The Bank of England's Incredible Stress Tests

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This posting is the second in a series on the 2016 Bank of England stress tests. A fuller report, "No Stress III: the Flaws in the Bank of England's 2016 Stress Tests", will be published later in the year by the Adam Smith Institute.

The previous posting is here.

The Bank reports two headline results for its 2016 UK bank stress tests. The first of these is the stress test result for the so-called CET1 ratio, the ratio of CET1 capital to Risk-Weighted Assets (RWAs), and the second is the result for the Tier 1 leverage ratio, the ratio of Tier 1 capital to leverage exposure.

The 2016 stress is assumed to start at the beginning of 2016 and the peak of the stress is projected to occur at the end of 2017. The core results are as follows:

- The average CET1 ratio is projected to rise from 12.6 percent at the beginning of 2016 to 13.8 percent two years later under the baseline scenario, but to fall to 8.8 percent under the stress scenario.
- The average leverage ratio is projected to rise from 4.9 percent at the beginning of 2016 to 5.3 percent two years later under the baseline scenario, but to fall to 3.9 percent under the stress scenario. [1]

From these results, the Bank concluded that the banking system as a whole is in good shape.

For the individual banks, the test did not reveal any capital inadequacies for four financial institutions (HSBC, Lloyds, the Nationwide and Santander) but problems were identified for the other three:

- RBS failed to meet the hurdle rates for either test.
- Barclays did not meet its CET1 SRP before AT1 conversion.
- Some minor issues were identified with Standard Chartered.

Based on these results, RBS was deemed to have failed the stress test and all the others were deemed to have passed it.

A stress test reality test

Before going any further, let's put the stress tests through a simple reality test:

1. As of 2106Q3, the big four banks had about £205 billion in book value CET1 capital and about £149 in market value CET1.
2. The stress scenario was almost as severe as the Global Financial Crisis (GFC).
3. The big four experienced losses from the GFC of the order of £440 billion and counting. [2]

4. Therefore we might expect that a shock similar to the GFC would more than wipe out the banks' capital.
5. Yet the Bank of England maintains that its stress tests demonstrate that the UK banking system would not only be able to withstand such a shock, but would still be in good shape afterwards.

To me it seems that this doesn't add up.

Of the seven banks involved in the exercise, the biggest five banks account for over 90% of the leverage exposure. I now drop the other two institutions from further consideration because of their relatively small size. An additional reason for dropping them is that in the analysis below I need institutions' price-to-book (P2B) ratios and these are not available for these two institutions: NW has no P2B ratio because it is a building society and Santander UK plc does not appear to have a published P2B ratio.

A series of mistakes

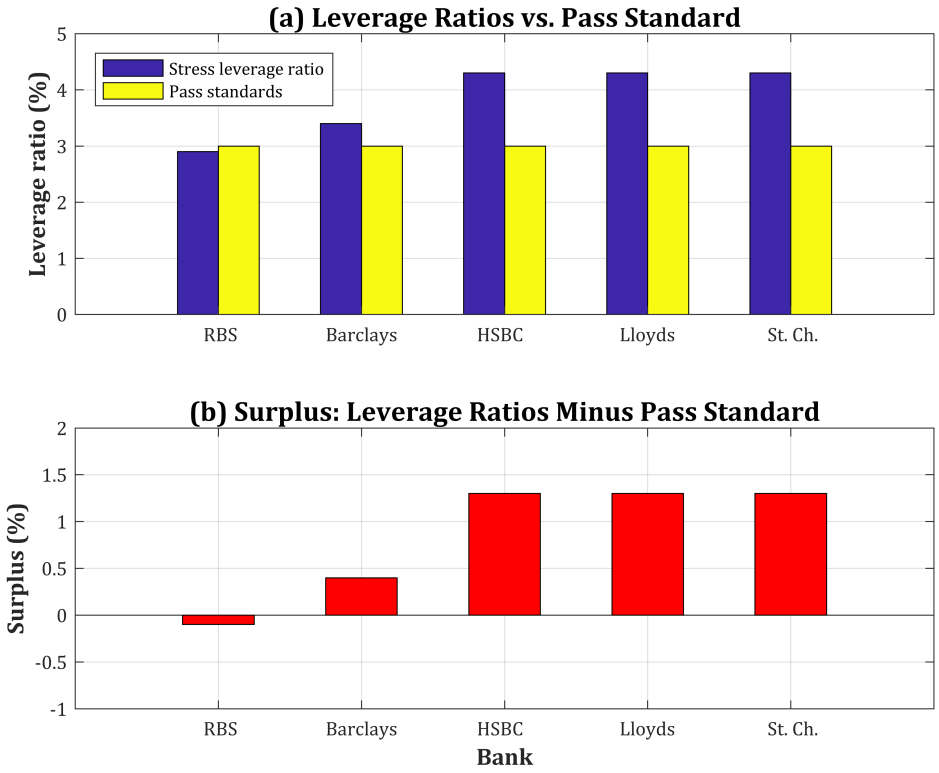
In fact, the Bank made a number of mistakes in the 2016 stress test exercise.

Mistake #1: Reliance on RWAs

The first was to pay any credence at all to the ratio of CET1 capital to RWAs, because the RWA denominator is discredited. [3] We should therefore throw these results away and focus on the leverage ratio results instead.

The leverage ratio used by the Bank was the ratio of Tier 1 capital to leverage exposure. These outcomes are represented in Chart 1:

Chart 1: Stress Tier 1 Leverage Ratios



The weighted average stressed leverage ratio is 3.95 percent. Assuming that the pass standard is the 3 percent hurdle ratio, the average surplus over the pass standard is 0.95 percentage points and we get the results reported in Table 1:

Table 1: Results of Tier 1 Leverage Ratio Stress Tests

Bank	Test result
Barclays	Pass
HSBC	Pass
Lloyds	Pass
RBS	Fail
Standard Chartered	Pass

RBS narrowly fails but the other banks pass.

Mistake #2: Use of book values instead of market values

However, these results are based on the book-value leverage ratio and the use of book values entails a second mistake: the Bank should have used market values instead. To obtain the market values from the book values, I need first to obtain the corresponding Price-to-Book (P2B) ratios.

So consider the following P2B ratios from SharesTelegraph. These numbers apply to the banks on January 9th 2017 and are given in Table 2: [4]

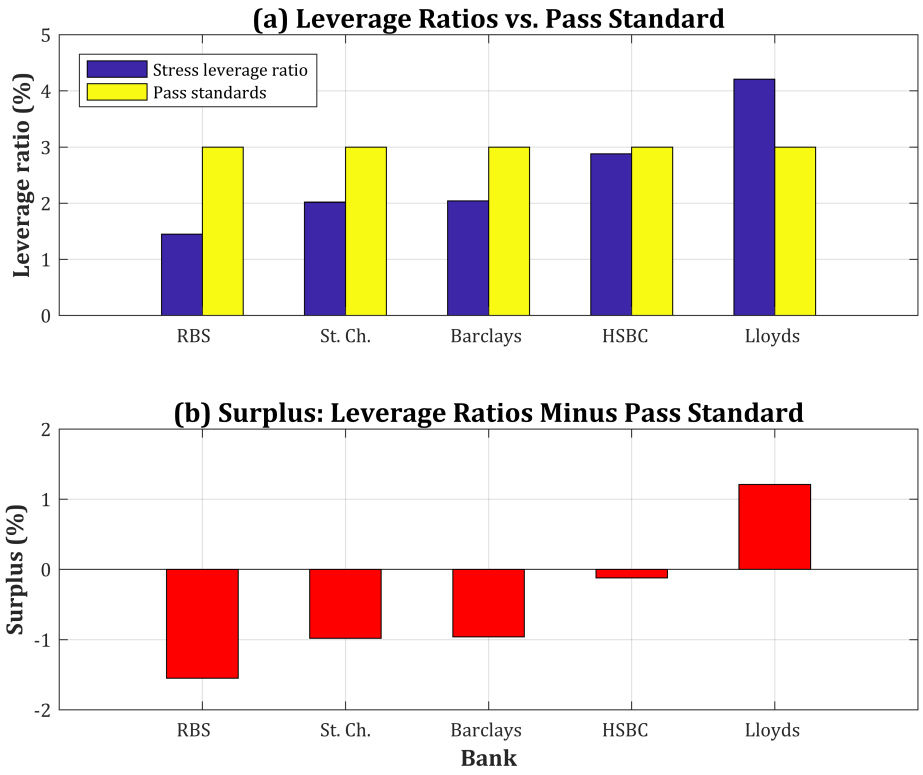
Table 2: Banks' Price-to-Book Ratios January 9th 2017

Bank	Price-to-Book Ratio
Barclays	60%
HSBC	67%
Lloyds	98%
RBS	50%
Standard Chartered	47%
LE-Weighted average	66.1%

Notes: These refer to the P2B ratios prevailing at the end of day January 9th 2017 and are based on FTSE data obtained from shares.telegraph.co.uk.

Applying these P2B ratios to obtain the market values from the book values gives us the results in Chart 2:

Chart 2: Stress Market Leverage Ratios vs. 3% Hurdle Rate



We can summarise the results of this second set of stress tests as follows:

Table 3: Results of Market Tier 1 Leverage Ratios Stress Tests

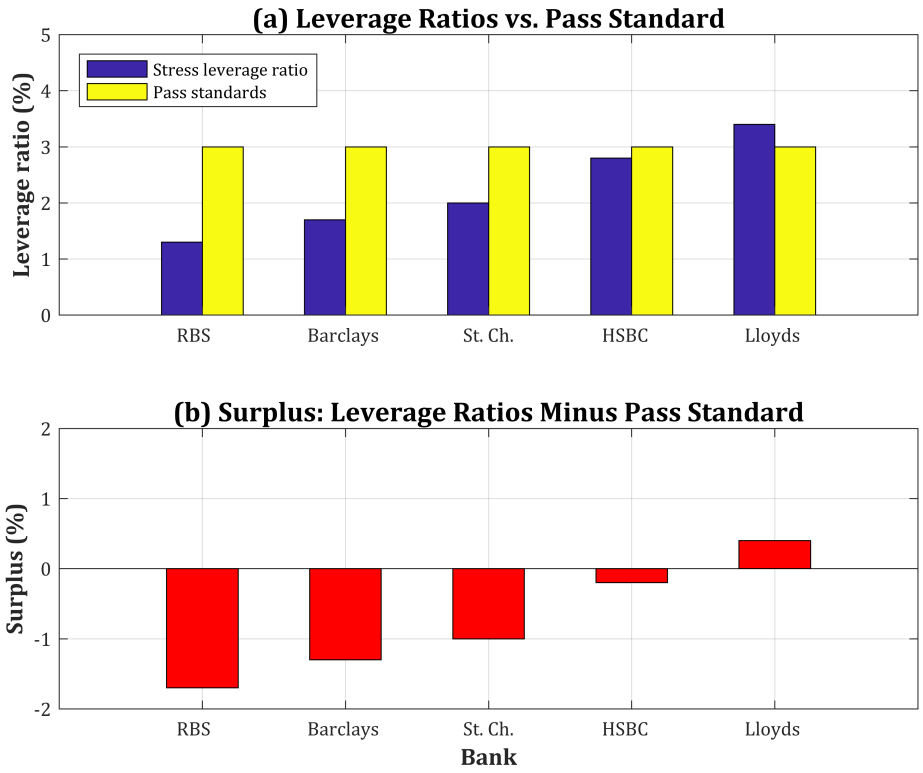
Bank	Test result
Barclays	Fail
HSBC	Fail
Lloyds	Pass
RBS	Fail
Standard Chartered	Fail

All the banks now fail the test except Lloyds. The average stress leverage ratio is 2.65 percent and the weighted average shortfall is 0.35 percentage points.

Mistake #3: Use of Tier 1 capital instead of CET1

The Bank used the wrong numerator. It should have used CET1 as the numerator instead of Tier 1. Using market-based CET1 capital instead of market-based Tier 1 capital then gives the results in Chart 3:

Chart 3: Stress Market CET1 Leverage Ratios vs. 3% Pass Standard



Again, all the banks fail the test except Lloyds. The average stress leverage ratio falls to 2.4 percent and the average shortfall rises to 0.69 percentage points.

One other adjustment to be made is to replace the 3 percent hurdle rate with the Systemic Reference Points for banks deemed to be systemic. If we apply this pass standard, we get the same pass/fail results as before but the average shortfall across the system rises to 0.89 percentage points.

Bear in mind that the results I have presented here take for granted virtually the entire stress test exercise as conducted by the Bank: the choice of scenario, the modelling, the settings of the 3% hurdle rate, the settings of the Systemic Reference Points etc.

Sources of stress test bias and hidden vulnerability in UK banks

It is also important to examine any sources of potential bias and hidden vulnerability in our 'best estimate' results. Let me address four significant sources of such problems.

Baseline versus stress P2B

My market-value numbers were based on the P2B ratios prevailing on January 9th 2017. In principle I should have used the stress P2B ratios – those prevailing when the stress scenario is most severe. However, I couldn't use the stress P2Bs because the Bank did not report them and I have no idea what stress P2Bs they might have used, or how they or even whether they used any stress P2Bs at all.

Let's go back to first principles. We have the book value *Book* and the market value *Market* and

$$Market = P2B \times Book \quad (1)$$

We also have initial values and post-stress values of these variables. Therefore:

$$Market_{initial} = P2B_{initial} \times Book_{initial} \quad (2)$$

$$Market_{stress} = P2B_{stress} \times Book_{stress} \quad (3)$$

We need to select the actual capital measure and I used CET1. (2) and (3) then become:

$$Market_{initial} = P2B_{initial} \times Book\ CET1_{initial} \quad (4)$$

$$Market_{stress} = P2B_{stress} \times Book\ CET1_{stress} \quad (5)$$

Now consider what we do and do not know. We know $Book\ CET1_{initial}$ and we know $P2B_{initial}$. Granted that we know these two items, we can infer $Market_{initial}$ from (4). This is standard practice but I am really interested in $Market_{stress}$.

The Bank then does its stress test to come up with a number for $Book\ CET1_{stress}$. Whether that number is any good is another issue, but lets take that as given here. Once we have $P2B_{stress}$ then it follows by (5) that we also have the stress market value, $Market_{stress}$.

All that then remains is to obtain a value for $P2B_{stress}$, but as the Bank didn't report any $P2B_{stress}$ number in its stress test report the best I could do was to use $P2B_{initial}$ as a substitute.

However, I believe that any reasonable $P2B_{stress}$ is likely to be (considerably) *lower* than $P2B_{initial}$ because during a stress prices tend to approach their firesale values whereas book values may fall, but not by as much. Two examples:

- On January 1st 2007, the average P2B ratio for the big four UK banks was 190 percent, but during the Global Financial Crisis, it fell to 33 percent. [5]
- Banks' P2Bs (or more precisely, their ratios of market value to par values) fell sharply in the crisis that occurred after the failure of the Herstatt Bank in 1974. For example, the UK merchant bank Hill Samuel saw its price-to-par value fall to a low of 25 percent before recovering.

If this belief (that $P2B_{stress} << P2B_{initial}$) is correct, then my $P2B_{stress}$ numbers would be too high and the 'correct' stress test results would have been worse than my estimates suggested, i.e., my 'pessimistic' stress-test numbers would not have been pessimistic enough.

Hidden off-balance sheet leverage

There is a lot of hidden off-balance sheet (OBS) leverage caused by positions that do not appear on the balance sheet but involve further risk exposure. Sources of OBS exposure include: operating leases; contingent liabilities, including those involving unconsolidated companies that are not fully owned by the parent company; rules that allow netting offsets that hide imperfectly hedged risks; securitisation and Special Purpose Vehicles; Total Return Swaps; Credit Default Swaps (CDS); Collateralised Debt Obligations; Collateralised Loan Obligations and failed sale rules.

Hidden OBS leverage is a hideously difficult subject, however, and I cannot begin to do it justice here. [6] Suffice to note that many of these instruments are explicitly designed to game the accounting or Basel capital rules, their purpose being to hide risks or exploit arbitrage possibilities to reduce regulatory capital charges (e.g., to game RWAs). Indeed, one can say that the core purpose of credit derivatives is to game the Basel risk weights by allowing banks to move assets from the banking book to the trading book where they are subject to much smaller capital charges. Consider this quote from Janet Tavakoli's textbook on credit derivatives:

> The driving force for this revolution in banking is the fact that the BIS risk weighting of the trading counterparty will become irrelevant.

Meaning that the driving force behind credit derivatives is to *make* the risk weights irrelevant and so achieve much higher leverage, most of which will be hidden:

> The magnitude of the credit exposure as expressed by trading models will determine regulatory capital requirements. All banks will have an incentive to figure out ways to move assets from the bank book to the credit derivatives trading book. Trades, which did not make sense from a past regulatory perspective, will make sense in the future whether the bank is buying or selling credit protection.

> The regulatory capital charge in the trading book is a fraction of the charge in the bank book, and exposure netting makes trading book management viable [or seem so: KD]. [7]

Ms. Tavakoli's analysis looks awfully prescient given that she wrote these words almost 20 years ago. Now bear in mind that credit risk modeling was Basel II's 'single big thing' and you can see why Basel II was doomed to fail. Bear in mind too that credit modeling is a central feature of Basel III.

We should also keep in mind that the hidden OBS exposures will mean that the true 'at risk' exposures will be greater (and potentially much greater) than indicated by regulatory measures such as total assets or leverage exposure, and therefore the true levels of leverage will potentially be much greater than suggested by regulatory leverage ratios. The result is that no-one can tell from the published information how leveraged a bank really is.

Level 1, Level 2 and Level 2 positions

Another insight into hidden vulnerability is given by the Level 1, Level 2 and Level 3 fair valuations of banks' marketable positions. Roughly speaking:

Level 1 assets have readily observable prices, and therefore reliable fair market values. Level 1 assets include listed stocks, government bonds, or any assets that have a regular "mark to market" mechanism for pricing.

Level 2 (or 'mark to model') assets do not have directly observed market values and are traded less frequently in thin markets, but have (hopefully approximate) fair values that can be obtained from models calibrated to observed market prices. Examples include some corporate and most municipal bonds. Level 2 valuations are at best approximate and can sometimes be gamed by selecting the model that gives the preferred valuations.

Level 3 (or 'mark to myth') assets are highly illiquid and can only be fair-valued using models calibrated to guesstimates of key parameters. Level 3 valuations are unreliable and potentially highly gameable, because both models and calibrations can be chosen to manipulate valuations and this gaming is difficult for outsiders to detect. Examples include asset-backed and mortgage-backed securities and many forms of CDS. The experience of the GFC showed that Level 3 positions can be wiped out in a major crisis.

Table 4 gives the 5 big banks' Level 1, Level 2 and Level 3 positions for the end of 2016 expressed as percentages of their CET1 capital:

Table 4: Level 1, Level 2 and Level 3 Valuations as Percentages of CET1 Capital

	Level 1	**Level 2**	**Level 3**
Barclays assets	174%	1,060%	60%
Barclays liabilities	57%	980%	31%

HSBC assets HSBC liabilities	368% 40%	427% 54%	9% 5%
Lloyds assets Lloyds liabilities	479% 358%	214% 215%	3% 20%
RBS assets RBS liabilities	176% 64%	1,030% 998%	15% 10%
St. Ch. assets St. Ch. liabilities	176% 7%	341% 216%	6% 2%

Notes: Based on banks' 2016 *Annual Reports*.

Here are the main takeaways:

- The Level 1 numbers indicate significant market risk exposure to Level 1 positions. For example, Barclays' Level 1 assets are 174 percent of CET1, so a 20 percent fall in assets values would imply a loss of almost 35 percent of CET1.
- The Level 2 numbers indicate large exposures to Level 2 positions. Barclays' Level 2 assets are 1,060 percent of CET1 capital. All the banks are highly exposed not only to Level 2 positions' market risk, but also to gameability and other weaknesses in the models used to value these positions.
- The Level 3 numbers indicate relatively low exposures to Level 3 positions. The exception is Barclays, whose Level 3 assets are equivalent to 60 percent of CET1. Bearing in mind the unreliability of Level 3 valuations, this exposure is a red flag.

We should *not* assume that banks' assets and liabilities are in any way perfectly hedged, e.g., we should not assume that Barclays' net Level 3 position is equal to its Level 3 asset position of 60 percent minus its Level 3 liability position of 31 percent. This last point reminds us that all these valuations are based on assumptions about netting and hedge effectiveness that may not be reliable and are also open to gaming.

Inadequate accounting standards

A final source of bias is inadequate accounting. The weaknesses of IFRS accounting standards have been well-documented: they include the overvaluation of retained earnings, asset values and profits; and inadequate provisions for expected losses. [8] To quote a recent letter in the *Financial Times* by the Local Authorities Pension Fund Forum:

> better forecasts and better weatherproofing both depend on a deeper problem being resolved: the poor quality of the numbers we are relying on to tell us what banks' capital actually is. Is the stated "capital" in fact capable of absorbing lending or trading losses that inevitably come in a downturn?
>
> At the heart of the crisis would appear to sit faulty accounts and unreliable audits. In the EU alone, between September 2008 and

> the end of 2010, more than 300 banks went cap in hand to governments for support—in the form of capital injections, asset relief, liquidity aid or debt guarantees. Few banks [had been] identified as having insufficient capital [prior to September 2008]. [9]

All of these banks had previously been signed off as capital adequate by their regulators. That is some failure by the regulatory system. To continue:

> The fact is that bank accounts — drawn up according to IFRS accounting standards—showed "profit" and "capital" that overstated their true strength. Supplementary regulatory disclosures of capital under the Basel framework help little as they lean heavily on these faulty accounting numbers, and are themselves unaudited.

Further concerns about accountancy standards were expressed by Iain Coke, the head of Financial Services at the Institute of Chartered Accountants of England and Wales in May 2017. "[M]any people were more confident than they should be" about banks' key regulatory capital ratios, he stated. "There is almost an assumption that someone else is poring" over them. These concerns came a month after the Central Bank of Ireland had ordered all banks operating in Ireland to review their operating procedures after an investigation there found that standards "were significantly below what is expected". [10]

It is important to recognize that because of leverage, even small errors in reported asset values can translate into large errors in the reported leverage ratio or capital ratio. Suppose that there is a 1 percent overstatement in the reported asset value. Then it is easy to show that the reported capital will be subject to an error of much the same (absolute, not percentage) magnitude as the error in the reported asset value. [11] So if the bank has a reported capital to asset ratio of 3 percent, then the true capital to asset ratio will be 3 percent minus 1 percent = 2 percent. If the error in the reported asset value is 2 percent, the true capital to asset ratio will be 1 percent, and if the error in the reported asset value is 3 percent or more, then the true capital to asset ratio will be zero percent or negative. In short, an accounting system that is prone to over-value asset values can lead to a situation where banks' true capital ratios are much lower than they are reported to be.

Nor is it just reported asset values that are the problem. If retained earnings or profits are inflated – and the IFRS rules give bank management give plenty of scope and incentive to game these figures – then inappropriate distributions of dividends and bonuses will be made, which will have the effect of secretly depleting bank capital and inflating reported capital figures – and once again, you cannot tell from the reported figures what the true situation actually is. Indeed, one cannot even tell from the reported figures whether a bank is even solvent or not. [12]

It is not for nothing that that the balance sheets of the big banks have been

described as the blackest of black holes.

Conclusions

The conclusions are stark. The Bank of England made a number of errors in its stress test exercise and correcting for these errors leads to a much gloomier assessment of the financial health of the UK banking system. Most, if not all, of the big banks would have failed the test and are demonstrably capital inadequate. As if that were not bad enough, my 'best estimates' of the stress leverage ratios are subject to number of upward biases and other sources of vulnerability that suggest that the true picture is even worse, and potentially much worse, than my numbers suggest.

End Notes

[1] Bank of England, "Stress testing the UK banking system: 2016 results," November 2016, p. 7.

[2] J. Ferguson, "UK bank 'stress' test," *The Macrostrategy Partnership*, 2 December 2016, p. 2.

[3] For more on the major problems that undermine the reliability of RWAs, see K. Dowd *No Stress II: The Flaws in the Bank of England's Stress Testing Programme,* Adam Smith Institute, London, August 3rd 2016.

[4] These P2B numbers were not available to the Bank at the time the stress tests were published, and one would not wish to criticise the Bank for not using values that were unavailable to it. I use these here as they were the ones that featured in the ITN report mentioned in the previous posting, but the overall results would not have been that much different had the Bank used the latest P2Bs available to it at the time it published its stress test results.

[5] To illustrate, Table B.2. on p. 30 of the Bank's November 2016 *Financial Stability Report* indicates that the big 4 UK banks' average P2B fell from 190% at the start of 2007 to 33% during the GFC.

[6] Gordon Ker provides a nice overview: see G. Kerr, *The Law of Opposites: Illusory Profits in the Financial Sector*, Cobden Partners and Adam Smith Institute, 2011.

[7] J. Tavakoli, *Credit Derivatives: A Guide to Instruments and Applications*, New York and Chichester: Wiley, 1998.

[8] For more on these issues, see, e.g., Local Authority Pension Fund Forum, *UK and Irish Banks Capital Losses – Post Mortem*, September 2011, or *No Stress II*, Chapter Two, section 6.

[9] N. Landell-Mills, K. Quinn, E. Tracey, R. Collinge, R. Talbut and F. Curtiss, "Clearer picture of banks' capital is required to help avert crises," *Financial Times*, January 12th 2017**.**

[10] N. Megaw, "Banks overconfident about capital strength, accountancy body warns," *Financial Times* May 14th 2017.

[11] Suppose that assets are reported with an error *x.* Since capital equals assets minus liabilities, then capital will also be reported with the same error *x.* If c is the true capital and A the true asset value, then the reported capital ratio will be equal to $(c+x)/(A+x)$ which will be approximately $(c+x)/A$ if the bank is highly leveraged.

[12] There are also important data, data systems and data reporting issues which are discussed further in *No Stress II*, Chapter Two, section 5.