

Stress Testing in Wartime and in Peacetime

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Abstract

Stress testing served us well as a crisis management tool, and we see it applied increasingly to peacetime oversight of banks and banking systems. It is rapidly becoming the dominant supervisory tool on both sides of the Atlantic. Yet the objectives and certainly the conditions are quite different, and to date we see a range of practices across jurisdictions. Stress testing has proved to be enormously useful, not just for the supervisors but also for the banks. Using a simple taxonomy of stress testing – scenario design, models and projections, and disclosure – I analyze some of those different approaches with a view to examining how wartime stress testing can be adapted to peacetime concerns.

Keywords: risk management, capital requirements, CCAR, systemic risk, financial stability

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1. Introduction

Stress testing as a bank supervisory tool is rapidly spreading across the globe. From Australia, US and Canada, UK, to Scandinavia and continental Europe, stress testing is becoming a familiar sight to banks and bank supervisors alike. The tool that helped draw a line under the recent global financial crisis by providing clarity into the health of the banking system is migrating into ordinary and everyday risk management as well as regulation and supervision. It worked so well in the crisis, in wartime, why not keep using it in peacetime?

In this paper, I consider the merits and demerits of porting stress testing from the theatre of crisis fighting to peacetime bank supervision. The success of stress testing, starting with the US in 2009 with the SCAP (Supervisory Capital Assessment Program), has resulted in new laws (such as the Dodd Frank Act in the US) and in regular supervisory stress testing programs on both sides of the Atlantic. System-wide stress testing leverages the only informational advantage that the supervisor has over the banks: the ability to compare exposures, vulnerabilities, models, and resilience to shocks across the firms. In every other way the supervised are informationally advantaged vis à vis the supervisors. This horizontal perspective is one of the great strengths of a stress testing program at any time.

Yet effective as it was in helping end the financial crisis, the objectives and goals are different in peacetime. In wartime, a central objective is to provide credible insight into the health of bank balance sheets in an effort to stabilize the banking system and thus minimize damage to the real economy. Banks are notoriously opaque even in the best of times (Morgan, 2002). Since existing metrics such as risk weighted assets (RWA) and regulatory capital requirements were not really informative – banks were well capitalized by those metrics – a new approach was needed.

In the depth of the crisis, the credibility problem in banks was matched by the lack of credibility in their supervisors. The metrics by which supervisors judge bank solvency – those involving RWA – were not believable. For that reason, significant and unprecedented disclosure of the stress testing process and details of results was needed so that the market could, effectively, check the supervisors' math.

It is hard to restore confidence if there is no solution to a credibly revealed problem. The presence of a credible financial backstop is critical to allow authorities to comfortably reveal the true depth of the capital hole in the banking system. For example, of the 19 banks in the SCAP, 10 needed capital, one of these – GMAC – needed to be nationalized and thus drew on the government backstop funded by TARP;¹ it was the only one. The other nine were able to fill their hole through a combination of fresh capital raises from the market, many of which were oversubscribed, and retained earnings.

So what are necessary elements for a successful wartime stress test? First, the proposed scenario needs to be severe enough to probe the vulnerabilities of the banks and the banking

¹ <https://www.treasury.gov/initiatives/financial-stability/TARP-Programs/bank-investment-programs/Pages/default.aspx>

system. Scenario design touches on what to stress, i.e. which risk factors to focus on (for instance housing prices, unemployment, or equity prices), and how much to stress them.

Second, the scenario needs to have a correspondingly severe translation to capital impacts via increased losses and reduced profitability. A harsh scenario that results in only a modest capital impact is hard to believe and may even exacerbate the credibility problem. Third, the disclosure regime has to be sufficiently detailed to allow verification of process and results. And fourth, there needs to be a credible capital backstop by the government in case banks who need to raise capital can't do so on their own in a timely manner (for the US case, six months following the release of SCAP results). Indeed, without a credible backstop, supervisors may be reluctant to propose a harsh enough scenario and/or provide less conservative translations of that scenario to the loss, profitability and ultimately capital impact outcomes. The perceived credibility of a backstop underscores the close tie between bank and sovereign risk.

We know much less about what a successful peacetime stress testing program should look like. If wartime stress testing is about revealing the capital hole and filling it – i.e. getting capital into the banks – then peacetime must be a state where the hole, credibly sized, has been (or is being) filled, and credibility in both the banks and their supervisor(s) has been restored. At this stage the relevant question is whether the banks, either individually (microprudential) or collectively (macroprudential) are sufficiently resilient to withstand real economy and financial shocks, given their strategic business objectives and plans. In other words, it is no longer about just surviving (that has already been demonstrated by the recently completed wartime stress test) but rather about ensuring that banks have the capacity to keep lending and to provide other key financial services.

The Federal Reserve has taken this a step further. The CCAR program, by virtue of being a capital planning exercise, requires banks to demonstrate that they have sufficient financial resources (capital) to support their business plans even under severely adverse conditions. If yes, banks can afford to pursue those strategies, and they may be aggressive, or capital could actually be returned to shareholders in the form of increased dividends or share repurchases. If wartime stress testing is about getting capital into the banking system, peacetime is about deciding whether to let it out.

Resilience can be attained and evaluated in two ways: quantitatively and qualitatively. The quantitative question is simple enough: is there enough capital to support the risks taken on by the bank? But bank supervisors traditionally spend their time evaluating whether banks' practices are safe and sound, in other words, bank supervisors regularly conduct qualitative assessments of banks. Are risk and capital/liquidity management practices at banks up to supervisory expectations – are they "good enough"? Stress testing can provide new insights into this old question as is elaborated below.

2. Anatomy of a stress testing program

Let's consider a three-component framework of stress testing to help parse this peacetime problem: scenario, modeling/forecasting machine and results. For each component there are a set of questions to answer.

2.1. Scenario design

Who should design the scenario? How severe should it be, and severe for whom? What shape should it take (e.g., a sharp decline followed by gradual recovery, or a gradual decline and no recovery) and how long should the projection horizon be? How often should one run such a stress test?

A practical issue plaguing supervisors and bank risk managers alike is how to effectively span the state space. Which are the relevant risk factors to focus on, and how many do you need to sufficiently cover the exposures or vulnerabilities of the banks? For example, the SCAP in 2009 made do with just three risk factors, all domestic: GDP growth, unemployment rate and a residential house price index. By 2014, the US stress scenario state space had grown to 16 domestic variables and three variables (GDP, inflation and FX) across each of four non-US regions (the UK, the Eurozone, Japan and developing Asia) for a total of 28 variables.

The 2014 stress test in Europe had a far bigger challenge as it needed to cover 28 countries, of which 18 were part of the Eurozone, where the stress test was part of a wider “comprehensive assessment”.² About ten risk factors were specified for each country, in addition to FX between euro and non-euro EU countries, plus two (GDP and inflation) for each of 20 regions comprising the rest of the world.

Banks with significant capital markets activities (sales and trading, investment banking) regularly cover a much larger set of financial risk factors. In the US, the six largest banks are required to conduct a global market shock (GMS) on their trading book. For CCAR-2015, the Fed specified about 24,000 parameters across about 20 categories such as equities, FX, rates, energy and commodities, securitized products, credit correlation and so on. The 2014 exercise in Europe had approximately 950 parameters plus about 580 sovereign haircuts (by country and maturity).

When considering the state space numbering in the dozen or so (per country) plus trading shocks for capital markets banks numbering in the thousands, the complexity of the scenario design problem becomes daunting. The challenges of building a model that can generate a set of coherent scenarios at such high dimensions are formidable!³

² The comprehensive assessment comprised two elements: 1) an asset quality review (AQR) – to enhance the transparency of bank exposures, including the adequacy of asset and collateral valuation and related provisions; 2) the stress test itself, performed in close cooperation with the European Banking Authority (EBA). Lithuania joined the Eurozone on January 1, 2015.

³ Kapinos and Mitnik (2015) have proposed a dimension reduction approach to top-down stress testing.

Assuming one can agree on the state space and on the severity, expressed perhaps as a likelihood of occurrence (say 1 in 100), with multiple risk factors there is a continuum of equiprobable scenarios to choose from. Here we need some information about the banks' vulnerabilities. The SCAP provides an interesting example. Within a month of the start of the exercise, the realized unemployment rate already exceeded the projected rate under the stress scenario (Figure 1, left panel). However, US banks were most vulnerable to a decline in housing, and that risk factor was indeed appropriately stressed (Figure 1, right panel).

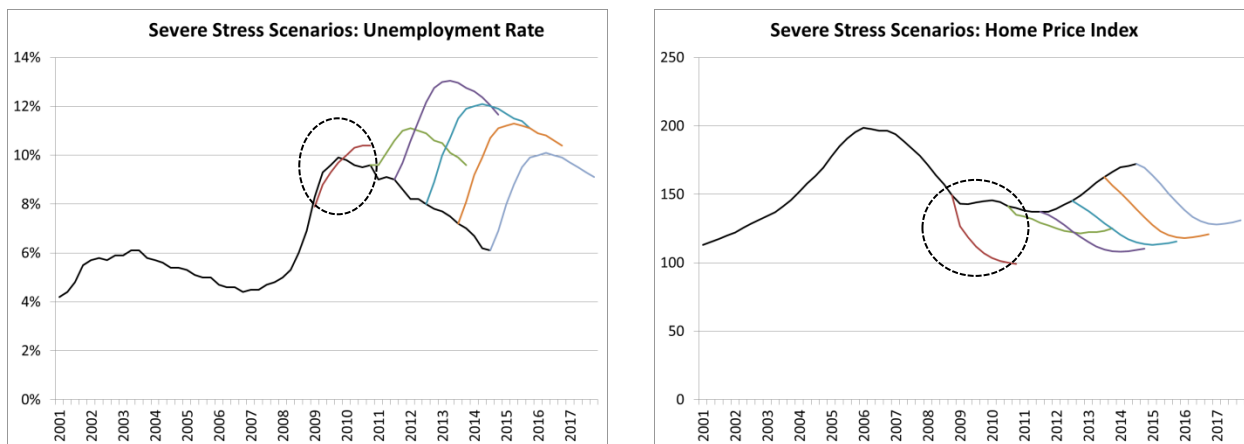


Figure 1: Federal Reserve severely adverse scenarios, 2009-2015. Black line depicts realizations, and colored lines denote stress scenario paths across different stress tests.

The chosen supervisory stress scenario will not be equally stressful for all banks. For instance, banks with modest loan exposures, particularly to mortgages, would be little harmed by stresses to house prices. Unless all banks have similar business models and exposures, it is hard to design a scenario that challenges the capital position of all banks.

To solve this problem, supervisors have to either design a myriad of scenarios to address a range of business models and exposure profiles, or they can ask banks to design their own scenarios in such a way as to probe their specific vulnerabilities. In this way one would expect the scenario of, say, an internationally active trust and custody bank to be rather different from that of a regional commercial bank with a purely domestic business focus.

This approach of requiring both supervisory and bank designed scenarios is followed by the Federal Reserve's CCAR program. In Europe, bank designed scenarios are executed separately from the supervisory tests under Basel's ICAAP.⁴ By asking banks to design bespoke stress scenarios of at least equal severity to the generic supervisory scenario and run them side by side, supervisors are able to glean rich qualitative information about a bank's ability to

⁴ ICAAP: internal capital adequacy assessment process. See, for instance, Bank of England (2015).

effectively identify its risks and vulnerabilities which is foundational to effective risk management. It is hard to overstate the value of this information to supervisors given their difficult task of assessing whether a bank's practices are safe and sound.

A stress test effectively functions as a highly bespoke set of risk weights (Acharya, Engle and Pierret, 2014). Ordinary regulatory risk weighting is invariant to the state of the world, current or expected. Moreover, risk weights are applied only to the left side of the balance sheet (assets) instead of the full set of bank financials (balance sheet and income statement) that impact the capital position of the bank.⁵ When the risks change, so should the assessment (or weighting) of risks.

Stress scenarios can be countercyclical by leaning against the wind, much like monetary policy. Indeed, the Bank of England is explicitly using the stress scenario to calibrate the Basel 3 countercyclical capital buffer of banks. The Federal Reserve's scenario design regime does not go so far, but it does anchor the scenarios in the unemployment rate: it needs to increase by at least four percentage points but have a peak rate of no less than 10%.⁶ For example, the unemployment rate in November 2015 is 5%, so the expectation for the next US stress test scenario is a doubling to 10%. This explicitly system-wide approach is a key feature of what is meant by "macroprudential" (Demekas, 2015).

Regulatory capital regimes such as Basel 1, 2 and 3 have typically been calibrated to a one-year horizon. Stress test horizons to date are typically two years (SCAP) to three years (EBA), and up to five years (Bank of England); the Fed's CCAR program is for nine quarters. A horizon of two to three years roughly matches the asset duration of a typical commercial bank. An investment bank where the balance sheet is dominated by trading assets is much shorter duration, while insurance assets are much longer duration.

There is another possibly significant distinction between the US and European approach. The scenario provided by the Fed and the PRA is published in quarterly time steps and the EBA in annual time steps.⁷ The projections of the bank outcomes – losses, profitability and, of course, capital – is done in quarterly time steps under the Fed regime, and annual time steps on the other side of the Atlantic. Given how quickly banks can fall into insolvency following a shock and the uneven timing of loss realizations across asset classes, as well as profitability dynamics, the more granular or higher frequency approach is likely to better uncover vulnerabilities.

Since CCAR-2014, the Fed has also required the eight globally systemically important banks (GSIBs) to conduct a counterparty default scenario as part of the overall stress test exercise.⁸

⁵ To be sure, both ordinary risk weighting as well as stress testing considers off balance sheet exposures.

⁶ <http://www.federalreserve.gov/newsevents/press/bcreg/20131107a.htm>

⁷ Federal Reserve: <http://www.federalreserve.gov/newsevents/press/bcreg/2015-macro-scenario-tables.xlsx>.

EBA: https://www.eba.europa.eu/documents/10180/669262/2014-04-29_ESRB_Adverse_macro-economic_scenario_-_specification_and_results_final_version.pdf

⁸ G-7 sovereigns and designated clearing counterparties are excluded.

This is an interesting addition to the test as the stress scenario on its own may not be harsh enough to result in a default of a bank's largest counterparties, but such a default would clearly be quite stressful to the bank and yield valuable insights to the supervisor. Moreover, as part of the exercise banks are required to report their top twenty or so counterparties to the supervisor who can use this data to stitch together at least part of the network of interdependencies across the largest financial institutions, a good example of gaining macroprudential insights from microprudential data.

2.2. Models and projections

With the scenario design settled, the next task is to translate that macro-scenario into the micro-outcomes of interest: losses, profitability and capital impact. Should these models be built by both banks and supervisors? How much leeway should banks have in building these models, in mapping the scenario to capital impact of their bank? How can supervisors effectively evaluate the reasonableness of the banks' projections?

All crisis stress testing involved supervisory models to some degree, and the US has gone furthest in building out and relying on such models for peacetime stress testing. An independent assessment with supervisory models using bank data was viewed as critical to the success of the SCAP (Hirtle, Schuermann and Stiroh, 2009). The stark difference in results from the initial European exercises in 2010 and 2011 and subsequent country-specific stress tests are at least in part attributable to the rigorous use of independent models in the latter. Two notable examples are Ireland in 2011 and Spain in 2012. The Irish stress test revealed a capital need for the four largest Irish banks of €24 billion only months after the CEBS-2010 EU-wide exercise found none of the four Irish banks needing any capital.⁹ None of the 25 Spanish banks that participated in the EBA-2011 exercise were required to raise capital following the test, yet a subsequent exercise in 2012 revealed a capital need of €57bn across seven of the then 14 participating banking entities.¹⁰ Frankly it seems hard to imagine how a supervisor could effectively evaluate the impact of scenarios on bank balance sheets (and income statements) without their building own models.

Acharya, Engle and Pierret (2014) point out that the early European stress tests suffered less from mild scenarios or from loss impacts that were too benign. Rather they allowed profitability projections through the stress scenario that were perhaps overly optimistic. For many banks, profitability more than covered projected losses, implying no capital consumption at all. To illustrate this, Table 1 below compares two US stress tests (2009 and 2015) and two European exercises (2011 and 2014). The average coverage ratio in the SCAP was 61%, and only 16% of the banks were projected to cover their losses with profits. This rose to 80% and 23%

⁹ <http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Documents/The%20Financial%20Measures%20Programme%20Report.pdf>.

¹⁰ There had been a number of bank mergers in 2011 which reduced the number of entities without reducing the coverage of the banking system. http://www.bde.es/f/webbde/SSICOM/20120928/informe_ow280912e.pdf.

respectively for the peacetime stress test in 2015. The EBA exercise in 2011, at a time of acute sovereign risk concerns in Europe, allowed 42% of the tested banks to more than cover their projected losses with profits. By contrast, the 2014 exercise was markedly harsher by this metric: the average loss coverage ratio was 44%, and just 11% of the banks were able to cover the projected losses with profits.¹¹

	Average coverage ratio	% of banks with coverage ratio >1
SCAP 2009	61%	16%
CCAR 2015	80%	23%
EBA 2011	75%	42%
CA 2014	44%	11%

Table 1: Loss coverage ratios across stress tests. Coverage ratio = pre-provision profits over total losses.

How much freedom should banks have in modeling the impact of stress scenarios? US regulators have provided relatively few constraints in modeling approaches and parameters, while European regulators, perhaps concerned with banks’ overly optimistic projections, have constrained some of the loss and profitability projection parameterization. US supervisors have similar concerns, but with richly built-out supervisory modeling machinery it is easier to confront any undue optimism more directly. There is no better way to understand a modeling challenge than to build it yourself.

The supervisory value of allowing for a richer diversity of modeling approaches could be quite high. Supervisors may learn from the range of modeling practice to both improve their own modeling as well as guide best practices as they emerge and evolve in the industry. Moreover, some freedom of development mitigates against models monoculture, a risk that certainly exists in any model intensive risk management and supervisory process (Hirtle and Lehnert, 2014). However, it is a resource intensive proposition. The supervisory models and corresponding modeling expertise need to exist in the first place.

Modeling energy by the supervisor can be focused more on the micro-prudential problem – forming an independent view of bank level results at a fairly granular level – or more on the macroprudential problem – understanding the system-wide effects involving spillovers into the rest of the financial system and the real economy. The Bank of England (2015) has made it clear

¹¹ To be sure, the maturity of modeling profitability under stress is much less than for loss models (Duane, Schuermann and Reynolds, 2014) which have been the longtime focus of bank risk managers.

that, for the medium term at least, their modeling energy will be focused on the latter. While the Fed has not been explicit about its view, judging by the enormous effort devoted to modeling granular bank-level financials, it seems the focus is more on the former.

If the peacetime objective is to ensure that the banking system, individually (for the largest, most systemically important banks) and perhaps collectively is resilient to shocks, then the more microprudential focus of the Fed seems appropriate. If, however, the objective is to understand the resilience of the financial and real economic ecosystem to shocks, then the more macroprudential orientation of the Bank of England seems desirable. To be sure, the more an economy's credit formation and financial intermediation is dominated by banks, the less system-wide insights are lost by just focusing, in detail, on banks. The US, however, is one of the least bank-dependent industrialized economies.

2.3. Use and disclosure of results

The most creative and stringent scenario translated to capital impact outcomes with robust and conservative models is not enough; the results need to be properly communicated to the public. How much disclosure? And who should disclose?

Credibility of results is critical for effective crisis response. To quote Ong and Pazarbasioglu (2013; p.1), "Credibility is the bedrock of any crisis stress test." A generous disclosure regime is needed for this to happen, both in terms of process and outcomes/results. Both banks and supervisors need to overcome market skepticism, and transparency is the only way to regain lost confidence. The stress test has to produce genuinely new information (e.g. new insights into bank balance sheet resilience), and this information has to be credible.¹²

A lot of information on its own is not enough. The EBA in 2011 provided very rich disclosures, down to well-organized Excel files containing data and results¹³, but the projected capital need was too small to be credible (€2.5 for the 90 participating banks). Examples of the right mix of transparency and credible results are the SCAP (2009), Ireland (2011), Spain (2012), and the 2014 Comprehensive Assessment by the EBA and ECB.¹⁴

¹² Gorton and Tallman (2015) make an interesting argument that crisis response before the Fed came into being involved suppressing information about individual banks but providing it about the system as a whole.

¹³ <http://www.eba.europa.eu/documents/10180/15935/2011+EU-wide+stress+test+disclosure+templates+-+revised.xls/cc3e791a-af03-4e7b-a48f-97f671fd6bf0>

¹⁴ SCAP: <http://www.federalreserve.gov/newsevents/press/bcreg/20090507a.htm>. Ireland (2011): <http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Pages/FinancialMeasuresProgramme.aspx>. Spain (2011): http://www.bde.es/f/webbde/GAP/Secciones/SalaPrensa/InformacionInteres/ReestructuracionSectorFinanciero/Ficheros/en/informe_oliverwymane.pdf. EBA/ECB (2014): <http://www.eba.europa.eu/-/eba-publishes-2014-eu-wide-stress-test-results>; <https://www.bankingsupervision.europa.eu/banking/comprehensive/2014/html/index.en.html>

Once credibility is re-established and the financial system is on the mend, more careful thought may need to be given to the peacetime disclosure regime. What is the purpose, and what information should be conveyed, and who should convey it? Goldstein and Sapra (2013) describe well the benefits and costs of stress test disclosures, pointing out, among other things, that the signal from the regulator, now highly credible, may drown out the signal from the bank (via its own disclosure), both hampering market discipline and inducing strategic behavior in bank disclosures. My own view: in a crisis, the supervisor ought to be very transparent and have rich disclosure. However, in peacetime a more modest disclosure regime may be desirable. Meanwhile, banks should disclose generously at all times to promote monitoring and market discipline.

Other than to disclose results, what decisions are or can be made in peacetime? In a crisis, the main decisions hinge on the capital shortfall projected by the stress test. That shortfall may be so acute as to question the viability of the bank forcing more drastic action (e.g., nationalization or liquidation). A bank can either raise capital on its own or make use of capital backstops and other programs (e.g., a government sponsored “bad bank”) to meet the revealed capital need. Banks that need capital are typically required to submit a capital plan that lays out how, and by when, the bank plans to fill the capital shortfall.

In peacetime, what supervisory action is contemplated? There may be further capital shortfalls arrived at through quantitative approaches developed in the crisis (and carried forward). Such shortfalls or stress test failures should be rare, however, if the wartime stress test was sufficiently severe, but they may occur from time to time.

What, then, of the wealth of qualitative information gathered in the course of a stress test, especially a peacetime stress test performed without the time pressure and exigency that comes with financial crisis management? The Federal Reserve, with its CCAR program, has made use of this qualitative information to prevent firms from distributing capital back to their shareholders. Such “failure” based on qualitative assessment is in addition to possible failure for quantitative reasons (outright projected capital shortfall). This has not (yet) been implemented by other supervisors. Note that the US has a mixed model, where banks subject to the DFAST (typically smaller banks) but not the CCAR program are not exposed to the risk of such qualitative failures; see Hirtle and Lehnert (2014) for a discussion.

The bridge between wartime and peacetime is the capital plan. Recall that revealed capital shortfalls from a crisis stress test result in a capital plan, developed by the bank, but approved by the regulator, which maps out how the bank will close the identified capital gap. The CCAR program, ostensibly, is a capital planning exercise. Banks must demonstrate that their business/strategic plan for the coming nine quarters will survive a stressful scenario, one (or more) designed by the supervisor and one (or more) of their own design.

3. Other applications of stress testing

Stress testing is finding wider uses and applications. With increasing emphasis on recovery and resolution planning (RRP), the stress testing framework and machinery can be readily used to stress the bank more and more to the point of needing to take drastic action such as asset sales or business disposition to raise funds (recovery mode) or all the way to a terminal shock. Large US banks are making use of their CCAR stress testing machinery to satisfy RRP requirements.

Increasingly, the stress testing and projection capabilities are being used by banks for ordinary business decisions like budgeting and performance assessment. To satisfy stress testing requirements, the bank needs to generate dynamic projections of their balance sheet and income statements, conditional on a realization of the economy and financial markets in the form of a two to five year path. One of those realizations is a baseline scenario, the most likely path the economy will take. A natural application is to the budgeting process, and increasingly CCAR banks are discarding their old, more heuristic budgeting approach and making use of the baseline forecast from their CCAR process.

Essentially, the stress testing modelling machinery allows the bank to understand how much of its performance is driven by macro-risk factors – unemployment, house prices, interest rates – which are largely beyond management control, and therefore what extra push is needed to achieve desired performance goals above and beyond what the economy and the market can deliver organically. The stress test machine can help a bank be much more articulate about the drivers of its business plan and thus be able to separate performance into ‘alpha’ and ‘beta’.

4. Concluding thoughts

Stress testing as the dominant supervisory tool is no panacea. The pre-crisis supervisory regime of the GSEs in the US is a spectacular failure of using stress testing to set required capital levels (Frame, Gerardi and Willen, 2015). That regime involved two sets of interest rate shocks and was left unchanged after its implementation in 2002. This experience, however, points to one of the real values of stress testing, properly done, both from a micro- and macroprudential practice: risks are time varying, and so the risk assessment or risk weighting should also be time varying (Acharya, Engle and Pierret, 2014).

Stress testing is not new; it is a well-worn component in the risk manager’s toolkit. But comprehensive and dynamic stress testing with explicit conditioning on observable macroeconomic and financial risk factors requiring projections of firm financials – balance sheet and income statement – is recent. It has provided banks, and supervisors, with new insights into their vulnerabilities. It has pushed the culture of senior management to be more imaginative in identifying risks and using stress testing (and reverse stress testing) as a way of evaluating forward looking actions. When aggregated across many banks, the whole provides more information than just the sum of the parts.

This discussion has focused just on capital stress testing, yet banks typically run short of liquidity long before they run short of capital. Much less has been written about liquidity stress testing, and to date little guidance has emerged from the regulatory and supervisory community about what a good liquidity stress testing process ought to look like.

As we leave the financial crisis behind, stress testing in peacetime is rapidly becoming the supervisory tool of choice: for quantitative assessment of resilience and capital adequacy; for qualitative insights into the risk and capital management practices of banks. The concreteness of the tested scenario – unemployment going to, say, 10%, house prices declining by 20%, equity market volatility doubling – is one of the real virtues of this risk management approach. It is tangible and lends itself to clear understanding by senior management, boards of directors, supervisors and the public. Stress scenarios are a tangible expression of risk appetite, one of the hardest, yet most important preference parameters in risk management, whether by the bank or by the supervisor. Given the inherent opacity of bank balance sheets, such clarity is especially welcome.

References

- Acharya, V., R. Engle and D. Pierret (2014). "Testing Macroprudential Stress Tests: The Risk of Regulatory Risk Weights." NBER Working Paper No. 18968.
- Bank of England (2015). "The Bank of England's approach to stress testing the UK banking system." Available at <http://www.bankofengland.co.uk/financialstability/Documents/stresstesting/2015/approach.pdf>
- Central Bank of Ireland (2011), *The Financial Measures Programme Report*, Dublin (<http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Documents/The%20Financial%20Measures%20Programme%20Report.pdf>)
- Demekas, D.G. (2015). "Designing effective macroprudential stress tests: progress so far and the way forward." IMF Working Paper No. WP/15/146.
- Duane, M.P., T. Schuermann and P. Reynolds (2014). "Stress Testing Bank Profitability." *Journal of Risk Management in Financial Institutions* 7:1, 72-84.
- Frame, W.S., K. Gerardi and P. Willen (2015) "The Failure of Supervisory Stress Testing: Fannie Mae, Freddie Mac, and OFHEO". FRB of Boston Working Paper No. 15-4. Available at SSRN: <http://ssrn.com/abstract=2675697>.
- Goldstein, I. and H. Sapra, 2013, "Should Banks' Stress Test Results be Disclosed? An Analysis of the Costs and Benefits", *Foundations and Trends in Finance*, vol. 8, pp. 1-54.
- Gorton, G. and E. Tallman (2015), "How Did Pre-Fed Banking Panics End?" Available at http://faculty.som.yale.edu/garygorton/documents/GortonTallmanPaper_June_9_2015.pdf
- Hirtle, B.J., T. Schuermann and K. Stiroh (2009). "Macroprudential Supervision of Financial Institutions: Lessons from the SCAP." FRB of New York Staff Report No. 409.
- Hirtle, B.J. and A. Lehnert (2014). "Supervisory Stress Tests." FRB of New York Staff Report No. 696.
- Kapinos, P.S. and O.A. Mitnik (2015). "A Top-down Approach to Stress-testing Banks". Forthcoming, *Journal of Financial Services Research*.
- Morgan, D. P. (2002). Rating banks: risk and uncertainty in an opaque industry. *American Economic Review*, 92(4), 874-888.
- Ong, L.L. and C. Pazarbasioglu (2013). "Credibility and Crisis Stress Testing." IMF Working Paper WP/13/178.