corporate governance in banking and this requires the restoration of strong personal incentives on the part of key decision makers. Bank senior managers – and their auditors – need to be made personally

and strictly liable for the consequences of the decisions they make, and this requires that their own personal wealth should first on the line to cover any losses. Policymakers can then do their bit too by putting the weakest banks into receivership and by rolling back all the policy interventions that they have accumulated over the years – most notably, the lender of last resort, deposit insurance and Too Big to Fail – which have greatly increased the incentives for bankers to take excessive risks and are, indeed, the root cause of our banking problems. Once those props have been kicked away, capital regulation could itself be abolished and we could safely rely on market forces to deliver a strong and sound and free banking system.