

Submission to the Australian Payments Plan Consultation: Shaping the Future of Australian Payments

by

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We would like to address three issues in our submission: (i) the proper meaning of ‘resilience’ when applied to payments systems, (ii) the potential benefits to federal and state governments of growth in electronic payments in Australia, and (iii) the need for an improved, streamlined regulatory regime for stored value payments in Australia.

1. The Meaning of Resilience When Applied to a Payments System

The Payments Council has rightly, in our view, identified resilience, efficiency, accessibility and adaptability as the desirable characteristics of the Australian payments system. Resilience, properly understood, needs to be one of the most important characteristics of our payments system yet when the term resilience is used in the context of financial systems, it is almost invariably used as a synonym for strength or robustness, and resilience and strength are different concepts.²

A system that is strong is able to withstand external shocks. A system that is resilient is either able to withstand external shocks or if the shock is so substantial that this is impossible, is able to reorganize itself in such a way as to continue to deliver the same essential services but in a different manner. Examples *par excellence* of highly resilient systems abound in the natural world. Nature prioritizes resilience over efficiency. There is typically a number of species in an ecosystem that each discharge the same function, so that if one species dies out, the entire ecosystem continues to function well. We explore this insight in much greater detail in the research paper in the Appendix. Applying that paper’s insights to a payments system suggests the best payments system for Australia is going to include a number of different payments channels, for if one channel fails (or is not available)

¹ The team members who worked on this submission are Professor Ross Buckley, CIFR King and Wood Mallesons Professor of International Finance Law; Ms Louise Malady, Senior Research Fellow; and Evan Gibson, Research Fellow. The research and preparation of this submission was supported by the Centre for International Finance and Regulation (CIFR) (project no. T025). CIFR is a Centre of Excellence for research and education in the financial sector which is funded by the Commonwealth and NSW Governments and supported by other consortium members (see <www.cifr.edu.au>).

² Mary Dowell-Jones & Ross Buckley, “Reconceiving Resilience: A New Guiding Principle for Financial Regulation?”, research paper – attached in the Appendix to this submission, as yet unpublished.

for a period of time alternatives will be required. Such thinking would argue, for example, for the retention of the ability to manually process credit card payments to accommodate periods when electronic processing is not available. As a general principle, the strengthening of channels is good unless it is accompanied by the exclusion of alternate payment channels so that the collapse of the dominant channel brings chaos.

2. The Potential Benefits to Federal and State Governments of the Growth of Electronic Payments in Australia

Some 45%, by value, of the currency in circulation in Australia is comprised by one hundred dollar notes.³ Yet most Australians rarely handle a one hundred dollar note. These notes are being held somewhere and used for something. It may be that a proportion are under mattresses so that people can meet the various tests required for eligibility for the aged pension. However, one suspects that the great majority of these notes are used to make payments in the construction industry, particularly the flourishing trade in home renovations in Australia, or in other aspects of the black economy. Anecdotal evidence would suggest that some 15 years after the introduction of the Goods and Services Tax, Australia retains a sizeable black economy estimated to be of the order of \$24 billion a year.⁴ If cash payments were to stop being routine in daily life, sizeable cash payments for the purposes of avoiding taxation, both the Federal taxation on income, and the GST which accrues to States, would become far more apparent and easily traceable. Australia already has the world's highest take up of Pay-Wave (Tap-n-Go) technology in the world. It is already easier to make a minor payment by waving one's card in front of a register than it is to reach into one's pocket for coins and notes. It is somewhat surprising that governments at both levels have not embraced this change and thrown their robust support behind it, for it is government that stands most to benefit from efforts to shrink the black economy. It seems to us that the Payments Council has a potentially important educative function to fulfil here. The payments industry, and government, should be allies in the quest to move Australia towards electronic payments and away from cash.

Experience abroad suggests that stored value products have a central role to play in this evolution towards payments and away from cash. Already, in Hong Kong, the Octopus card enjoys an extraordinary 99% acceptance rate among adults and over 50% of the transactions paid for by Octopus are non-transport related.⁵ Stored value cards, such as

³ As at end June 2014, see: Reserve Bank of Australia, "Banknotes: Distribution,": available at <http://www.banknotes.rba.gov.au/production-and-distribution/distribution>.

⁴ Australian Payments Clearing Association, "The Evolution of Cash An Investigative Study (July 2014) Summary of Findings, 86: available at <http://www.apca.com.au/docs/policy-debate/evolution-of-cash.pdf>: referring to the Australian Bureau of Statistics.

⁵ "Adults" refers to 15 to 64 year olds in Hong Kong: OCTOPUS, "Corporate Profile" (January 2015), at 9, available at http://www.octopus.com.hk/web09_include/_document/en/company_profile.pdf; Ben Fung, Miguel Molico and Gerald Stuber, "Electronic Money and Payments: Recent Developments and Issues", Bank of Canada Discussion Paper 2014/2 (2014), at 27.

Octopus in Hong Kong, or the Oyster card in London, offer greatly improved levels of both convenience and efficiency for consumers. For instance the near universal adoption of such cards means that one can merely wave one's card to gain entry to a car park and then wave it again upon exit to have the appropriate fee debited against it. Yet today, in Australia, stored value products are potentially liable to be regulated under five different pieces of legislation administered by four different regulators. Which bring us to the final subject in our submission below.

3. The Need for an Improved, Streamlined Regulatory Regime for Stored Value Payments in Australia

Stored value products in Australia are principally regulated by a system of exemptions. This is understandable for, to date, they have mainly comprised road toll payment systems, retail gift cards and travel cards upon which intending tourists can load foreign currency. However, the result of the current regulatory regime is that we have seen very little innovation in the stored value space in Australia. Many potential entrants to the market, upon learning of the complexity of its regulation and the likelihood that, if their product goes to scale, they will be regulated as an Authorised Deposit-Taking Institution (ADI), simply do not enter the market. In our view, there is a strong need for a single regulator of stored value products in Australia applying a single set of regulatory rules. This would transform the marketplace. In the initial years the regulator's staff need not be large and it could well be a very small department housed within an existing regulator such as ASIC or the RBA. Precisely where it is located, is not of the greatest importance. What matters, immensely, is that there is one regulator charged with the efficient regulation of this sector of the marketplace applying one streamlined and coherent set of rules appropriate to the sector's current stage of development.

APPENDIX

Reconceiving Resilience: A New Guiding Principle for Financial Regulation?

Mary Dowell-Jones* & Ross Buckley**

Most post-crisis financial regulation is expressed to be in the pursuit of increasing the resilience of the global financial system. “Resilience” features in the formal title of the Basel III reforms to bank capital adequacy rules. This article explores the meaning of resilience from socio-ecological systems science and applies it to international finance. We conclude that post-crisis financial regulation has in fact sought to build a stronger, more robust system, not a more resilient one. The regulation imposed on global systemically important financial institutions is designed to make these institutions too strong to fail, not give them the capacity to reorganize themselves, or transition to a new equilibrium, in the face of major external shocks. This article challenges the fundamental thinking behind seven years of post-crisis financial regulation and suggests we need far more rigorous research into what a truly resilient international financial system would look like and how it would be regulated.

INTRODUCTION

Resilience is broadly defined as: ‘the capacity of a system to avoid disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks’.⁶ It is a concept with a multi-disciplinary pedigree with roots in ecology, security analysis and childhood trauma, among others, and which focuses on the dynamic capacity of a complex, adaptive, non-linear system to self-repair in response to stress or to transition to a new stable equilibrium, rather than the capacity of a system to function without succumbing to crisis in the first place. It is therefore a useful concept to apply to finance because of the tendency of the globally integrated financial system to swing from one crisis to another,⁷ and it is a term that has come to feature heavily in post-crisis

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⁶ B. H. Walker, C. S. Holling, S. R. Carpenter & A. Kinzig, ‘Resilience, Adaptability and Transformability in Social-Ecological Systems’ (2004) 9(2) ECOL SOC 5, 4.

⁷ When the crises that have been produced by the financial markets over the last quarter of a century are listed, it is immediately striking that the periods without crises are by far the rarer creature: Eurozone crisis (2010–); Global Financial Crisis (2007–9); Global Food & Fuel Crisis (2005–8) (although this is not counted as a financial market crisis proper, it resulted from the global asset boom & increased trading in agricultural commodities, and it had a very serious impact on the world’s poorest people); Dotcom Crisis/Argentina (2001–

debates about financial stability.⁸ In light of the scale of the global financial crisis of 2008 and the bailouts required to save the system, resilience is seen as a highly desirable attribute of today's integrated global markets and an objective of post-crisis regulatory reforms.

However, as a broad, multi-disciplinary concept, it is not unproblematic in its application to finance because it does not immediately offer a practical, concrete agenda for reform specific to the financial markets. 'Resilience' as it is applied in disciplines like ecology, for example, is generally a descriptive rather than normative attribute of a system, i.e. undesirable systems can be characterised as resilient because they also have the capacity to endure in the face of shocks. To understand resilience, the key structural attributes of a system and its essential dynamics, interdependencies and feedback loops need to be mapped. However the complexity and lack of transparency of today's global financial markets make this exceptionally difficult. Where the term 'resilience' is used in regulatory debates, it often indicates a generally desired condition of systemic stability which is assumed to flow from the proposed regulatory measures. It is not generally used to denote a particular approach to understanding the dynamics of global finance and the required management/regulatory responses for achieving stability. Thus resilience is used in a generic, descriptive manner rather than as the organising goal of a new regulatory approach. While there is wide-ranging stakeholder agreement on the value of increased financial system resilience, 'resilience' does not in and of itself offer an immediate agenda for reform, and despite the frequent use of the term in regulatory debate, no one really knows whether the post-crisis regulatory changes will have this effect.

Our purpose is to review certain key characteristics of resilience as it has been applied in social-ecological systems science (SES) where the concept first emerged, and to analyse whether they offer insights into the better management of financial systems, particularly the global financial system. Applying SES resilience thinking to finance raises acute questions around our understanding of financial systems as systems, and their key dynamics, risk factors and stability determinants; and raises the fundamental issue of whether we understand the financial system sufficiently well to even be able to develop a regulatory agenda for resilience.

RECOGNISING RESILIENCE – WILL WE KNOW IT WHEN WE SEE IT?

One of the problems with applying the concept of resilience to the international financial system is that it is not clear that we will know it when we see it. Nor is it self-evident that the

3); Russia/Latin America (1998–9); LTCM (1998); Asian Financial Crisis (1997–8); Bond Market Crisis (1994); European ERM Crisis (1992–3); Stock Market Crash (1987). C. Kindleberger & A. Robert, *Manias, Panics and Crashes: A History of Financial Crises* (Palgrave Macmillan, 6th ed, 2011); C. Reinhart & K. Rogoff, *This Time is Different: Eight Centuries of Financial Folly* (Princeton University Press, 2009); R. Buckley & D. Arner, *From Crisis to Crisis: The Global Financial System and Regulatory Failure* (Kluwer, 2011).

⁸ See for example: Basel Committee on Banking Supervision, 'Consultative Document: Strengthening the Resilience of the Banking Sector' (Bank for International Settlements, December 2009); Bank of England, 'Building a More Resilient Financial System' (Bank of England, Financial Stability Report June 2009), chapter 3 at <http://www.bankofengland.co.uk/publications/Pages/fsr/2009/fsr25.aspx> (last accessed 17 July 2014); Financial Stability Forum, 'Financial Stability Forum on Enhancing Market and Institutional Resilience' (Financial Stability Forum, April 2008); Mario Draghi, 'Strengthening Financial Resilience' (Speech delivered at the 2013 International Monetary Conference, 3 June 2013) at <http://www.ecb.europa.eu/press/key/date/2013/html/sp130603.en.html>.

concept provides a specific roadmap for change. Resilience has become a ‘pervasive idiom of global governance’⁹ which:

[H]as in the recent past rapidly infiltrated vast areas of the social sciences, becoming a regular, if under-theorized, term of art in discussions of international finance and economic policy, corporate risk analysis, the psychology of trauma, development policy, urban planning, public health and national security.¹⁰

As should be expected of a concept that can be applied so broadly across disciplines, its inherent malleability fosters its multi-disciplinary uptake, but the challenges in reconfiguring the international financial architecture mean it can only provide broad principles of thought.

Perhaps the biggest problem with the concept of resilience is that it can easily be mistaken for something else. Most commonly, it has been mistaken for interludes of market calm between crises. It is also called in aid to justify the apparent success of new financial products, ideas and reforms, before they have had time to cause harm.

In 2005, the Director of the IMF’s International Capital Markets Department stated that: ‘For four straight years the global financial system has shown impressive resilience.’¹¹

In 2005, Alan Greenspan remarked that: ‘The use of a growing array of derivatives and the related application of more sophisticated approaches to measuring and managing risk are key factors underpinning the greater resilience of our largest financial institutions’.¹²

In 2006, the IMF asserted that: ‘the dispersion of credit risk by banks to a broader and more diverse set of investors, rather than warehousing such risk on their balance sheets, has helped make the banking and overall financial system more resilient.’¹³

In August 2007, the Governor of the Bank of England, Mervyn King stated:

[I]t is very important to set a very, very key point here, which is that our banking system is much more resilient than in the past. Precisely because many of these risks are no longer on their balance sheets but have been sold off to people willing and probably more able to bear it.¹⁴

One month later, the Bank of England was dealing with the first run on a British bank in over a hundred years.¹⁵

⁹ J. Walker & M. Cooper, ‘Genealogies of Resilience: From Systems Ecology to the Political Economy of Crisis Adaptation’ (2011) 42(2) *Security Dialogue* 143, 143.

¹⁰ *ibid.*

¹¹ G. Hausler, ‘Why the Global Financial System is More Resilient’ (International Monetary Fund, 7 October 2005) at www.imf.org/external/np/vc/2005/100705e.htm.

¹² A. Greenspan, ‘Risk Transfer and Financial Stability’ (Remarks delivered to the Federal Reserve Bank of Chicago Conference on Bank Structure, 5 May 2005) at <http://www.federalreserve.gov/Boarddocs/Speeches/2005/20050505>.

¹³ ‘Global Financial Stability Report: Market Developments and Issues’ (International Monetary Fund, Washington DC, April 2006), 51.

¹⁴ ‘Inflation Report Press Conference – 8 August 2007’ (Bank of England) at <http://www.bankofengland.co.uk/publications/Documents/inflationreport/conf080807.pdf> (last accessed 8 July 2014).

¹⁵ Although there had been bank collapses such as Barings in 1995, a run on the retail deposits of a British bank had not occurred since Victorian times. In 1866, a run on deposits was triggered by the collapse of Overend, Gurney & Co., and in 1878 by the collapse of the City of Glasgow Bank. UK House of Commons Treasury

Despite these errors in recognising resilience, the idea of resilience has become ubiquitous in regulatory debates. As the Bank of England remarked in its 2009 Financial Stability Report chapter on ‘Building a more resilient financial system’:

The financial system should be capable of absorbing shocks from the economy and from financial markets rather than generating them. It also needs to be much better able to support economic activity on a sustainable basis, without relying on large-scale publicly funded support to weather shocks. This will require fundamental changes to the way the financial sector is regulated, supervised and manages its own affairs.¹⁶

The Basel III international capital adequacy regulations which emerged out of the crisis are formally titled: ‘A Global Regulatory Framework for More Resilient Banks and Banking Systems’, and their overarching objective is: ‘to improve the banking sector’s ability to absorb shocks arising from financial and economic stress, whatever the source, thus reducing the risk of spillover from the financial sector to the real economy’.¹⁷ This conceives of resilience of the financial system as separate and distinct from the resilience of the broader economy or society, as if the one can be defined in isolation from the other. The fact that regulators in various jurisdictions have chosen to adopt higher capital requirements than those mandated in these regulations indicates in any case less than full consensus on the framework’s ability to achieve the desired financial stability and resilience outcomes.¹⁸ The Basel III framework establishes a soft law set of minimum standards for the global banking system, with national regulators free to go beyond the minimum. In practice: ‘most jurisdictions have adopted minimum requirements that exceed the global standard’, which has been labelled as ‘super-equivalence’.¹⁹

The Financial Stability Forum, precursor to the Financial Stability Board, also adopted a resilience framework for its reform agenda, without specifying how it defined ‘resilience’ or what a resilient financial system should look like. The schedule of measures that it proposed responded to the particular failures identified during the crisis, rather than setting out a new vision for the financial system. The stated goal was: ‘to strengthen the efficiency and resilience of the system, without hindering the processes of market discipline and innovation

Committee, ‘The run on the Rock’ (United Kingdom Parliament, Fifth Report of Session 2007–08, vol 1, Box 1, 24 January 2008), 8–9 at <http://www.publications.parliament.uk/pa/cm200708/cmselect/cmtreasy/56/56i.pdf> (last accessed 12 September 2014).

¹⁶ ‘Financial Stability Report June 2009’ (Bank of England), chapter 3, 36 at <http://www.bankofengland.co.uk/publications/Pages/fsr/2009/fsr25.aspx> (last accessed 23 July 2014).

¹⁷ Basel Committee on Banking Supervision, ‘Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems’ (Bank for International Settlements, 2011), 1 at <http://www.bis.org/publ/bcbs189.pdf>.

¹⁸ For a summary see: International Monetary Fund, ‘Australia: Addressing Systemic Risk Through Higher Loss Absorbency — Technical Note’ (IMF, Country Report No 12/311, November 2012), 10, table 4; ‘Basel 4: Emerging from the Mist?’ (KPMG, 2013) at <http://www.kpmg.com/global/en/issuesandinsights/articlespublications/regulatory-challenges/pages/emerging-from-the-mist.aspx> (last accessed 18 September 2014); A. Admati & M. Hellwig, *The Bankers’ New Clothes: What’s Wrong with Banking and What to do About It* (Princeton University Press, 2013); R. Buckley, R. Weber & M. Dowell-Jones, ‘A Swiss Finish for Australia? Approaches to Enhancing the Resilience of Systemically Important Banks’ (2015) 10(1) CMLJ 41.

¹⁹ S. Ingves, ‘Basel III Implementation: Progress, Pitfalls and Prospects’ (Speech delivered at the Meeting for the Americas, Lima, Peru, 3–5 November 2014) at <http://www.bis.org/speeches/sp141105.htm>; see also Basel Committee on Banking Supervision, ‘Implementation of Basel Standards: A Report to G20 Leaders on Implementation of the Basel III Regulatory Reforms’ (BIS, November 2014) at <http://www.bis.org/bcbs/publ/d299.pdf>.

that are essential to the financial system's contribution to economic growth.'²⁰

Notwithstanding that recent 'innovation' had caused systemic meltdown, this implied that the system and the ideas on which it is built are fundamentally sound, but that action was needed on the specific failures that led to the crisis. This is an approach which has been continued by its successor the Financial Stability Board. In his letter to the G20 summit in Brisbane, Mark Carney, the Chair of the Financial Stability Board, declared that: 'Strengthened international standards are building more resilient financial institutions and more robust markets.' He noted that the G20 had 'worked intensively ... to correct the fault lines that led to the global financial crisis.'²¹

Another example of the post-crisis use of resilience in financial regulatory debates is provided by a speech in 2011 by Gonzalez-Paramo, member of the Executive Board of the European Central Bank.²² The speech uses 'resilience' or 'resilient' twelve times, and yet fails to provide any indication of what is meant by a 'resilient' financial system. It is assumed that this is an objective that requires no further explanation. Gonzalez-Paramo states: 'Why is the resilience of the financial system so important? The financial system is the lifeblood of the real economy. It touches all facets of our economy from households to corporations and even governments.' He then focuses on the need for 'a resilient risk management framework for the future' resting on 'the twin pillars of statistical risk models and stress testing', even though this is precisely the architecture of risk management which failed so spectacularly in the run up to and during the crisis.

Resilience, then, appears to be generally used as a broad descriptive term for the goal of measures which regulators have decided upon, rather than a new paradigm for financial stability from which to build. As one commentator has noted: 'current efforts to rebuild and reshape the financial system fail to engage in depth the necessary preliminary questions about what resilience might mean and who should be the subject of resilience-building measures.'²³ They are heavily, if not exclusively, focused on the resilience of the financial system alone, as if that can be defined in isolation from the way the financial system interacts with broader economic and socio-political institutions. If financiers and regulators with decades of experience in the international financial and monetary system cannot correctly identify market resilience, and instead mistake pre-crisis symptoms for it, even as these are reaching a critical stage, how useful is the concept as a broad policy tool? Does the notion of resilience inject a new dynamic in the regulatory endeavour, or is it merely a generic term for financial stability?

UNDERSTANDING THE CONCEPT OF RESILIENCE

²⁰ Financial Stability Forum, 'Report of the Financial Stability Forum on Enhancing Market and Institutional Resilience' (Financial Stability Board, April 2008), 2 at http://www.financialstabilityboard.org/publications/r_0804.pdf (last accessed 22 September 2014).

²¹ M. Carney, 'Financial Reforms: Completing the Job and Looking Ahead' (Financial Stability Board, 7 November 2014), 1, 5 [FSB Chair's Letter to G20 Leaders for the Brisbane Summit]; *See*: 'Building Resilient Financial Institutions' (Financial Stability Board) at www.financialstabilityboard.org/what-we-do/policy-development/building-resilience-of-financial-institutions.

²² J. M. Gonzalez-Paramo, 'Risk, Return, Resilience: The Future Financial System' (Speech delivered at the 3rd Annual Risk and Return Russia Conference, 14 April 2011) at <http://www.ecb.europa.eu/press/key/date/2011/html/sp110414.en.html>.

²³ J. Gray, 'Toward a More Resilient Financial System?' (2013) 36 *Seattle University Law Review* 799, 802.

As a starting point, it is increasingly recognised that the financial system is a complex, non-linear system²⁴ like the social-ecological system, and is therefore akin to a ‘financial ecosystem’.²⁵ One of the key issues in defining an agenda for a resilient financial system is to understand the nature, structure, and key characteristics of the financial ‘system’. Given the scale, complexity and rapid growth of financial markets, this is not self-evident as the system has fundamentally changed over the last two decades. During the crisis it became apparent that regulators and financial institutions had simply failed to understand the changes that had taken place in the financial system over the years leading up to the crisis, and did not recognise transmission mechanisms and interconnections between firms and markets and between the financial system as a whole and the broader economy.²⁶ Without a deep understanding of the nature of the system and the way it evolves co-dependently with other interlocking systems such as economic, political, social and ecological systems, it is impossible to determine an agenda for building financial resilience.²⁷ Analysing the dynamics of resilience in the social-ecological domain and applying them within the context of financial markets should enable the construction of an agenda for building resilience in financial systems.

Resilience as a paradigm shift

Resilience theory emerged in ecology debates during the 1970s, as an attempt to analyse the capacity of ecological systems to resist disturbance in the face of shocks.²⁸ It drew on complex adaptive systems theory and second-order quantum cybernetics to move thinking away from the model of classical equilibrium that had until then predominated in scientific thinking. The classic model had focused on the idea of a ‘balance of nature’ or a steady, stable state in ecology which did not accommodate the reality of constant, dynamic and random change within a system which permitted adaptive responses to disturbance.²⁹ The shift in thinking was largely a response to scientific approaches to natural resource management that had focused on quantitative metrics of producing the maximum yield from an ecosystem, based on the idea of a simple, steady state equilibrium to which a natural system would tend to revert after a shock. This approach had downplayed and underestimated the importance of complex networks of interdependencies within the system and was argued to be fundamentally destabilising to an ecosystem:

[T]he long-term expectation of stability may be inherently destabilizing. When managed with the expectation of a permanent and fixed yield, the complex

²⁴ See for example: A. Haldane, ‘Rethinking the Financial Network’ (Speech delivered at the Financial Student Association, Amsterdam, 28 April 2009) at <http://www.bis.org/review/r090505e.pdf>; J. Kambhu, S. Weidman & N. Krishnan, ‘New Directions for Understanding Systemic Risk: A Report on a Conference Cosponsored by the Federal Reserve Bank of New York and the National Academy of Sciences’ (2007) 13(2) NYFR Econ Pol Rev 83.

²⁵ A. Haldane & R. May, ‘Systemic Risk in Banking Ecosystems’ (2011) 469 Nature 351, 351–355; R. May, S. Levin & G. Sugihara, ‘Ecology for Bankers’ (2008) 451 Nature 893, 893–895.

²⁶ Financial Crisis Inquiry Commission, ‘The Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States’ (PublicAffairs, 2011).

²⁷ As May, Levin & Sugihara comment: “the dynamical implications of the topology of financial networks emerge as good candidates for further research.” See n 20 above, 894.

²⁸ A seminal paper in this regard was: C. S. Holling, ‘Resilience and Stability of Ecological Systems’ (1973) 4 Annu Rev Ecol Evol Syst 1, 1–23.

²⁹ J. Kirchner, *The Balance of Nature: Ecology’s Enduring Myth* (Princeton University Press, 2009).

interconnections supporting the resilience of the ecosystem as a whole may become undetectably fragile, undermining its productivity.³⁰

The emphasis of this management approach on stressing the ecosystem to produce the maximum yield weakened the system by reducing the fundamental diversity which supports its capacity to absorb shocks. Because this approach fundamentally misunderstood the complex, adaptive nature of an ecosystem and the function of diversity; and assumed linear, stable relationships between various aspects of the system; it led to mono-cropping, over-exploitation and the loss of the diversity essential to system survival:

The very approach ... that assures a stable maximum sustained yield of a renewable resource might so change these deterministic conditions that the resilience is lost or reduced so that a chance and rare event that previously could be absorbed can trigger a sudden dramatic change and loss of structural integrity of the system.³¹

One example of the damage done by this approach is provided by scientific forestry. To maximise the return on commercial forestry, a new 'science' of forest management emerged in Germany during the nineteenth century. In place of the old, messy mixed forests, German state planners envisaged and planted uniform rows of single-species forests so as to produce the maximum useable commercial timber harvest. Every aspect of the forest was assessed to gauge its economic, utilitarian value which led to many subtle processes and flora being discounted as worthless. While the first crop was a huge success which produced vastly more timber than the old forests, returns declined steeply thereafter because the scientific plan to simplify the forest and produce a maximum yield had failed to understand the dynamic importance of the diversity of the old forest to systemic resilience:

An exceptionally complex process involving soil building, nutrient uptake, and symbiotic relations among fungi, insects, mammals, and flora – which were, and still are, not entirely understood – was apparently disrupted, with serious consequences. Most of these consequences can be traced to the radical simplicity of the scientific forest.³²

A new word 'Waldsterben' meaning 'forest death' even entered the German language to describe the results of such forestry mono-crops, which starkly demonstrated 'the dangers of dismembering an exceptionally complex and poorly understood set of relations and processes in order to isolate a single element of instrumental value.'³³

This experience parallels the more recent one of credit derivatives and the housing market, and illustrates the relevance of ecological resilience ideas for the financial ecosystem. In order to securitize thousands of home loans into structured products, the complex dynamic of relationships, both financial and personal, that comprise a housing market were reduced to a simple concept of 'credit risk'.³⁴ This was itself simplified by using a proxy (life insurance

³⁰ Walker & Cooper, n 4 above, 146.

³¹ Holling, n 23 above, 21.

³² J. C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (Yale University Press, 1998), 20; See pp. 11–22 for a description of scientific forestry.

³³ *ibid* 21.

³⁴ S. Liebowitz, 'Anatomy of a Train Wreck: Causes of the Mortgage Market Meltdown' in B. Powell & R. Halcomb (eds), *Housing America: Building Out of a Crisis* (Transaction Publishers, 2009); D. Greenlaw et al, 'Leveraged Losses: Lessons from the Mortgage Market Meltdown, Proceedings of the US Monetary Policy Forum 2008' (The University of Chicago Booth School of Business) at http://research.chicagobooth.edu/igm/docs/USMPF_FINAL_Print.pdf (last accessed 17 September 2014). For

survivorship rates) to create a homogenised product: Residential Mortgage Backed Securities (RMBS).³⁵ These could then be widely commercialised so as to produce the maximum financial yield from the underlying resource. Once the availability of RMBSs collided with conducive conditions in the international financial markets, it led to financial mono-cropping. In doing so, the complex 'scientific' mathematics of credit risk modelling and credit derivatives massively over-simplified and misunderstood the diverse range of relationships that drive a nation's demand for housing credit and the complex interdependencies that ensure its resilience, by focusing on mortgage repayment probabilities and correlated default rates, assessed through statistical abstractions and historical data. As the head of asset-backed finance at Moody's told a New York Times interviewer: 'We aren't loan officers, our expertise is as statisticians on an aggregate basis.'³⁶ Finance became blind to the subtle network of systems and social processes of which it was only one part, and on which it depended.

Underlying the apparent success of credit derivatives and the risk transference they enabled in the short run, processes were set in motion by the application of this financial mono-cropping culture which restructured the subtle dynamics of the system and ignored those aspects which were of no commercial value, or difficult to programme into their models. The range of economic and social dependencies that typify a housing market which are largely locality specific, were then subsumed within broad-based financialisation.³⁷ Although the initial result was a massive increase in profitability for entities involved in structuring asset-backed securities, the end result was the near collapse of the banking system. A process that transformed mortgage finance - one of the oldest of banking products - into a 'scientific', top-down mortgage system designed to enhance financial returns, nearly destroyed the entire financial system. Of course, the credit crisis was driven by a multitude of factors,³⁸ of which credit derivatives were only one, but in terms of the particular dynamics of the housing market and ideas about ecological resilience, the immediate parallels with the mono-cropping of ecosystems are striking.

The end result of the process was that banks had reduced their own resilience by homogenising their portfolios and loading up on a commercialised, standardised product with seeming mathematical justification, without regard to the basic health of the underlying ecosystem/asset base.³⁹ This was compounded by the narrow specialisation of financial roles

an analysis of the social complexity of residential space see Scott, n 27 above, 103–146; R. Sennett, *The Conscience of the Eye: The Design and Social Life of Cities* (Norton & Co, 1990).

³⁵ D. Li, 'On Default Correlation: A Copula Function Approach' (2000) 9(4) *Journal of Fixed Income* 43, 43–54. Modelling the correlation of defaults in a mortgage market was one of the key issues in managing the credit risk, and David Li's work on solving this problem led the way to the massive growth in mortgage-backed securities. The failure of the models was central to the credit crisis, see P. Jorion & G. Zhang, 'Credit Contagion from Counterparty Risk' (2009) 64(5) *Journal of Finance* 2053, 2053–2087 for an analysis of credit model fragility in estimated default correlations for specific obligors.

³⁶ R. Lowenstein, 'Triple-A Failure' (NY Times, 27 April 2008); see P. Jorion, 'Risk Management Lessons From The Credit Crisis' (2009) 15(5) *Europ Finan Manage* 923, 923–933; J. Danielsson, 'Blame the Models' (2008) 4(4) *Journal of Financial Stability* 321, 321–328.

³⁷ C. Burnside, M. Eichenbaum & S. Rebelo, 'Understanding Booms and Busts in Housing Markets' (National Bureau of Economic Research, Working Paper no. 16734, January 2011).

³⁸ Of the many factors that contributed to the subprime meltdown, one was a desire on the part of US policymakers to make housing finance more available to low income borrowers, which led to banks seeking new ways of managing and profiting from the increased credit risk on their books.

³⁹ This comes through very clearly in accounts of the crisis, as banks/investors relied entirely on credit ratings and the outputs of risk models, without performing basic checks on the reality of the underlying housing market.

and the segmentation of the credit process within financial institutions, which removed the incentive for a system-wide perspective. The guiding logic of securitization focused on maximising efficiency and economic output through risk transfer, without regard to possible entropy in the system as ‘risk’ was transferred through the layers of the securitisation process.⁴⁰ The need to maintain the subtle socio-economic dynamics which supported resilience was overlooked. As Andy Haldane has commented:

[F]inancial sector balance sheets became homogenised. Finance became a monoculture. In consequence, the financial system became, like plants, animals and the ocean before it, less disease-resistant. When environmental factors changed for the worse, the homogeneity of the financial eco-system increased materially its probability of collapse.⁴¹

This underlines the importance of understanding the complex nature of the financial system and the inter-locking nature of co-dependent systems (financial-economic-social) as part of resilience thinking in finance. It also suggests the importance of subtle, non-financial processes for building and maintaining resilience – that a quest to isolate and maximise financial value may fundamentally reduce systemic resilience by weakening the underlying processes on which the financial system depends. The quest to maximise financial yield cannot be pursued on the assumption that the processes it sets in motion simultaneously maximise efficiency, human welfare and systemic resilience. This calls into question the Financial Stability Forum’s juxtaposition of financial system resilience, efficiency, and innovation as ‘essential to the financial system’s contribution to economic growth.’⁴² It also calls into question the focus of the Financial Stability Board on ‘fixing the fault lines that underlay the crisis’ by addressing a range of narrowly financial issues: bank capital, shadow banking, more transparent derivatives markets and ending too-big-to-fail through coherent resolution mechanisms.⁴³ This approach assumes the characteristics of the system that plunged the world into severe crisis are fundamentally sound, and building ‘resilience’ simply requires fixing the defects that led directly to the crisis.

IDENTIFYING CHARACTERISTICS OF RESILIENT SYSTEMS

Panarchy

In response to the problems of over-exploitation of the natural environment, ecological resilience thinking moved away from a focus on classical equilibrium, to one of ‘panarchy’, or multiple equilibria through which a system can transition. Panarchy has been defined as ‘the interactive dynamics of a nested set of adaptive cycles’⁴⁴ and it broadly refers to the concept that a complex ecosystem has multiple potential points of equilibrium, balanced

See for example ‘Shareholder Report on UBS’s Write-Downs’ (UBS, Annual General Meeting, 18 April 2008) at www.ubs.com/global/en/about_ubs/investor_relations/agm/previous-agms/2008/agm2008/invagenda.html.

⁴⁰ Entropy is a central feature of ecological interdependencies: it refers to the rate of energy loss as energy is passed through food webs and ecological systems. In contrast, theories of risk assumed that risk could be dissected, disassembled and reassembled along the chain of intermediation without any ‘energy’ loss or rate of dissipation. Entropy is an interesting idea to apply to finance and risk. See Kambhu, Weidman & Krishnan, n 19 above, 25; R. Zhou, R. Cai & G. Tong, ‘Applications of Entropy in Finance: A Review’ (2013) 15(11) Entropy 4909, 4909–4931.

⁴¹ Haldane, n 19 above, 24–19.

⁴² Financial Stability Forum, n 15 above.

⁴³ FSB Chair’s Letter to G20 Leaders for the Brisbane Summit, n 16 above, 3.

⁴⁴ C. Folke et al, ‘Resilience Thinking: Integrating Resilience, Adaptability and Transformability’ (2010) 15(4) Ecol Soc article 20, 3. See also, L. H. Gunderson & C. S. Holling (eds), *Panarchy: Understanding Transformations in Human and Natural Systems* (Island Press, 2002).

across actors operating at multiple spatial and temporal scales, and may never in fact be at a point of optimal equilibrium.⁴⁵

A resilient ecosystem is one characterised by constant mutation at different interlocking levels, from the fast change among microorganisms to slower change at the level of regional ecosystems to the geological scale over many millennia. All scales have the capacity to affect change at surrounding levels, and attempts to manage for stability at one scale can have unintended consequences at other scales. So for example, the attempt to manage forestry for the life-cycle of trees affected the life-cycle of microorganisms which in turn affected the slower process of gradual nutrient building in the soil which supported successive populations of trees. Undermining these processes altered the ability of the forest to regenerate and led to the failure of the scientific approach to forestry. Similarly with credit derivatives, the financial system became deeply unstable because financial objectives and returns were seen as an end in themselves. Little attention was paid to the broader impacts on social and economic processes of the boom in mortgage finance as financial profitability was taken as a proxy for increasing general welfare. Applying panarchy thinking to finance makes it clear that the resilience of a financial system cannot be viewed simply as the resilience of financial institutions; it is a much broader concept which draws on the deep interconnections across social, political, economic and ecological systems.

Furthermore, the resilience of a financial system cannot be understood without understanding how it interacts with systems at higher and lower scales. For instance, the resilience of East Asia's financial system cannot be understood without an appreciation of its interactions with the global system and vice versa, and any appreciation of the resilience of Indonesia's financial system requires an assessment of its interactions with both East Asia's and the global financial systems.

Resilience 'embraces change as a requisite to persist'⁴⁶ and it is different from the concept of robustness, which means the capacity of a system with one broad point of equilibrium to resist crisis and return to that point. In his 1973 paper, Holling differentiated between resilience and stability:

[S]tability ... represents the ability of a system to return to an equilibrium after a temporary disturbance; the more rapidly it returns and the less it fluctuates, the more stable it would be. But there is another property, termed resilience, that is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables.⁴⁷

Stability has come to be denoted as 'robustness' and this is an important differentiation in understanding resilience: 'robustness' signifies 'an ability to withstand shocks to the system' whereas resilience means an ability to 'adapt and reconfigure in response to them.'⁴⁸ Robustness implies stability is built into the system given assumptions about the magnitude of potential shocks – as is currently the case with financial risk management. So a robust system will be one designed to withstand a once in 100 year event for example, an approach used in risk management. In contrast resilience makes no assumptions about the magnitude

⁴⁵ R. O'Neill, 'Recovery in Complex Ecosystems' (1999) 6(3) *J Aquat Ecosyst Stress Recovery* 181, 184.

⁴⁶ Folke et al, n 39 above, 1.

⁴⁷ Holling, n 23 above, 28 14.

⁴⁸ M. Welsh, 'Resilience and Responsibility: Governing Uncertainty in a Complex World' (2014) 180(1) *Geogr J* 15, 20.

of possible shocks, but rather looks to build systems that can deal with the entire range of shocks, and fail safely if they must.

Robustness has a static quality, whereas resilience is more dynamic.⁴⁹ Resilience is more open to the possibility of broad systemic change within defined parameters – i.e. that a system will have different potential equilibria and may cope with a shock by returning to a different equilibrium than before. Indeed, resilience stresses the importance of this flexibility as essential to system stability: it is this very capacity of the system to move from one point of equilibrium to another which is essential to its resilience. Resilience is therefore a view of a system as inherently heterogeneous and characterised by response diversity which enables the system to cope with shocks: ‘the stability of SES [socio-ecological systems] is conceptualized as a moving baseline made up of multiple states rather than a static pit in which systems strive to remain.’⁵⁰

In this sense, regulating for resilience implies the need for regulations which maintain adaptive flexibility or adaptive governance. Applying such resilience thinking is challenging, not least because it is not entirely clear from regulatory documents at which type of stability/robustness/resilience the current post-crisis regulatory reforms are aimed. Do they aim to protect and underpin the status quo, on the basis that the current system is fit for purpose save for key defects which led to the global financial crisis, or is there a more fundamental agenda of reform that is necessary for global financial stability? What would a state of multiple equilibria look like in finance and could regulation accommodate it? For example, it has been pointed out that bank runs are entirely rational,⁵¹ and that they represent the system flipping from one equilibrium to another,⁵² and yet they are a classic example of the type of undesirable panic/crisis event that policymakers seek to prevent and which work on systemic stability attempts to prevent. Work is therefore needed to determine what a multiple-equilibria regulatory model would look like. It would at least be helpful if regulators could clarify how they perceive resilience in the post-crisis reform agenda. What, for example, does the Financial Stability Board mean by stating that strengthened international regulation is ‘building more resilient financial institutions and more robust markets’?⁵³

Resilience thinking moves away from the simple equilibrium of classical economics, and works instead from the premise of a system’s adaptive capacity for overall stability through multi-scalar internal instability, flexibility, and adaptability. Applying such thinking about resilience to finance therefore raises pointed questions about the suite of modern financial theories which underpin the markets, which have been constructed on the premise of a single

⁴⁹ “Contrary to resilience, robustness does not include the ability to reorganize, and instead is seen as a (static) system property.” R. W. Scholz, Y. B. Blumer & F. S. Brand, ‘Risk, Vulnerability, Robustness, and Resilience from a Decision-Theoretic Perspective’ (2012) 15(3) *J Risk Res* 313, 319. The terms are sometimes used interchangeably; see e.g. Kambhu, Weidman & Krishnan, n 19 above, where the robustness of complex adaptive systems is a recurrent theme.

⁵⁰ M. Cote & A. Nightingale, ‘Resilience Thinking Meets Social Theory: Situating Social Change in Socio-Ecological Systems (SES) Research’ (2012) 36(4) *Prog Hum Geogr* 475, 478.

⁵¹ As Mervyn King commented to Alistair Darling, British Chancellor of the Exchequer, during the run on Northern Rock in 2007: “They’re behaving perfectly rationally, you know.” Quoted in H. Pym, *Inside the Banking Crisis: The Untold Story* (Bloomsbury, 2014), 35.

⁵² The maturity transformation performed by banks creates multiple possible equilibria, and bank runs have been characterised as “an undesirable equilibrium” which can result from the illiquidity of assets and information asymmetries that characterise deposit-taking banking systems. D. W. Diamond & P. H. Dybvig, ‘Bank Runs, Deposit Insurance, and Liquidity’ (2000) 24(1) *Q Rev – Fed Reserve Bank Minneapolis* 14, 15.

⁵³ FSB Chair’s Letter to G20 Leaders for the Brisbane Summit, n 16 above, 1.

equilibrium system.⁵⁴ These theories broadly assume that economies and markets are stable and have a point of equilibrium to which the system will naturally tend, but are periodically and only temporarily punctuated by disruption.⁵⁵ This is typified by the Value at Risk approach to risk management, based on the Gaussian bell curve distribution of risk/returns which assumes that they are normally clustered around the mean. Tail risk then becomes an outlier in an otherwise relatively stable system.

Rather than viewing the challenge of systemic risk through the assumption that markets efficiently and rationally price assets for financial stability in the normal course of events, and are only intermittently interrupted by cataclysmic crises which cannot be predicted from within the markets own frame of reference, resilience would appear to require a cognitive approach that gives a central role to constant flux and disequilibrium across the markets: '[f]or what is resilience but the notion of disequilibrium as a general organising principle?'⁵⁶

From this perspective, the focus of system governance, and the management of episodes of disruption should not necessarily be to return the system to the pre-existing point of equilibrium – if a point of financial system equilibrium can indeed be identified – as is the case with current regulatory thinking. Resilience thinking in ecology requires the acceptance of notions of inherent instability and flux as the actions of agents continually evolve to reshape the dynamics of the system. It requires governance around dynamic flexibility because resilience depends on 'diversity in norms, institutions, laws, incentive structures and behavioural practices. Market competition [in contrast] favors productivity but leads to diversity loss which cripples the system's ability to adapt to change.'⁵⁷

Hysteresis

Another concept that is closely linked to the challenge of managing for dynamic flexibility around panarchy, or multiple equilibria, is the notion of 'hysteresis'. Hysteresis in ecology refers to the energy changes within a system as it moves between equilibria, which can have a decisive effect on its recovery trajectory after shock. The recovery path of a system following a change in state can be very different from the path it took during the change in state because the energy required to return a system to its previous state may be much greater than the energy required to bring about the original change. Hysteresis means that as a system moves from point A to point B, it loses energy or the energy dynamics change such that it may not automatically shift back to point A: '[o]nce the system has shifted to a new stable equilibrium, simply removing the stress will not automatically produce recovery.'⁵⁸

⁵⁴ See for example R. C. Merton & Z. Bodie, 'Design of Financial Systems: Towards a Synthesis of Function and Structure' (2005) 3(1) JOIM 1, 1–23 which discusses institutional design of financial architecture in light of frictionless neoclassical equilibrium and the rational behaviour of agents. O. Blanchard, 'Where Danger Lurks' (2014) 51(3) Finance and Development 28, 28–31.

⁵⁵ For an overview of how modern financial theory contributed directly to the crisis and malfunctioning of the system see K. Dowd & M. Hutchinson, *Alchemists of Loss: How Modern Finance and Government Intervention Crashed the Financial System* (John Wiley & Sons, 2010). As Haug & Taleb have commented: "theories about practice should arise from practice or at least avoid conflict with it. This explains our concern with the "scientific" notion that practice should fit theory". E. G. Haug & N. N. Taleb, 'Option traders use (very) sophisticated heuristics, never the Black-Scholes-Merton formula' (2011) 77 J Econ Behav Organ 97, 97.

⁵⁶ Walker & Cooper, n 4 above, 154.

⁵⁷ S. Levin et al, 'Social-Ecological Systems as Complex Adaptive Systems: Modeling and Policy Implications' (2013) 18(2) Environ Dev Econ 111, 126.

⁵⁸ O'Neill, n 40 above, 185.

Linking to the notion of panarchy, therefore, hysteresis in complex adaptive systems means that it cannot be assumed that the ‘balance’ or particular configuration of the system prior to a stress event is in fact its ‘natural’ state to which it will naturally return after a crisis, or to which the system should be returned with targeted post-crisis management. Hysteresis and panarchy stress the transient nature of systems:

The study of scale effects demonstrates with great clarity that nature is dynamic, always changing at various scales of space and time. Ecologists study what appear to be discrete ecosystems often giving the appearance of being in equilibrium (i.e., “balanced”) but which are, in reality, small segments of a temporal and spatial continuum.⁵⁹

The point of managing a system for resilience, then, may not be to return it to its original point of perceived ‘balance’ but to accept that it may settle elsewhere post-crisis. As such: ‘the resilience perspective shifts policies from those that aspire to control change in systems assumed to be stable, to managing the capacity of social-ecological systems to cope with, adapt to, and shape change.’⁶⁰

Applying this to financial governance and regulatory reform would suggest a shift in conceptualising the purpose of regulation beyond a focus on restoring market equilibrium to the pre-crisis situation. In the case of a bank run such as Northern Rock, for example, should the role of the regulator be to intervene to save what can be salvaged of the bank? Or should it be accepted that the system has shifted to a new equilibrium, and in doing so has lost energy (the reputation of the banks’ brand) such that efforts to return it to its former equilibrium as a functioning bank should not be pursued? Similar questions can be asked about policies to support particular markets, and efforts to restore their functioning post-crisis.

Adaptive management around dynamic, inter-locking systems

Managing for resilience requires a fundamentally different approach to system governance than managing for stability around an assumed point of equilibrium. It requires dynamic management which aims to maintain flexibility in the system and scope for internal change – and to allow such organic change - rather than seeking to limit change and maintain the status quo on the basis that the underlying markets are ‘efficient’. It requires adaptive rather than static management which accepts and allows post-crisis adaptation in the system. Partly this stems from a need to accept the uncertain dynamic of ‘interactions between slow-moving and fast-moving processes and between processes that have large spatial reach and processes that are relatively localized.’⁶¹ Managing for systemic stability around only one scale or assumed point of equilibrium can have impacts on other interlocking scales or processes which can in turn destabilise the system and undermine resilience. By managing for stability, resilience can be reduced: ‘[c]omplex systems that have artificially suppressed volatility tend to become extremely fragile, while at the same time exhibiting no visible risks.’⁶²

⁵⁹ Kirchner, n 24 above, 109–110.

⁶⁰ C. Folke, ‘Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses’ (2006) 16 *Global Environ Chang* 253, 254.

⁶¹ C. S. Holling, L. H. Gunderson & D. Ludwig, ‘In Quest of a Theory of Adaptive Change’ in L. H. Gunderson & C. S. Holling (eds), *Panarchy: Understanding Transformation in Human and Natural Systems* (Island Press, 2002), 3, 9.

⁶² N. N. Taleb & M. Blyth, ‘The Black Swan of Cairo: How Suppressing Volatility Makes the World Less Predictable and More Dangerous’ (2011) 90(3) *Foreign Aff* 33, 33–39.

Yet, to date, financial regulation has focused almost exclusively on financial system stability by reducing volatility and strengthening the viability of financial institutions using prescriptive metrics for risk weighting of assets, capital adequacy, liquidity, etc. Key regulatory debates are framed almost entirely from this vantage point, without taking into account (i) the impact of financial system dynamics on other interlinked processes and systems which can create unanticipated feedback loops for financial system stability, or (ii) the unintended consequences of trying to manage for stability in a complex adaptive system.

An example is the impact of the global asset bubble of 2005-7 on localized political structures which in turn created new systemic vulnerabilities. Management of the financial system in those years assumed the success of financial innovation and new trading opportunities. From the purely financial point of view from which financial stability work was then focused, this was underpinned by the lack of market shocks during that period and the rise in returns and profitability at financial institutions, both of which were taken as signs of health in the financial system. However, the global boom created severe stress across the world in the cost of living, as the growing trading in commodity derivatives creating a global food crisis which triggered political unrest in several developing countries.⁶³

A threshold effect of this process could be seen in the events of December 2010 and after, when a Tunisian fruit seller immolated himself in protest at repressive police treatment and the stress that rising costs and disparities in growth were placing on his livelihood, sparking the first of the Arab revolts: '[t]he spark that ignited the uprising was not a cry for democracy but a demand for jobs.'⁶⁴ Yet the consequences were the destabilisation of financial markets globally. Multi-scalar effects are evident here: poverty, global development and political reform are generally slow moving processes that are managed separately to financial stability because they operate on a different scale and are institutionalised in different fora.⁶⁵ However, their interdependencies create dynamic feedback loops which require integrative management strategies around flexibility, which takes into account multi-scalar effects and the possibility of transmission of vulnerabilities across different scales and different interlocking systems. Arguably, network interconnectivity such as this requires broader thinking around what financial stability means, beyond simply embedding country risk or political risk as a discrete category of the risk management framework, focused purely on managing financial loss on a particular transaction or defining risk limits for exposures.

Resilience in this sense is a challenge to the limits of current thinking about the objectives of financial regulation, which focuses purely on the dynamics of the financial system itself and outcomes for system participants. It fails to take into account the dynamics of symbiotically mutating systems which are all non-linear and 'nested', i.e. embedded in each other.

⁶³ M. Lagi, K. Z. Bertrand & Y. Bar-Yam, 'The Food Crisis and Political Instability in North Africa and the Middle East' (New England Complex Systems Institute, 2011) at http://necsi.edu/research/social/food_crises.pdf (last accessed 23 September 2014); O. De Schutter, 'Building Resilience: A Human Rights Framework for World Food and Nutrition Security' (United Nations, Report of the UN Special Rapporteur on the Right to Food, UN Doc A/HRC/9/23, 8 September 2008); in April 2008 the United Nations created a High Level Task Force on the Global Food Security Crisis, see at <http://www.un-foodsecurity.org> for details (last accessed 23 September 2014).

⁶⁴ M. A. El-Khawas, 'Tunisia's Jasmine Revolution: Causes and Impact' (2012) 23(4) *Mediterranean Quarterly*, at http://muse.jhu.edu/journals/mediterranean_quarterly/v023/23.4.el-khawas.html (last accessed 23 September 2014).

⁶⁵ As Jeffrey Sachs noted: "we have trillions of dollars directed at banks and bail-outs but we're told there's nothing for the poor. Meanwhile, we are teetering on the brink of collapse and violence in parts of the world where people have been pushed to the brink." Quoted in: 'Forgotten Victims of the Global Downturn' (*Financial Times*, 10 March 2009).

Systemic stability has been understood as an issue of business continuity at financial institutions (particularly systemically important financial institutions) and stability across various financial markets. Drawing on resilience in social-ecological systems science would indicate that to truly understand dynamic resilience in finance, it cannot be framed from such a limited point of view, particularly with globalised markets. Instead it requires a perspective which captures financial system dynamics in interaction with multiple other dynamic systems: legal, political, ecological, cultural, institutional etc. These are all in turn complex adaptive systems evolving at their own rate. Applying resilience thinking to finance therefore arguably requires a broad theoretical expansion far beyond the current technical limits of the financial stability debate to incorporate a more expansive cognitive map of the factors which ultimately impact upon financial system stability. It raises broad public policy questions around how we can or should define an optimal financial system, and in particular whether the expansion of global financial markets is an end in itself, even if it destabilises other systems on which it ultimately depends.

As persuasive as the idea of adaptive governance is, it is complex to apply as a management tool in finance because an adaptive system can inherently adapt to the properties of its own governance regime. The financial system does already display properties of such adaptive behaviour, which can help pre-pave the conditions for the next crisis. Following the South East Asian crisis of 1997/8, for example, the countries involved began stockpiling foreign currency reserves and keeping their currencies low against the dollar to encourage exports. This was one factor that fuelled global liquidity and global imbalances which in turn contributed to the global credit bubble.⁶⁶ Although the South East Asian countries, as with many developing countries, were able to weather the storm of the crisis reasonably well, the currency imbalances helped stoke problems elsewhere, highlighting the interdependencies at different ranges and scales which have come about through integration of global markets. This raises the question: ‘Does the resilience of some livelihoods result in the vulnerability of others?’⁶⁷ How should the system be managed to take into account these effects? If the system is managed purely around the stability and profitability of financial system participants, should the impact of financial flows on standards of living and global livelihoods be a matter for financial system regulation, or should it continue to be ancillary to regulatory mandates? Clearly, the way we define system ‘resilience’ is as important as the way we manage for it.

Resilience and ‘efficient’ markets

Resilience and the notion of panarchy therefore offer a different cognitive paradigm for systemic risk analysis and questions of market stability than the current intellectual framework, and they raise pointed questions about the ideas which have dominated financial theory over previous decades: equilibrium, efficient markets and the assumption of a normal (Gaussian) probability distribution of returns in which the whole spectrum of risks are calculable in a meaningful way.⁶⁸ If markets are in constant flux and features of the system are dynamically shifting in unpredictable ways, does the theory that they efficiently price assets through the incorporation of all relevant information at any given point actually fit, or

⁶⁶ M. Obstfeld & K. Rogoff, ‘Global Imbalances and the Financial Crisis: Products of Common Causes’ (Paper presented at the Asia and the Global Financial Crisis: Federal Reserve Bank of San Francisco Conference, 19–20 October 2009) at <http://www.frbsf.org/economic-research/events/2009/october/asia-global-financial-crisis>.

⁶⁷ Cote & Nightingale, n 45 above, 482.

⁶⁸ E. P. Caldentey & M. Vernengo, ‘Modern Finance, Methodology and the Global Crisis’ (2010) 52 *Real-World Econ Rev* 69, 69–81.

do we need to conceive of the system in radical new ways? Do pricing signals effectively convey the information necessary for market participants to make decisions that promote resilience? The fluidity of a complex adaptive and resilient system would imply that financial markets may not be characterised by the stability of the relationships between actors and risk factors that drive a market and that the efficient market hypothesis requires.⁶⁹ Instead, markets are conceived as dynamically non-linear in functioning:

Theories of complex systems portray systems not as deterministic, predictable and mechanistic, but as process-dependent organic ones with feedbacks among multiple scales that allow these systems to self-organize. The study of complex adaptive systems attempts to explain how complex structures and patterns of interaction can arise from disorder through simple but powerful rules that guide change.⁷⁰

If the markets are dynamically non-linear and liable to flip from one equilibrium to another in unexpected ways, a wholesale rethink of the intellectual architecture of risk will arguably be necessary – from an assumption of calculable uncertainty to an acceptance of incalculable uncertainty.⁷¹ Non-linearity, multiple equilibria and the dynamic uncertainty of constant change challenges the utility of reliance on probability and a normal distribution of returns as a baseline for risk management because it implies that the system is constantly shifting and mutating – i.e. that it is not amenable to a probability-type assessment. This raises the question whether risks can be meaningfully assessed and managed in a constantly changing system, or whether attempting to do this in a complex dynamic system pushes risk into the statistical tails, creating ‘silent risks [which] accumulate beneath the surface.’⁷² If risk cannot be meaningfully measured, this would call into question the current architecture of risk weighted capital adequacy, which requires a calculable distribution of risk which can be measured and hedged across the spectrum of asset classes.

One major problem with the current regulatory approach to stability/resilience in the financial markets then, is that as it assumes inherent stability in the distribution of returns it systematically downplays the likelihood of tail risk events – which it cannot address from within its own framework.⁷³ A resilience approach to risk management which accepts the nature of finance as a complex, non-linear system would imply a need for a more dynamic model which focuses on the constantly shifting, dynamic interplay of system participants and factors which are constantly shaping the potential outcomes of the system in subtle ways. It would require a focus on the influence of different scales, and different interacting systems on risk, and not just a focus on market data as the primary vehicle for assessing risk, and outcomes for system participants alone as the aim of the process. Risk then moves from being calculable uncertainty to incalculable uncertainty:

⁶⁹ Economists “might say ‘get the prices right’ without recognizing that price systems require a stable context where social and ecosystem processes behave ‘nicely’ in a mathematical senses (i.e. are continuous and convex) without recognizing the surprises that nature and people inexorably and continuously generate.” L. H. Gunderson & C. S. Holling (eds), *Panarchy: Understanding Transformations in Human and Natural Systems* (Island Press, 2002), xxi–xxii.

⁷⁰ Folke, n 55 above, 60 257.

⁷¹ N. Boy, J. P. Burgess & A. Leander, *The Global Governance of Security and Finance: Introduction to the Special Issue* (2011) 42(2) Security Dialogue 115, 115–122. This links into N. N. Taleb’s thinking on risk and randomness in financial markets, see N. N. Taleb, *Foiled by Randomness: The Hidden Role of Chance in Life and in the Markets* (Random House, 2nd ed, 2005); N. N. Taleb, *The Black Swan: The Impact of the Highly Improbable* (Allen Lane, 2007).

⁷² Taleb & Blyth, n 57 above, 33.

⁷³ K. Dowd et al, ‘How Unlucky is 25-Sigma?’ (2008) 34(4) J PORTFOLIO MANAGE. 76, 76–80.

A new epistemic condition of deep or radical uncertainty has come to dominate ... because the increased interconnection and complexity of ‘traffic’ and communication – be it financial in the form of credit channels, transport-based as in the aviation system, or biological as in the spread of pandemics – vastly increases exposure to rare events that exceed calculability and shatter existing provisions of crisis management and insurance.⁷⁴

Considering the dynamics of resilience within socio-ecological systems indicates the need for a radical shift in thinking about risk in finance. This would need to move away from statistical modelling of market and economic data on the assumption of a reasonably stable distribution of returns, to a framework that is more fluid, and more able to aggregate risks across markets and to understand the interplay of risk across different interlocking systems.

Although a rethinking of risk around a deeper understanding of resilience is arguably essential, it is clearly problematic at the same time because it would require fundamental changes to the current cognitive architecture of risk. Recovery trajectories in complex systems are unique because the system is always evolving, and ‘the complexity of the system combined with unanticipated compounded effects can make recovery trajectories difficult or impossible to predict ... The system may look similar but it is not the same system, because like any living system it is continuously developing.’⁷⁵ Given the realities of today’s markets, a more fluid, less deterministic approach to risk management (whatever operational form that may take) may be far more useful than the statistical assumption of normal returns. An over-supply of global liquidity, a global hunt for yield by investors, the prevailing narratives of financial analysts, the dynamics of risk management and capital adequacy regulations, monetary policies, and the size of the financial economy relative to the real economy are all factors internal to the financial markets which affect values, risks and financial stability and which raise questions over the ‘efficient’ pricing of capital by market participants. As has been commented:

Capital superabundance will increase the frequency, intensity, size and longevity of asset bubbles. The propensity for bubbles to form will be magnified as yield-hungry investors race to pour capital into assets that show the potential to generate superior returns. Because the global financial system has grown so large relative to the underlying economy, asset values can quickly reach unsustainable levels and remain inflated for months or years.⁷⁶

Developing a global risk architecture suited to this type of constant change and un-calculable uncertainty, as well as the influence of resilience across multiple interlocking systems, must be part of a resilience agenda which can provide a meaningful way of managing systemic change.

Heterogeneity – building resilience on diversity

A further factor which SES resilience thinking emphasises is the essential heterogeneity of system participants and behaviour as a crucial component of the capacity of systems to reorganise in the face of shocks.

⁷⁴ N. Boy, J. P. Burgess & A. Leander, n 66 above, 117.

⁷⁵ Folke, n 55 above, 257.

⁷⁶ ‘A World Awash in Money’ (Bain & Company Inc, 14 November 2012), 4 at <http://www.bain.com/publications/articles/a-world-awash-in-money.aspx> (last accessed 6 June 2014).

The simplest intuitive case contrasts a competitive system in homogenous versus heterogenous space. ... homogeneity leads to a single equilibrium in which the dominant population eliminates all others. Heterogeneity, combined with limited dispersion, allows multiple competitors to coexist, each within a local cell. The result is that the total community, summed across the spatial heterogeneity, can have a number of stable states, depending on the heterogeneity.⁷⁷

This contrasts with the noted tendency of the international finance architecture and financial theories to produce homogenised behaviour of system participants, even though the theories themselves fail to account for the homogenising tendency on participant behaviour of their widespread uptake.⁷⁸ The standardisation of global rules of financial regulation has also been argued to reduce systemic diversity by mandating the harmonisation of procedures and management within financial institutions. As leading commentators warned over a decade ago about the proposed Basel II regulations:

Of special concern is how the proposed regulations would induce the harmonisation of investment decisions during crises with the consequence of *destabilising* rather than *stabilising* the global financial system.⁷⁹

The homogenisation of participant behaviour is also exacerbated by the use of similar benchmarks for performance, and similar analytical and valuation techniques drawn from the same financial theories and narratives of market trends. As a result, financial behaviour becomes highly correlated under stress, leading to one-way markets in response to shocks which destabilise financial structures and serve as a conduit for the transmission of problems from one market sector to another.⁸⁰ Rather than the market mechanism serving to contain the forces of crisis by bringing heterogeneous buyers and sellers together, the standardisation of practice through harmonised rules, theories and benchmarks reinforces a crisis and exacerbates its global impact.

The drive to standardise the regulation and governance of the system around what is perceived to be best practice and cutting edge financial theory therefore may lead to diminished systemic resilience. Efforts to build greater resilience must focus on fostering heterogeneity such that ‘competitive advantage shifts among species and never remains constant long enough to permit dominance or elimination.’⁸¹ Heterogeneity being essential to systemic resilience raises questions over the current approach of the Basel Committee on Banking Supervision, which is pursuing a Regulatory Consistency Assessment Programme. This is based on the assumption that: ‘Consistent implementation of the Basel framework is

⁷⁷ O’Neill, n 40 above, 183.

⁷⁸ Homogenisation has even been argued as strengthening the system: “When financial institutions become more homogenous, the need for inter-institutional risk sharing is lowered. Any imperfections such risk sharing may be subject to are hence mitigated. Moreover, institutions then need to rely less on such risk sharing, which reduces externalities among them. This, in turn, improves their incentives and lessens the need for regulating them.” W. Wagner, ‘The Homogenization of the Financial System and Financial Crises’ (CentER Discussion Paper Series No 2006–72, 2008) at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=842107.

⁷⁹ J. Danielsson et al, ‘An Academic Response to Basel II’ (LSE Financial Markets Group, Special Paper no. 130, May 2001), 3 at <ftp://ftp.math.ethz.ch/users/embrecht/Basel2.pdf> (last accessed 18 July 2014). Italics in the original.

⁸⁰ C. Goodhart & W. Wagner, ‘Regulators Should Encourage More Diversity in the Financial System’ (VOX, 12 April 2012) at <http://www.voxeu.org/article/regulators-should-encourage-more-diversity-financial-system> (last accessed 26 September 2014); M. Brunnermeier et al, ‘The Fundamental Principles of Financial Regulation’ (Geneva Reports on the World Economy, No 11, 2009).

⁸¹ O’Neill, n 40 above, 183.

fundamental in raising the resilience of the global banking system.’⁸² Yet the standardised international capital adequacy framework and risk models were identified during the crisis as having failed to build adequate reserves into the system.⁸³ How consistent implementation of the new framework will deliver resilience is not articulated, beyond the fact it will maintain ‘market confidence in regulatory ratios’ and provide “a level playing field for internationally operating banks.’⁸⁴

The need for heterogeneity also raises the question of whether a system can be truly resilient when it is dominated by a cadre of too-big-to-fail (TBTF) financial institutions that benefit from substantial public guarantees which ensure their survival, despite the negative externalities they generate pursuing their own private gains. Arguably this is inimical to systemic resilience: in multiple equilibria ecological systems ‘[l]ocal conditions change so rapidly that competitive advantage shifts among species and never remains constant long enough to permit dominance or elimination.’⁸⁵ After the crisis, improving competition among the banking industry has been a theme of public policy debates, yet with the efforts to underpin banking giants in many countries and the special global regulation of systemically important financial institutions, the effects on competition are questionable.⁸⁶

TBTF financial institutions are justified on the basis of economies of scale. However much recent research has questioned whether economies of scale in banking diminish beyond a certain size, and are offset by the management and governance problems created by greater institutional complexity and lack of transparency of risks.⁸⁷ Furthermore, the global negative externalities TBTF banks generated during the crisis raise questions over whether further embedding the dominance of TBTF financial institutions through creating a targeted regulatory regime assists or undermines resilience. Given the strain on public sector balance sheets in the advanced economies, if the regulatory measures targeted at TBTF financial institutions fail, there is little scope for further public bailouts. Such institutions therefore pose critical ongoing risks to the health of the international financial system. It may well be that a thorough understanding of resilience in financial systems will establish that no system can be truly resilient if it contains institutions that are TBTF.

⁸² Basel Committee on Banking Supervision, ‘Regulatory Consistency Assessment Programme (RCAP) – Analysis of Risk-Weighted Assets for Market Risk’ (BIS, 2013), 5 at <http://www.bis.org/publ/bcb240.pdf> (last accessed 22 September 2014).

⁸³ See for example, P. Booth (ed), *Verdict on the Crash: Causes and Policy Implications* (Institute of Economic Affairs, 2009).

⁸⁴ Basel Committee on Banking Supervision, ‘Regulatory Consistency Assessment Programme’, n 77 above.

⁸⁵ O’Neill, n 40 above, 183.

⁸⁶ Basel Committee on Banking Supervision, ‘Global Systemically Important Banks: Updated Assessment Methodology and the Higher Loss Absorbency Requirement’ (BIS, 2013). Twenty nine banks have currently been identified as systemically important banks: ‘2013 Update of Group of Global Systemically Important Banks’ (Financial Stability Board, November 2013).

⁸⁷ A. Haldane, ‘On Being the Right Size’ (Speech delivered at the Institute of Economic Affairs, London, 25 October 2012) at <http://www.bis.org/review/r121030d.pdf>; R. De Young, ‘Scale Economies are a Distraction’ in *The Region* (Federal Reserve Bank of Minneapolis, 2010), 14–16; A. Boot, ‘Banking at the Crossroads: How to Deal With Marketability and Complexity’ (2011) 1 *Review of Development Finance* 167, 167–183; R. Anderson & K. Joeveer, ‘Bankers and Bank Investors: Reconsidering the Economies of Scale in Banking’ (LSE Financial Markets Group, Discussion Paper no. 712, 2012).

One regulatory approach which could enhance systemic resilience is the work to develop an effective and credible resolution regime for TBTF financial institutions – ‘living wills’.⁸⁸ These are designed to respond to the particular dominance of these institutions by building a process of bankruptcy and/or restructuring which will allow them to be wound up in an orderly way without requiring public funds or destabilising the markets. The fact that such companies require these living wills indicates how far from resilient the system actually is, but if living wills can be successfully implemented, they will surely enhance the resilience of the financial system by expanding the capacity of markets for self-renewal in the face of shocks.⁸⁹

Living wills depend upon effectively anticipating the types of stress events which may occur and how they would impact the organisation. If done well, stress testing will enhance financial institution resilience in the SES sense because it builds dynamic responsiveness to changing conditions into the heart of the organisation. It can also build a capacity in the organisation to anticipate and reconfigure in the face of market shocks, particularly if used effectively in terms of capital budgeting and risk appetite planning. However, translating a resolution procedure from theory to practice is far from easy given the complexity and opacity of these organisations. The next major crisis may teach us that living wills, well fine on paper, do little to limit contagion and corral systemic risk in an actual crisis.

One segment of the financial markets that has displayed resilience in the ecological sense in recent years is the hedge fund industry.⁹⁰ The collapse of Long-Term Capital Management (LTCM) in 1998 is often used to illustrate the dangers of hedge funds. However, in practice, the dynamics of the sector are very different to that of the global banking industry: there is a very high attrition rate among funds which largely passes unnoticed, does not cause systemic ripples and does not require taxpayer-funded bailouts. Even LTCM was bailed out by private sector financial institutions at the instigation of the Federal Reserve, rather than by an injection of public funds.⁹¹ According to a recent report, in the five years to 2014 half of all hedge funds were found to have closed, and the average life of a hedge fund that survives its first year of operation is just over five years.⁹² The UK’s Financial Conduct Authority has commented: ‘Hedge funds fail or close down on a regular basis without causing a significant impact on the financial system, but [the few] very large hedge funds potentially pose a risk.’⁹³ It is noteworthy that the sector displays very different characteristics to the global

⁸⁸ ‘Key Attributes of Effective Resolution Regimes for Financial Institutions’ (Financial Stability Board, October 2014); EU Bank Recovery and Resolution Directive, Directive 2014/59/EU of 15 May 2014; ‘Cross-Border Bank Resolution: Recent Developments’ (IMF, June 2014).

⁸⁹ Such living wills are difficult to translate from theory into workable plans given the scale and complexity of TBTF institutions and the cross-border issues involved. See T. Hoenig, ‘Credibility of the 2013 Living Wills Submitted by First Wave Filers’ (FDIC, Statement of Vice Chairman, 5 August 2014); E. Avgouleas, C. Goodhart & D. Schoenmaker, ‘Bank Resolution Plans as a Catalyst for Global Financial Reform’ (2013) 9 *J Financ Stabil* 210, 210–218; I. Otker-Robe et al, ‘The Too-Important-to-Fail Conundrum: Impossible to Ignore and Difficult to Resolve’ (International Monetary Fund, Staff Discussion Note SDN/11/12, 27 May 2011).

⁹⁰ Hedge funds are alternative investment funds that invest using bespoke, proprietary investment strategies to try to generate higher returns than those produced by standard asset managers.

⁹¹ ‘Hedge Funds, Leverage and the Lessons of Long-Term Capital Management’ (US Department of the Treasury, Report of the President’s Working Group on Financial Markets, 1999) at <http://www.treasury.gov/resource-center/fin-mkts/documents/hedgfund.pdf> (last accessed 29 September 2014); F. Edwards, ‘Hedge Funds and the Collapse of Long-Term Capital Management’ (1999) 13(2) *J Econ Perspect* 189, 189–201.

⁹² D. McCrum, ‘Zombie hordes thrive, await further hedge fund corpses’ (FT Alphaville, 25 March 2014), citing data from Hedge Fund Research.

⁹³ ‘Hedge Fund Survey: March 2014’ (Financial Conduct Authority, London, 2014), 4.

banking industry. Hedge fund assets under management are roughly US\$2 trillion.⁹⁴ In comparison, the top five largest banks in the world have over US\$13 trillion in assets.⁹⁵ The hedge fund industry is also characterised by many small funds, with nearly 90 per cent of funds managing less than US\$500 million in assets.⁹⁶ The sector operates on much higher leverage than the banking industry – average leverage was estimated at 130 per cent in 2012, down from 150 per cent in 2010 – but is characterised by regular fund liquidations which do not impact market stability.⁹⁷ As part of a resilience research agenda, further investigation of the relative dynamics of the banking and hedge fund sectors may prove fruitful.

Such a study may shed light on the role of regulation in shaping market dynamics, for the latest crisis at least has been centred in highly regulated financial institutions.⁹⁸ The failures of regulation and supervision have come in for heavy criticism following the crisis, and the post-crisis regulatory response has also been criticised as not going far enough. The response has been characterised as being insufficient to have prevented the latest crisis, let alone the next one.⁹⁹ The dynamics of the regulatory and supervisory process as in itself a complex, adaptive system may need to be examined in light of a resilience research agenda, and the limits of what regulation may be able to achieve honestly assessed. As had been pointed out about the process of drafting the Basel framework: such international regulation is produced by a ‘highly politicized committee process ... [is] the product of innumerable arbitrary decisions, irrational compromises, and political horse-trades – not to mention the personalities and prejudices of the main participants involved.’¹⁰⁰

Adaptive governance of the complex adaptive financial system through the medium of a legal framework also therefore needs to take into account the complex, adaptive nature of the law:

The legal system comprises a multitude of institutions and actors interacting and evolving over time in ways that give rise to complex system dynamics ... putting panarchy theory into practice will require adaptively managing the complex adaptive legal system to adaptively manage other complex adaptive natural and social systems.¹⁰¹

Integrative resilience

Analysing resilience in finance therefore requires an agenda for defining systemic resilience at the outset, as well as an agenda for how characteristics of resilience can be fostered through legal and governance processes. This is a very tall order. At the level of the law, for example, financial regulation interacts with a range of other legal provisions such as property rights, contract law, corporate law, international investment law, as well as with the political,

⁹⁴ ‘Hedge Funds’ (TheCityUK, London, May 2013), 1.

⁹⁵ SNL Financial, ‘Largest 100 Banks in the World’ (SNL, 23 December 2013) at <https://www.snl.com/InteractiveX/Article.aspx?cdid=A-26316576-11566> (last accessed 20 September 2014).

⁹⁶ TheCityUK, n 89 above, 5, chart 13 “Concentration of Hedge Fund Assets”.

⁹⁷ *ibid* 6.

⁹⁸ Of course, credit default swaps were unregulated products that were part and parcel of the failures at large financial institutions like AIG, Citigroup, etc.

⁹⁹ D. Arner, ‘Adaptation and Resilience in Global Financial Regulation’ (2011) 89 NCL Rev 1579, 1579-1628; A. J. Pollock, ‘Lots of Regulatory Expansion but Little Reform’ (2010) Regulation Outlook, no 4; R. Buckley, ‘The G20’s Performance in Global Financial Regulation’ (2014) 37(1) UNSW Law Journal 63, 63–93.

¹⁰⁰ K. Dowd & M. Hutchinson, *Alchemists of Loss: How Modern Finance and Government Intervention Crashed the Financial System* (Wiley, 2010), 290.

¹⁰¹ J. B. Ruhl, ‘Panarchy and the Law’ (2012) 17(3) Ecol Soc 31, 32.

institutional and power structures of a given country. It also suffers from the fact that the organisational bureaucracies put in place to implement financial regulation can themselves become rigid and resistant to change over time, and subject to their own particular dynamics.

The behaviour of agents in various interacting processes and systems is then another essential component affecting the dynamics of the system and its ability to cope with shocks. Ecology theory quickly realised that the resilience of an ecological system could only be meaningfully understood and defined through reference to the interplay of ecological and human/social systems. The influence of human agency on an environment is too great to analyse the ecology in isolation. Both systems were symbiotically undergoing dynamic change, and resilience therefore embodies the notion of constant change of symbiotically mutating systems which nonetheless generates stability. The resilience of one system therefore draws upon the resilience of other systems with which it is nested or interdependent. Could this mean that resilience in finance requires a far greater capacity to capture and respond to feedbacks from social, economic, political, and institutional dynamics than is currently the case? Such dynamics express the tapestry of power-relations in different societies and how this can affect financial system functioning. Due to the fragmentation of institutional, legal and disciplinary boundaries, they are currently largely isolated from each other as areas for policy debate. Analyses of financial sector governance will typically ignore issues of political organisational development, local poverty and economic inequality, and ethical issues, but once resilience is defined from a broader frame of reference than simply the business continuity of financial institutions, they all become part of an agenda for resilience, particularly in a globalised world.

A further relevant question, then, is the scale of observation from which we observe resilience of the financial sector. Is it purely a question of business continuity and viability under stress of financial market participants as regulation is currently drafted? Or in this globalised world is it also a question of the impact of dynamic financial processes on a whole range of other systems – ecological, political, social, for example – which in turn shape the resilience and continuity of financial markets? Expanding enquiry to this scale to take into account interlocking dynamics of various systems will invariably raise normative questions of the functions of finance and the impact of its dynamics on local processes. If trading commodity derivatives generates profits for firms in New York, London and Switzerland, but impacts livelihoods in Sub-Saharan Africa which in turn affects the resilience of their social and political structures, is this a question for the resilience of the financial architecture? If markets aren't efficient allocators of capital, then what is their purpose and what should the resilience agenda aim to protect? Ultimately, a fundamental question that needs to be asked at the outset is: resilience of what and for whom?

AN AGENDA FOR FINANCIAL RESILIENCE

Although this paper has merely skimmed the surface of what is a complex and ever-expanding debate in order to highlight some themes, we can now contrast eight differing characteristics of a resilient system as defined in ecology with features of the modern financial system. The characteristics of a resilient system in a SES sense are:

- Capacity to reorganise and persist in response to shocks;
- Panarchy;
- Hysteresis;
- Adaptive governance and management processes;
- Dynamic interplay of resilience at different temporal and spatial scales;

- Interlocking, nested complex adaptive systems;
- Uncalculable dynamic uncertainty;
- Heterogeneity.

In contrast the features which characterise the current approach to conceptualising and regulating the financial system are:

- Robustness/stability;
- Frictionless equilibrium;
- Static governance around a perceived single equilibrium;
- Isolation of financial system stability as the single purpose of regulation;
- Financial system stability assessed from the perspective of market dynamics, with impacts of the financial system on other systems largely ignored;
- A calculable distribution of risk, only intermittently disrupted by tail risk events;
- Homogenisation of system participants fostered by regulation, benchmarking and herding, heightening correlation in times of stress.

These lists indicate a need to rethink our understanding of the nature of the financial system and its resilience, including what is meant by ‘resilience’ in finance. Applying the notion of resilience as it has come to be understood in social-ecological systems science raises some fundamental questions about the prevailing architecture of financial theory, of financial regulation, of the management and governance of the system, as well as normative questions about the purpose of the financial markets and their impacts on other systems. A broader systems perspective on the interaction of finance with other interdependent systems raises the question whether we need in fact to rethink its boundaries as part of a study of the nature of financial resilience. If global financial markets are causing acute stress in the cost of living and destabilising political regimes which in turn impact financial markets, should this be part of a broader debate on financial resilience even if it does not immediately impact on the viability of financial institutions? How wide do we cast the net of resilience? The deepening of global financial markets has resulted in the growing interdependence of systems and an ever-expanding influence of financial markets on other features of daily life. These can in turn symbiotically influence the performance of financial markets and cannot be excluded from a resilience framework.

Once we have defined resilience, how then do we manage for it? The post-crisis regulatory architecture builds largely on the pre-existing architecture rather than on radical rethinking.¹⁰² It aims to bolster the stability of key hubs of the system, for example, systemically-important banks and insurers, or through central clearing for over-the-counter derivatives, and otherwise by addressing specific issues that were critical to the last crisis. This in no way guarantees systemic resilience going forward as the epidemiology of each crisis is unique, and this approach may in the long-run exacerbate fragility: ‘there is a danger in becoming too focused on specified resilience because increasing resilience of particular parts of a system to specific disturbances may cause the system to lose resilience in other ways.’¹⁰³

It has become clear in ecology that designing a management system around a particular web of ecosystem diversity implies effectively imposing value judgements on the system as to which characteristics we wish to protect and help endure. The choice of management

¹⁰² R. P. Buckley, ‘The Changing Nature of Banking and Why It Matters’ in R. P. Buckley, E. Avgouleas & D. Arner (eds), *Reconceptualising Global Finance and Its Regulation* (Cambridge University Press, forthcoming 2015).

¹⁰³ Folke et al, n 39 above, 4.

methodology in itself then affects the dynamics of the system. In application to finance, this raises theoretical questions around what we are managing ‘resilience’ for, which strays into normative territory. Currently, the regulatory debate assumes that the current ‘efficient’ financial system is the optimal one, if only we can fix the failings that led to the last crisis – and hence we have an incremental approach to post-crisis regulation. But this approach is effectively loaded with a qualitative judgement on what functions the financial system is meant to serve and which features are ‘optimal’ from a particular worldview. When deconstructed in light of alternative equilibrium states of the system, this is fraught with value judgements which only take into account a limited range of socio-economic impacts and which prioritise maintaining the status quo for financial entities as the optimal outcome of a regulatory regime. A broader analysis of resilience dynamics requires that this normative judgement be placed at the forefront of redesigning an architecture of financial resilience.

CONCLUSION

‘Resilience’ is a fashionable concept that is currently being applied in a variety of disciplines, and which has frequently been used in debates on financial regulatory reform since the crisis. Current use of the term ‘resilience’ in regulatory pronouncements appears to be based on an assumption that ‘resilience’ is another word for financial stability, and that post-crisis changes which improve the current framework to address the specific failings that led to the latest crisis are sufficient to build resilient financial markets. However, resilience is a much deeper and more complex concept than this and work in socio-ecological systems science has identified key features of resilience in complex adaptive systems that allow systems to persist and renew in the face of disturbance. Applying those features to the characteristics of the contemporary financial system and the regulatory agenda indicate that there is a need for a much more comprehensive debate on what we mean by a resilient financial system, and who or what should be resilient.

Most often today when financial regulatory agencies speak of ‘resilience’ they mean ‘robustness’, and it not clear that anyone really knows what a truly resilient global financial system would look like. It is usually taken as a given today that the objective of regulation is the viability and business continuity of financial entities, but this presupposes key aspects of resilience which do not necessarily hold true in complex, dynamic non-linear systems. Building resilience in the global financial architecture may require a broader perspective which builds upon notions of multiple equilibria, uncalculable uncertainty, the dynamic heterogeneity of system participants and the importance of the interaction of resilience in multiple interacting systems for the resilience of the financial system. Drawing on resilience as it is defined in ecology would therefore require a cognitive shift in perceptions of resilience in the financial markets towards a more dynamic, multivariate concept of the system which in turn calls for a re-envisioning of the system and its governance.