



Institute of Actuaries of Australia

# Some Further Thoughts on Systemic Risk – and How to Control it

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# Some Further Thoughts on Systemic Risk – and How to Control it

## Abstract

The paper addresses the current global financial crisis. It commences by drawing on the earlier paper by the author, *Some Thoughts on Systemic Risk*, presented to the IAAust Convention in 1999. In particular it looks at the roles of leverage, optionality, and price-insensitive investors as described in that previous paper. It then builds on this previous work to discuss the causes of the global financial crisis, particularly focusing on the contribution of the pro-cyclicality of the regulatory regime and its associated accounting issues. The paper goes on to ask whether the crisis could have been foreseen, and whether future crises could be prevented. A brief exploration of control mechanisms and systems theory is undertaken, followed by some suggestions as to how systemic risks might be mitigated in future. In particular the paper proposes a dynamic capital adequacy regime for financial institutions, and the creation of a Chief Risk Supervisor in each country, with a role analogous to that of the central bank. These proposals were developed as part of an International Actuarial Association taskforce which presented its recommendations in February 2009 and the contributions of other members of that taskforce are acknowledged.

### *Key Words:*

*Dynamic Capital Adequacy, Leverage, Pro-cyclicality, Systemic Risk, Systems Theory*

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# Some Further Thoughts on Systemic Risk – and How to Control it

## 1. Introduction

This paper extends some of the thoughts expressed in an earlier paper “ *Some Thoughts on Systemic Risk* “ presented at the IAAust Convention in Darwin (Barker 1999). Much has happened in the ten years since then, and this paper is intended partly to update some of the thoughts expressed earlier. It will also go further by making more constructive suggestions.

When writing ten years ago, I felt the need to start the paper with a definition of systemic risk for those not familiar with the term. In fact some confused it with the term *systematic* risk, a more familiar term in financial economics. Today it is hard to pick up a financial newspaper without finding an article on systemic risk. The so-called global financial crisis (or GFC) seems to be on everyone’s mind, and each commentator seems to have a different version of its causes and solutions.

This paper cannot cover all the possible angles, and will try to focus on the areas of greatest interest to actuaries. Writing of the paper commenced many months ago, but has benefited from the author’s membership of a Risk & Credit Crisis Taskforce set up by the International Actuarial Association under the Chairmanship of Tony Coleman, and which published its report in February (IAA 2009). Whilst the ideas in this paper are mostly my own, and I take full responsibility for the suggestions made, I have greatly appreciated the thoughts of the other members of this IAA taskforce.

I would also like to acknowledge the very helpful contributions of Richard Fitzherbert, both in commenting on an earlier draft of this paper and more generally by introducing me to the works of Hyman Minsky many years ago.

Section 2 of the paper summarises the main points I made in my 1999 paper, and sections 3 and 4 link these to the current GFC. Section 5 reviews the possible causes of the crisis, and section 6 considers whether the crisis could have been foreseen, while section 7 asks how much longer it will continue. In Sections 8-11 proposals are put forward which would help prevent future crises from occurring, including the concept of a Chief Risk Supervisor and the adoption of a dynamic capital adequacy regime. Sections 12 and 13 take a brief look at control theory and systems theory respectively, and section 14 considers indicators of potential systemic risk which should be monitored. Finally section 15 asks whether product innovation should come under greater regulatory control.

## 2. Warnings from 1999

My 1999 paper attempted to identify possible leading indicators of financial distress, and to sound warning bells for the future. In particular it focused on the following features:

(i) One of the basic assumptions of financial economics, that investors behave in a rational wealth-maximising fashion, buying assets which appear fundamentally cheap and selling those which appear fundamentally expensive, needs modification at certain times. Many transactions in practice are not price-sensitive. They are the subject of automatic triggers such as stop-loss orders, delta-hedging, and strategic asset allocation. The paper suggested that the volumes of such trades could dominate markets and contribute to or cause bubbles and crashes, threatening the concept of market efficiency.

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(ii) In order to predict such de-stabilisation, and in particular the sharp downward market corrections generally referred to as crashes, it was suggested that the most useful indicator was the degree of leverage in the system. Much of the paper dwelt on how to recognize and measure leverage in its various forms, and how it might be controlled. The potential leverage hidden in financial options was particularly addressed.

(iii) The role of institutional regulation was examined, and how apparently well-meaning capital adequacy standards applying to individual entities could combine to create an important systemic effect by forcing institutions to become forced sellers of assets all at the same time. In this respect, the institutions could be seen as collectively being the writers of a systemic put option in favour of their client base.

(iv) The paper raised the issue of the moral dilemma facing regulators in the event that they found themselves in the position of enforcing destructive selling by the institutions under their surveillance.

(v) The final conclusion of the paper was that we could be headed towards “*a world bank holiday, which would be required while the monetary authorities found a way of recycling funds back from the general public to an insolvent global banking system*”.

At the time of completing this paper in February 2009, the “*world bank holiday*” has fortunately not eventuated, but in most developed countries the banking system has needed government support by way of capital injections or guarantees. A crisis is certainly upon us, if not exactly the one I was forecasting ten years ago.

I will go back to some of my earlier concepts listed above to describe how I have perceived the current crisis to have developed, and then move further towards suggesting ways of avoiding a repetition.

### **3. The Sub-Prime Crisis – a Victim of Optionality?**

In 1999 I was particularly concerned about options granted by institutions to their clients, and the implications to markets of having to hedge those options in times of stress. When the sub-prime crisis hit, I did not at first relate it to my earlier comments. The connection only came to my attention some months later.

A particular feature of the US residential mortgage market, not shared by Australia, is that mortgages are generally of a “non-recourse” nature. A borrower whose home value reduces to below the outstanding mortgage debt can move out and send the keys to the lender (the popular term is “jingle mail”).

A non-recourse loan can be considered technically to be a straight full-recourse loan plus an embedded put option on the value of the house. Thus, in effect, lenders were writing put options on their portfolios.

An alternative way of looking at the issue is from the perspective of the borrower, whose investment in their house was effectively a call option. Of course, these two option positions were the same, their values linked by put/call parity.

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A compounding factor was that many sub-prime loans were at very high loan-to-value ratios, more than 100% in some instances, so that the options were already in-the-money.

In contrast to traders of options in securities markets, lenders did not typically hedge their housing option exposures, probably because:

- (i) there was not an established derivative market in which to carry out the hedging and
- (ii) there was a popular perception that the US housing market was well diversified and there was little chance of falls in value occurring simultaneously across the nation. The regulators and rating agencies implicitly went along with this view.

The result was an industry-wide systemic unhedged put option, and the rest is now history.

### 4. Pro-Cyclicality

Some of the issues raised in my 1999 paper now go under the generally accepted term “*pro-cyclicality*”. This has become a central debating point in international regulatory circles over the past couple of years.

The current risk-based regulatory regimes for a range of financial institutions are pro-cyclical in their effect. This comes about in two ways:

- (i) During favourable operating conditions, the high returns generated cause the capital base of financial institutions, and thus the risk-taking capacity, to grow at a fast rate;
- (ii) These same favourable operating conditions are often associated with falling volatility, and typical risk measures such as VaR cause an apparent fall in the level of risk carried for each position held.

Together these can lead to an excessive growth in risk-taking, and build up of leverage within the financial system.

The build up of risk-taking and leverage is often attributed by observers to complacency or greed, but it is important to note that the regulatory system itself permits and even supports the trend in a pro-cyclical fashion. There are no apparent incentives at present which would encourage institutions to build up extra reserves for when conditions turn negative.

A build up of leverage often develops into a financial bubble, which as economic literature explains, sows the seeds of its own destruction. The pro-cyclical regulatory factors then go into reverse. Poor financial performance damages the balance sheets of institutions, and the ability to accept risk, just as the world appears to be becoming more risky, and higher amounts of risk-based capital are required for each position. De-leveraging becomes the order of the day.

Pro-cyclicality can be illustrated quite simply by reference to sub-prime crisis. What started as a loss caused by unhedged exposure to a fall in house values in America had a severe impact on available capital in the financial sector. Risk-based capital measures then turned the poor experience into higher capital adequacy margins. On top of that, with the benefit of hindsight many institutions toughened their underwriting standards at the same time – a triple whammy.

The role of accounting standards should also be mentioned at this point as a contributor to pro-cyclicality. Fair values, insofar as they involve marking to market, accentuate the transmission of weak financial markets into balance sheets and capital adequacy, particularly where markets become illiquid and one-sided. When markets suffer distressed selling it is very questionable

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whether the prices at which transactions occur are “fair” in the generally accepted meaning of the word. Defining fair value in a narrow sense as being the last transacted price certainly adds to the pressures.

In the current crisis there has been effective market failure in a number of areas. In the case of many investment banks, they found themselves with more than 100% of their capital base in assets whose market had disappeared – assets whose prices then became almost impossible to determine under the accounting rules. Conservatism took over.

The role of the ratings agencies is also worth a mention. Much of the commentary on ratings agencies has been on their contribution to the sub-prime disaster by assigning relatively high ratings to paper which subsequently became of little value (or more correctly transacted at very low prices). Of lesser note has been the process by which they have downgraded the ratings on institutions with questionable asset portfolios. A ratings downgrade can cause automatic selling pressure on the bonds issued by those institutions as they may no longer meet the criteria of the mandates in which they are held. Whilst such downgrades may well have been perfectly justified, they formed part of the pro-cyclical pressure.

Pro-cyclicality is now well-understood by regulators. US Federal Reserve Chairman Bernanke in his speech at the annual Jackson Hole conference in August 2008 is quoted as saying:

*“However, as we consider ways to strengthen the system for the future in light of what we have learned over the past year, we should critically examine capital regulations, provisioning policies, and other rules applied to financial institutions to determine whether, collectively, they increase the pro-cyclicality of credit extension beyond the point that is best for the system as a whole.”*

So to summarize the situation in the terms of my earlier paper, the current regime of risk-based capital requirements, with its strong pro-cyclical effects, exacerbates selling pressures in stressed markets and operate like an institutionalized system of portfolio insurance. Since everyone is using the same system, it becomes a mutually destructive force. Another way of describing the problem would be that the regulatory system in effect has created for the industry an option pay-off which it is not able to hedge, as there is no-one (other than the taxpayer) who can take the other side of such a large trade.

While I am not asserting that pro-cyclicality was the *cause* of the crisis, I certainly believe it has been a major contributor to the severity of the crisis.

Work is underway in a number of forums to address pro-cyclicality – either by mitigation or suggestion of *counter-cyclical* measures. The IAA Risk & Credit Crisis Taskforce has been contributing to some of these discussions. This will be addressed further in later sections of this paper.

### 5. Causes of the Global Financial Crisis

It seems that everyone has their particular view on the principal cause(s) of the GFC. The blame is usually directed at another part of the system over which the commentator has had little control. In particular it is popular to blame human nature, behavioural factors or plain greed on the part of (other) market participants.

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The view I express in this paper is that, while human factors have contributed, the prime causes would be better described as those emanating from the financial system, by which I mean the structure of laws, regulations and products and the institutional providers of those products. In other words, it was the rules of the game that were flawed, rather than the players.

One well-argued paper by Andrew Haldane from the Bank of England in February 2009 looks at the market failure from a behavioural and systems perspective, detailing in turn:

- disaster myopia – the propensity of agents to underestimate the probability of adverse outcomes
- network externalities – the result of system complexity
- misaligned incentives – principal/agent problems on a grand scale

The paper is well worth reading, although much of its content has been familiar to market players for many years – but perhaps not to regulators.

In a very different approach, Prof. Kevin Davis of the University of Melbourne, writing in *Infinance* magazine in December 2008, attributes the crisis to:

- the growth of financial products and practices which involved high leverage...
- financial engineering which prompted the growth of liquidity creation techniques based around collateralised lending...
- the growth of the largely unregulated “shadow banking” sector...
- an absence of public information about the level and distribution of risk in the financial system...

A somewhat different view emerges in a paper by Adrian Blundell-Wignall and Paul Atkinson presented to a conference organised by the RBA in July 2008. Like me, they took a more critical view of the regulatory regime, but in their case particularly of the role of the transition to the Basel II framework in the development of the securitised mortgage market at the heart of the sub-prime disaster.

In a robust discussion to the Blundell-Wignall paper, John Laker of APRA indicated his view that market participants should take their share of the responsibility. He pointed out that of the eight underlying weaknesses identified by the Financial Stability Forum in early 2008, regulation ranked number eight, while poor underwriting standards and shortcomings in individual firms’ risk management practices ranked numbers one and two.<sup>1 2</sup>

Woody Brock, consultant to many leading fund managers, expresses a view with which I wholeheartedly agree:

*"Many of today's policy proposals start from the view that "greed" and "incompetence" and "poor risk assessment" are the ultimate source of what went wrong. In fact, they were not the true cause at all. Moreover, even if they had been, it is fatuous to think that we will now create a post-crash generation of bankers and traders who are not greedy, much less a new generation of quants who will be able to assess and manage risks much better than "the idiots" who have brought us to the current abyss. Greed cannot be exorcised. Nor can the inherent inability of any quants to determine the "true" probability distributions of all-important events whose true probabilities of occurrence can never be assessed in the first place."*

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<sup>1</sup> Perhaps that conclusion is unsurprising given that the Financial Stability Forum is made up of regulators.

<sup>2</sup> The full list is provided in the Appendix.



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Clearly there is plenty of room for disagreement, and, it seems, very little room for apologies!

If it is the rules that are at fault, as I am suggesting, then it can be noted that to some extent the rules have been designed by the players. In other cases they have been designed by regulators and bureaucrats, or by their political masters. Whichever is the case, however, the rules have been designed from the perspective of maintaining the financial health of individual firms. Standards and “best practice” have been the order of the day. The focus has been on micro-regulation, on the assumption that if individual firms are behaving properly, systemic dangers will be largely under control. This approach treats the system as the sum of its parts.

A system is more than the sum of its parts, though. Incentives designed for individual players can still leave a system that is sub-optimal, and indeed can be dysfunctional. The question needs to be asked “What if everyone is doing the same thing at once?” Crowd control measures need to be in place as well.

In my 1999 paper I used the example of Prisoner’s Dilemma to illustrate the point. For those not familiar with Prisoner’s Dilemma, it is worth re-visiting from time to time.<sup>3</sup>

Prisoner’s Dilemma is an example of a systems theory predicament. Systems theory is now a well-developed and thriving area of scientific research. I will come back to it in Section 13 of the paper.

The difference between entity risk and systemic risk is now recognised by regulators. Bernanke in his 2008 Jackson Hole speech mentioned earlier also proceeded to draw attention to the fact that rules devised by a micro-prudential regulator to protect an individual firm are likely to be very different from those preferred by a macro-prudential regulator looking to protect the system.

### **6. Could the Crisis have been Foreseen and Avoided?**

During the past twenty years there has been a strong body of academic conventional wisdom, based partly on the Efficient Market Hypothesis (EMH), which has claimed that assets are always correctly priced in terms of the collective knowledge of potential investors. I argued against this in my 1999 paper, using the concept of price-insensitive investors and “liquidity trades”. Other challenges have come from academic sources, particularly Mordecai Kurz with his Rational Beliefs theory quoted in my 1999 paper.

The RBA took a good look at the question of asset bubbles in 2003, devoting its annual conference to the topic “Asset Prices and Monetary Policy”. Although they found little academic support for the existence of bubbles, most conference participants appeared to agree that bubbles existed, noting that their definitions were highly subjective. The transactions are worth reading for a very entertaining after-dinner address by Trevor Sykes, in which he pointed out how little we had learnt from studying previous bubbles.

Notwithstanding the popular view that bubbles do exist, there has still been a strong view accepted by many institutional investors that it is not possible to know whether a particular market is too high or too low, and so the safe thing to do is to stick to a strategic asset allocation.

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<sup>3</sup> Wikipedia is a convenient source, although there are many variations and many books written on the subject.

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I have stated on many occasions that I disagree with this view. I do believe it is possible to form a judgement on whether a market is too high or too low, and I believe that a number of variables show mean reverting tendencies. However I make three qualifications:

- (i) it is very difficult to say where the mean actually is at any particular time
- (ii) it may take a very long time before mean reversion is evident, and
- (iii) the variable may move further away from its mean before it begins to revert.

The net result of these qualifications is that I see taking tactical positions on markets as quite a risky business, and if it is done as a business decision it needs to be backed by substantial business capital – resilience reserves being an example.<sup>4</sup>

Now turning to the current crisis, there were a great many people who identified a bubble developing. They included market economists, advisors, investors and academics, and of course actuaries. At the AFIR Colloquium in Boston in November 2004 a hot topic of coffee break discussion was the imbalances in the global economy and whether it was possible to deflate the bubble or whether it would burst.<sup>5</sup>

A number of those who identified the formation of a bubble were followers of the economist Hyman Minsky (1919 – 1996), best known for his study of financial crises. He describes how speculative bubbles form, based upon an expansion of leverage, until finally a crisis point or “Minsky moment” is reached.

Without going into Minsky’s detailed explanation, it is pertinent to note his description of three different types of debt:

- (i) hedged – where the borrower has sufficient cash flow both to pay interest and to repay the principal over the term of the debt
- (ii) speculative – where the borrower can pay the interest but needs to roll-over or re-finance the principal at some future time
- (iii) Ponzi – where further borrowings have to be made to service the debt

Minsky’s hypothesis states that:

*“over periods of prolonged prosperity, the economy transits ... to a financial structure in which there is a large weight to units engaged in speculative and Ponzi finance. Furthermore, if an economy is in an inflationary state, and the authorities attempt to exorcise inflation by monetary constraint, then speculative units will become Ponzi units and the net worth of previously Ponzi units will quickly evaporate. Consequently, units with cash flow shortfalls will be forced to try to make positions by selling out positions. This is likely to lead to a collapse of asset values.”*

Those familiar with the GFC will immediately recognise the extent to which Ponzi-type debt became a growing feature of markets globally. This was obviously a feature of the sub-prime market in the US. In Australia this was less noticeable at the retail level, but clearly a feature of

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<sup>4</sup> In addition, investment advisors who preach “efficient markets” may be doing so partly because of their business risk.

<sup>5</sup> From that time it took two years and eight months before the sub-prime crisis hit and we began to discover the answer.

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some of the corporate collapses which have taken place in the property and infrastructure space. Anyone familiar with Minsky's theory would have seen the signs writ large!

An added feature of the debt situation in Australia has been the extent to which we have become dependent on foreign debt, which is now in some cases being forcibly recalled because of difficulties experienced by the foreign lenders in their home countries.

Incidentally, Minsky believed that governments needed to intervene to forestall crises, and was a strong opponent of the de-regulation trends of the 1980's and 90's.

Those with an interest in this area may also like to study the works of earlier economists such as Schumpeter, Kondratieff, etc. They are well-known for their theories that all economies need to go through periods of creative destruction from time to time, in super-cycles which occur around fifty years apart.

### **7. How Much Longer – Are We There Yet?**

Although many commentators forecast that the imbalances building in the global economy would have a traumatic conclusion, few other than perhaps strict disciples of Schumpeter and Kondratieff were forecasting the degree to which the crisis would develop.

My view is that the depth and length of the crisis was directly the result of the slow reaction and intervention of regulatory authorities, particularly in the US. At the outset of the sub-prime crisis, a number of commentators were calling for government intervention along the lines of the previously successful Resolution Trust (RTC) example which followed the Savings and Loan crisis almost twenty years earlier. If such a fund had been established, of say \$500 billion, it may have been possible to put a floor under house prices before the systemic collapse was underway, and losses could have been contained. Against this background, the TARP, etc programs have generally been perceived by the markets as too little, too late.

We are now obviously in a serious period of deleveraging, and it is not clear how long this will need to continue. Although much of the Ponzi leverage has now been written off, we are now in the process of eating into the debt that Minsky referred to as "speculative". Any corporation with debt that needs to be rolled over at virtually any time in the future is under suspicion.

To any reasonable person, this has gone too far. To take the deleveraging process back to where all debt is "hedged", even if this were possible, would cause great social dislocation and hardship. Unfortunately the alternative, massive government intervention by way of underpinning and funding the global banking system, has at the time of writing not yet been sufficient to put a halt to the process.

At the same time, there are those who worry that the intervention is debasing the financial system by printing money and saddling future generations of taxpayers with intolerable levels of debt.<sup>6</sup> The tale may well end with a burst of hyperinflation as being the only way to deal with the debt that has been created.

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<sup>6</sup> The "quantitative easing" under consideration by the US Fed and the Bank of England means these two bodies may be joining the ranks of "price-insensitive traders" – another nail in the coffin of efficient market theory.

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Whereas 2008 was the year the banking system failed, it is now being suggested that 2009 will be the year in which many sovereign nations effectively default on their debts as well (or have to somehow be bailed out).

Perhaps the last word on this subject should go to Peter Bernstein, now 89 years of age, but still one of the most insightful market historians and commentators around. In a recent article in the Financial Times he argues that the future really is unknowable:

*“The long-run results we can discern in the data of stock market history are not a random set of numbers: each event was the result of a preceding event rather than an independent observation. This is a statement of the highest importance. Any starting conditions we select in the historical data cannot replicate the starting conditions at any other moment because the preceding events in the two cases are never identical. There is no predestined rate of return. There is only an expected return that may not be realised.”*

Then after briefly reviewing the current situation he finishes:

*“Will our economy and society emerge so risk-averse after these experiences that years will have to pass before we return to a system naturally generating vibrant economic growth and a renewed willingness to both borrow and lend? Or will we head in the opposite direction, where faith in ultimate bail-outs will justify the wildest kind of risk-taking? Or will the entire structure collapse from government debts and deficits that turn out to be so unmanageable that chaos is the ultimate result?*

*We can neither answer those questions nor can we claim they are a complete list of the possibilities. The unknown today seems more than usually unknown. Then my whole point remains the same. The long run is an impenetrable mystery. It always has been.”*

### 8. Can We Prevent Future Systemic Risk Crises?

I now turn to the main purpose of this paper – how we might attempt to control systemic risk and prevent future systemic crises occurring.

Over the past few months many international bodies have been putting together lists of things that need to be done. One such list, consisting mainly of suggestions in which actuaries could make a contribution, has been produced by the Risk & Credit Crisis Taskforce of the IAA. It is published on the IAA website under the heading “Dealing with Predictable Irrationality – Actuarial Ideas to Strengthen Global Financial Risk management”.

I will not attempt to cover all the suggestions raised by the various international bodies, as they would fill a book. What is more, they constitute an agenda which could take more than a decade to implement. Instead I will focus on the area in which I have contributed to the IAA taskforce, and which I sincerely believe could be the single most important and most effective component of any overall solution. Given my earlier comments, it will come as no surprise that my approach will be aimed at improving the regulatory regime, in particular via a counter-cyclical dynamic capital adequacy regime.

Previous government efforts to reduce economic cycles have generally fallen under the two headings of fiscal policy and monetary policy. Historically there have been many occasions

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when operation of these policies has failed to prevent the financial system building up excessive leverage, asset bubbles, and subsequent periods of correction which have been quite painful.

During these disruptive occasions, the financial institutions at the heart of the crisis (banks, other deposit taking institutions, insurers, pension funds, mutual funds, etc) have often seen calls for a change to their basis of regulation. Often these calls have involved a strengthening of capital requirements, by prescribing a new improved formula for capital adequacy.

This paper suggests that the capital adequacy rules for financial institutions should not be based on a static set of prescribed formulae, but should be considered a matter of ongoing policy review and adjustment, in a similar way to fiscal or monetary policy.

Thus control of the economy would be a three way policy interaction between (i) fiscal policy under review and control of the National Treasury (and Parliament) (ii) monetary policy under the review and control of the Central Bank and (iii) institutional capital adequacy policy under the review and control of a regulator which, for the purposes of this paper, will be denoted the Chief Risk Supervisor (CRS). Each of the three bodies would note the views of the other two when formulating its policy, as in practice the first two of these bodies generally do at present.

### **9. A Chief Risk Supervisor**

As a starting point, I propose that the CRS would incorporate the current roles of prudential regulators of the various financial institutions. However, it is important to understand that the role of the CRS would not just be to monitor the individual financial institutions under its control, but also to monitor the financial system, which as stated earlier is not merely the sum of its parts. Systems theory as a field of enquiry is introduced in Section 13 below.

The CRS role would in some respects be analogous to that of the Chief Risk Officer (CRO) within a large corporation. It would differ, though, insofar as it would also focus on systemic issues of the whole national economy, which would be outside the ambit of most CROs. In addition, my proposal is that the CRS would not just be an advisory role, but would have wide-ranging executive power to change capital adequacy requirements of the financial institutions for which it was the prudential regulator. Again I would draw the analogy with the powers of the central bank.

Until now, the monitoring of systemic risk, and subsequent action, has generally been a function of central banks. Certainly it is part of the RBA's mandate. It may well be asked as to whether the CRS function should not be subsumed within the central bank. My answer to this is threefold:

- (i) The issues involve the understanding of processes within individual organisations – knowledge that lies within the prudential regulator, not the central bank
- (ii) Controlling systemic risk may be necessary at a time when inflation is quite subdued – they are different objectives and may at times appear to be in conflict
- (iii) The precedent of separating central bank from Treasury has worked well – an expansion from two to three specialist groups may work even better

It may also be asked in Australia whether APRA does not already have sufficient power to change capital adequacy standards. APRA has certainly intervened in the case of individual organisations, imposing additional capital requirements until it is satisfied that certain flaws in those organisations have been addressed. It has also demanded particular stress tests in an effort

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to identify or draw attention to possible systemic risks.<sup>7</sup> As far as I am aware, however, APRA has not in the past seen it as its role to change capital adequacy requirements in response to changes in general market conditions. For the CRS role I am proposing this would be a key function.

This discussion also leads naturally to the question of independence. Giving independence to central banks is believed to have been a major contributor to the control of inflation. This is partly because raising interest rates is not usually popular - and borrowers are more vocal than savers. An independent central bank can carry the blame more easily than can politicians.

In the case of systemic risk control, tightening capital adequacy requirements would probably not be a popular move, and nor would any other action designed to lower the provision of credit, or cool asset markets. To use a popular analogy, the CRS would be taking away the punchbowl just when the party was in full fling! This is a very good reason for the CRS to have full independence in the same way as the central bank.

The suggestion above for a CRS has been on a country-by-country basis. This is for reasons of practicality. Clearly the overall need is for risk to be monitored and controlled on a global basis. To attempt to build such a role from the top down would be ideal, but is likely to take a lot longer than if a number of countries individually exercised leadership by creating their own CRS positions, then forming a network later. I would hope that Australia would be one of those countries exercising leadership, as it has done in a number of other areas of financial regulation.

### **10. Dynamic Capital Adequacy - Principles**

The purpose of a dynamic capital adequacy system would be to counter and restrain the natural forces at work within the financial system. Thus if excessive leverage appeared to be building within the economy, or if financial markets appeared to be overheating, “brakes” would be applied by raising capital requirements for some categories of financial market participant. The obvious analogy is the tightening of monetary policy by the central bank when inflation is rising.

In an opposite scenario, eg following an external shock to the system, the capital requirements would be reduced to provide a buffer and to avoid the potential need for institutions to competitively seek to liquidate their positions all at the same time.

In part, monetary and fiscal policy may already be used to attempt to influence institutional behaviour. However, these efforts are handicapped by the other aims of the policies concerned, and in particular in the case of monetary policy by the considerable lag between implementation and effect. Direct action by a CRS would have immediate and measurable impact on the relevant institutions. The actions could also be targeted towards particular areas of concern, eg credit risks or market risks, housing credit or business credit.

### **11. The Process – Automatic or Discretionary?**

Capital adequacy is normally defined in terms of capital ratios, based on amounts at risk, eg loans made by banks or liabilities of insurers. These are usually prescribed in a static form but it is

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<sup>7</sup> An example was the requirement of banks to carry out stress tests of their housing mortgage books in 2003.

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possible to design dynamic capital adequacy formulae where these ratios vary to some extent as automatic stabilizers. One dynamic formula is the use of VaR, which relates the required capital to historical market volatility. Unfortunately this particular method produces the opposite effect to that desired, as it tends to be pro-cyclical. It rewards falling volatility by an improved capital position, allowing additional risks to be taken, when prudence would suggest that instead the institution should be putting aside extra capital for when volatility moves back upwards to more normal levels.

An example of a dynamic formula which is counter-cyclical is already found in Australia. Life insurers are required to hold resilience reserves for equities which are based on a fixed increase in the dividend yield. Thus as markets rise, and yields fall, the resilience reserve gradually becomes a higher percentage of the equities held. The net amount of capital available still grows, but at a slower rate than if the resilience reserve were a fixed percentage of the portfolio.

The advantage of a capital adequacy regime which is static or formula-driven is that it creates a predictable set of rules within which an institution can design products and generally go about its business.

As an alternative, the process can be discretionary, with the CRS taking decisions from time to time to alter the levels of capital required, and hence creating a more uncertain environment for the businesses concerned. Whilst this uncertainty would probably not be welcomed by the industry, it is argued here that from the perspective of controlling systemic risk the uncertainty of facing a possible increase in required capital would be helpful in discouraging excessive risk-taking in a market which is showing signs of over-heating.

An analogy is in the setting of interest rates, which is in most countries a discretionary function of its central bank. Anticipation of future central bank actions is an important feature of the financial markets, and is generally agreed to influence market behaviour in a healthy way.

Although in the example above the central bank is using discretion, it is unlikely in practice to be doing so without first examining the decisions which would be indicated by one or more automatic formulae. A similar integrated approach is recommended for the CRS decisions. The important question then is which formulae or models are appropriate as support tools for these CRS discretionary decisions. A follow-up question is the extent to which these models should be revealed to market participants, so that changes in capital adequacy do not come as a complete surprise to the market any more than do changes in official interest rates.

## **12. Control Theory**

A dynamic formula can be viewed as a type of control process. A typical control process such as found in engineering literature identifies a variable which it is desired to control (the process variable), and a response mechanism which is expected to influence the variable in question (the manipulated variable). As a simple example, a central bank identifies inflation as the process variable it wishes to control, and the official cash interest rate as the manipulated variable by which it wishes to control it.

An example of a control system is the PID (Proportional-Integral-Derivative) controller, which is a generic control loop feedback mechanism widely used in industrial control systems. This varies the response in terms of (i) the extent to which the variable has deviated from its desirable level, (ii) the cumulative deviation, and (iii) the rate of change of the deviation.

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In formula terms, a PID expresses the manipulated variable MV as the sum of three components:

$$MV(t) = K(p)*E(t) + K(i)*I(t) + K(d)*D(t)$$

Where E(t) is the error in the process variable (ie the targeted variable) at time t

I(t) is the integral of the error up to time t

D(t) is the derivative of the error at time t

and K(p), K(i) and K(d) are tuning parameters.

Again using inflation as an example, a central bank could set its cash rate using the three-part formula above, based on how far inflation is above its target range (the proportional component), the cumulative amount by which inflation has exceeded its target range since it first rose above it (the integral component), and the rate at which inflation is rising (the derivative component).

As far as I am aware, the method by which the RBA determines interest rates has not been made public, but it would be of no surprise if the approach used had some similarity to the control process above, although no doubt more complex and sophisticated, and incorporating a subjective component. The RBA would in practice be targeting *forecast* inflation which would itself add a level of complexity by way of the forecasting process.

It is obviously possible to target more than one variable, and to have multiple response mechanisms, although selection of tuning parameters would become successively harder.

The PID control process shown as an example above is obviously very different from the Actuarial Control Cycle. In a sense it is more mathematical and could be of particular appeal to the actuarial profession, trained as it is in model-building techniques. I believe the use of such approaches to identifying and controlling systemic risk is an area where actuaries could play a major development role.

### 13. Systems Theory

As stated earlier, systems theory is a well-researched field of scientific enquiry. Starting from the study of micro-organisms in eco-systems nearly a century ago, it is now an important contributor to progress in the social sciences. Emphasising “the fundamental interconnectedness of all things”<sup>8</sup> it allows causes and effects to be understood as mutually interactive, non-linear and non-stationary. Systems theory looks for “influencing factors” whose power may only emerge after a “threshold” has been reached. Peter Senge’s work on “learning organisations” is an example of application in the corporate area.

Asked to describe systems theory, an organisational psychologist provided the following quote:

*“Systems theory does not concern itself with the lineal logic of causes and effects, nor with problems and solutions, nor with starts and finishes, nor with the unidirectional flow of information from generator, through transmitter, to receiver. Because of the connectivity and interrelatedness of wholes within wholes, systemic analysis is always recursive.”*

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<sup>8</sup> Douglas Adams “Dirk Gently’s Holistic Detective Agency”



## **Some Further Thoughts on Systemic Risk – and How to Control it**

As is evident from the quote above, systems theory does not fit easily alongside the mathematical control theory approach described earlier. Nevertheless, systems theory actually attempts to describe the boundaries of the system and its component sub-systems as well as what is happening within the system, and may draw attention to issues which would not be evident from a purely historical analysis of time series. If we going to attempt to control what is happening, then it would seem a good idea to attempt to understand it first – even if we have to be recursive in our approach.

Systems theory does not have a high profile in economics, which has been dominated by econometricians in recent years. Nevertheless it is a growing area, along with the area of behavioural economics. System dynamics - in terms of addressing interactions between economic agents and feedback within systems - can help explain the transformation of individual incentives and behaviour into greatly magnified outcomes. The comments of Andrew Haldane of the Bank of England about externalities to which reference was made in Section 5 are consistent with a systems view of the crisis.

An effective approach for the CRS role may need to combine the left-brain skills of the engineer with the right-brain skills of the social researcher. Actuaries are known more for the former than the latter, and may need to work at extending their skill base.

I attach an Appendix in which I attempt to explain the sub-prime crisis incorporating a wider group of causes which systems theory may have recognised earlier than the markets did.

### **14. Systemic Risk Indicators and Responses**

There are many economic and financial market indicators which can be used as indicators of systemic risk. Some of these may be appropriate variables for use in a model as suggested in Section 12 above. Possible indicators could include the following:

- Leverage in the economy, measured as household debt/GNP
- Leverage in institutions, measured as total assets/capital
- Money supply (various measures)
- Inflation
- Market volatility (egVIX)
- Credit spreads
- Growth in size of derivative markets, particularly options
- Real interest rates – actual or implied
- Dividend yields on stocks
- Commercial real estate yields or targeted IRRs
- Commodity prices
- Corporate profit margins
- Bonus levels paid by financial market participants

Some (or perhaps all) of these are already used by central banks as inputs to their determination of monetary policy. Their relative importance in terms of capital adequacy of financial institutions may well be somewhat different, and call for different responses.

Some of the list above relates to asset markets. The possible use of monetary policy to influence asset markets has been the subject of much controversy over the years, and the conventional view

## Some Further Thoughts on Systemic Risk – and How to Control it

has been opposed to it. The issues involved in determining capital adequacy would be somewhat different, however, and levels of asset markets could become an important component of the decision.

At the RBA Conference in 2003 which looked at the question of whether monetary policy should target asset prices, the consensus opinion appeared to be that, in determining monetary policy, regard should be paid to the level of asset prices but monetary policy should not actually target asset prices<sup>9</sup>.

The RBA is now prepared to take a fresh look at the issue. In a recent speech by the RBA Governor Glenn Stevens he stated:

*“In the case of central banks, surely we cannot avoid another look at the question of monetary policy, asset prices and leverage. This has been a long-running debate – going at least as far back as the early 1990s, in my memory. Distinguished scholars have disagreed on the extent to which monetary policy should respond to movements in asset prices over and above their estimated impact on inflation via wealth channels, etc. Some argue in favour of ‘leaning into the wind’ of asset price swings, while others eschew that on various grounds, in favour of dealing with the aftermath of asset price busts if and when they occur.”*

If the levels of asset markets are to be used in monitoring systemic risk, as I am suggesting they should, and the regulator is seen to be targeting asset prices, then there will no doubt be howls of protest from some quarters. This adds to the reasoning for the CRS to be independent of Parliament.

Some of the indicators listed above are already used in internal risk models, and could continue to be used in this way. Thus VaR would still be useful as a day-to-day risk measurement tool for individual institutions, but a general fall in volatility as measured by an index such as VIX would suggest a tightening of capital adequacy standards across the board may be desirable.

Importantly, a macro-regulator such as the CRS would also be monitoring changes within the financial system such as the rise of “shadow banking” institutions, and shifts of market between sectors due to non-uniform micro-regulation. This would be addressed in terms of changes to capital adequacy on a sector-by-sector basis.

It is implicit in the above that the principal response to an unsatisfactory set of indicators would be changes in capital adequacy requirements. For banks and insurers the existing capital adequacy definitions are in place and it would be a simple matter to raise or lower them. For other institutions, or more particularly the consumer sector, it may be more difficult.

For instance, if it appeared that margin lending in the equity markets was becoming excessive, there may be several avenues of attack – by setting higher capital requirements for lenders, by placing restrictions on allowable loan-to-value ratios for individual borrowers, by measures which put pressure on the stock exchange or the financial planning industry, or through taxation policy. Some lateral thinking may be needed, together with co-operation of other regulatory bodies.

In some cases exhortation or publicity which highlights the level of risk perceived by the CRS may be sufficient to cause the desired effect. The analogy here may be with the development of

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<sup>9</sup> At the time there was concern in Australia over the high level of housing prices.

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low-doc housing loans (Australia's equivalent to sub-prime). APRA indicated its concerns and asked the banks to carry out stress tests on their mortgage portfolios in 2003. Quickly the banks were reassuring their shareholders that they were in good shape. The low-doc market never showed the growth of its US cousin.

Responses to changes in the indicators would of course not be symmetrical. As is the case with interest rate changes, tightening would most likely be gradual, but cuts could be more dramatic, responding to conditions of stress in the economy. The toughest decisions may be the reduction of capital adequacy at a time when conditions appeared (using hindsight) to have become more risky. Whilst being politically controversial, it would need to be explained as using the reserves which had been provisioned in "good" times to provide support in "bad" times – similarly to a Keynesian approach in fiscal policy.

### **15. Product Regulation**

One area of potential systemic risk, which is not easily dealt with through capital adequacy, is that of product design.

If one thinks of the US-style sub-prime non-recourse mortgage as a financial product, then clearly this had major systemic implications, although few realised it at the time.

A similar source of systemic risk would be the reverse mortgage. Most if not all institutions offering this product in Australia only do so with a "no negative equity" provision, ie there is a written put option incorporated in the contract. The put option is acknowledged by the lenders, and they are compensated by an interest rate which is higher than the rate on conventional mortgages. So far so good. However, the risk is one which it is not possible to hedge at present, as there is no derivative market on residential housing. This could become an issue at some time in the future. Writing an option book which you cannot hedge is dangerous practice, as we have seen. Holding capital against an option position is not a good alternative – it appears unnecessary in good times, but almost certainly proves insufficient when needed most.

Should the CRS have a regulatory role in licensing such products, or should it merely rely on being able to establish appropriate capital adequacy charges for them? I tend towards the former view.

Other products with systemic implications for which it is more difficult to establish capital adequacy charges are the great variety of structured products issued usually by investment banks. These were particularly prevalent during 2006-7. They often consist of a note which promises a return at the end of a fixed period, calculated by reference to some market index, basket of indexes, or basket of stocks. Often there is leverage involved, together with some kind of option.

The important feature of these products is that from the perspective of the purchaser they think they are buying market exposure, but in fact they are also accepting 100% counterparty risk from the product vendor. In turn, the vendor would normally plan to hedge its exposure. Sometimes the reference basket is easily hedged through a familiar derivatives exchange. On other occasions, eg in the case of a basket of hedge funds, a derivative market does not exist. The vendor may hedge OTC with another party (usually in an offshore location), or may attempt to replicate the exposures through some kind of multi-factor model. Managing option exposures add extra complications.

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The bottom line for the purchaser is that they have considerable exposure to the internal risk management function of the investment bank, which is usually quite opaque. The typical product disclosure statement is of little help.

In most overseas jurisdictions such products are only available to sophisticated investors. In Australia there is no such limitation, with the regulator (ASIC) adopting a *caveat emptor* approach. The product vendors are often not APRA-regulated.

I believe that the numbers of these products and their nature (eg the levels of gearing included) are ironically quite good leading indicators of the level of systemic risk. When markets are booming and risk levels are high these products tend to become more popular. In contrast, it is probably not a co-incidence that very few of them are currently on offer in 2009.

These structured products would certainly be of interest to the CRS, but should the CRS have any role in vetting or licensing them? They certainly contain systemic risks, both in relation to their counterparty exposures and the hedging risks of the option positions contained within them.

The Wallis Committee in 1997 produced a well-argued case for separating the product licensing role (in ASIC) from the prudential regulation role (in APRA). I did not disagree with that approach at the time. However, I suggest it is now time to re-visit the discussion and consider giving some licensing power to the CRS.

### **16. Conclusion**

With the various suggestions above it may appear that I am advocating an increase in regulation. I make no apology for this. I believe that regulation, if carried out effectively by an adequately resourced, strong and skilled regulator, fulfils an important social good and improves the long term efficiency of the financial system. Arguments against regulation are often based on past anecdotes of under-resourced and inefficient regulation, and are often self-serving. The “regulation-light” regimes in the US and the UK have certainly been found wanting.

The argument that the best and brightest people will always work for the private sector where they can earn more money is insulting to the increasing number of professionals (including many actuaries I hope) who believe that the pursuit of maximum personal wealth is not the most important aspect of life.

There will always be market “guns for hire” whose aim will be to maximise their wealth or that of their employer at the expense of the client – the zero sum game mentality. One lasting benefit of the GFC may be that there are many more people now prepared to sit on the other side of the fence and become part of a strong and effective regulatory team.

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## **Some Further Thoughts on Systemic Risk – and How to Control it**

### **Appendix**

#### **A Case Study - Two Ways of Looking at the Sub-Prime Crisis**

##### **A. The Financial Stability Forum (FSF) Analysis April 2008**

(as summarised by A. Blundell-Wignall and P. Atkinson)

1. Poor credit underwriting standards
2. Poor risk management practices in firms
3. Poor investor due diligence/ excess reliance on credit rating agencies (CRAs)
4. Poor CRA performance
5. Incentive distortions in the originate-to-distribute model, Basel I and various compensation schemes
6. Weaknesses in disclosure
7. Thin market feedback loop with sharp price falls
8. Weaknesses in regulatory frameworks pre-Basel II
9. Originate-to-distribute model itself

##### **B. An Alternative Approach, taking a wider systems-based approach of possible “influencing factors”**

1. Non recourse mortgages (50+ years ago)
2. Invention of securitisation (20 years ago)
3. Anti-regulation philosophy – belief that the market will look after itself (20 years)
4. New political mood - every American entitled to a decent home (post 2000?)
5. Length of time since last property boom (varied by region)
6. Low interest rates since last recession (2001)
7. Low risk premium due to liquidity glut and Asian savings (2003-6)
8. Basel II lowered risk rating of housing debt (announced 2004)
9. Lack of a single regulator with systemic responsibility

**Was it an accident waiting to happen?**