Risk Frontiers' Submission to the Productivity Commission in respect of Natural Disaster Funding Arrangements

The Productivity Commissions Issues Paper poses questions regarding private individuals' investment in disaster risk reduction, whether or not governments provide the right framework for effective risk management by individuals and businesses, and if not, what could be done differently.

Part A: Community response issues (Drs Deanne Bird and Katharine Haynes)

In our view at Risk Frontiers, many risk mitigation initiatives fail because they have been developed without community engagement and consultation. In these cases, risk communication with the public is not considered until strategies and plans have been already developed. This communication often fails to reach the desired population or fails to motivate them to take action, and as a consequence, the public do not adhere to and implement official advice.

This practice also ignores the heterogeneity of many Australian communities – language, ethnicity and social disadvantage – that means that there is not one single public view or perception of risk.

In view of past failures in risk communication, new approaches are needed.

More inclusive, participatory methods for community consultation should be implemented to ensure that the public buy into risk reduction solutions. Methods such as *citizen juries* or *citizen science* need to be explored. Put simply, communities must be engaged throughout the development of risk mitigation plans that effect areas in which they live.

In relation to *charity hazard* raised in the PC Issues Paper, there is certainly anecdotal evidence to suggest this does happen. Risk Frontiers' research following the Queensland and Victorian floods of 2011 found few people interested in flood proofing their homes from future floods. Details of barriers preventing people to implement risk reduction measures at the household level can be found in Chapter 9 of:

Bird, D., King, D., Haynes, K., Box, P., Okada, T. and Nairn, K. 2013. Investigating factors that inhibit and enable adaptation strategies following the 2010/11 floods. *Report for the National Climate Change Adaptation Research Facility (NCCARF) synthesis and integrative research project*, Gold Coast. http://www.nccarf.edu.au/publications/floods-household-adaptation-strategies.

(For an analysis of the *charity hazard* or *Samaritan Dilemma*, in the parlance of Game Theory, the reader is referred to Appendix 1. It is the form of a Briefing Note to Risk Frontiers' insurance clients.)

From a land-use planning and local government perspective, local residents questioned the continued construction of 'slab-on-ground' homes on floodplains and, in one particular case, the reconstruction of a shopping complex in Emerald that was gutted in 2008 and then again in 2010 by floods. Again, the insurer Suncorp has baulked at rebuilding Roma a third time in the absence of a levee.

Other publications relating to disaster risk reduction in Australia that might be of interest are listed:

Bibliography

Bird, D., Govan, J., Murphy, H., Harwood, S., Haynes, K., Carson, D., Russell, S., King, D., Wensing, E., Tsakissiris, N., Larkin, S., 2013. *Future change in ancient worlds: Indigenous adaptation in northern Australia*, National Climate Change Adaptation Research Facility, Gold Coast. http://www.nccarf.edu.au/content/future-change-ancient-worlds-indigenous-adaptation-northern-australia.

Coates, L., Haynes, K., O'Brien, J., McAneney, J. and Dimer de Oliveira, F. 2014. An examination of extreme heat events in Australia 1844-2010: exploring 167 years of vulnerability. *Environmental Science and Policy* (in press).

Coates, L. Haynes, K. Bird, D. and McAneney, J. 2011. Adaptation to Climate Change, *Learning from Extreme Events.* Report prepared for *Sydney Water,* Risk Frontiers.

Haynes, K. Bird, D., McAneney. 2013. Mitigate damage risk from bush fires. *Nature,* 503 (7477), 469-469.

Haynes, K. Bird, D.K., Carson, D., Larkin, S. and Mason, M. 2011. Institutional response and Indigenous experience of Cyclone Tracy. *Report for the National Climate Change Adaptation Research Facility (NCCARF)*, Gold Coast. *http://www.nccarf.edu.au/publications/adaptation-lessons-cyclone-tracy-part-ii-institutional-response-and-indigenous.*

Haynes, K., Bird, D., Coates, L. and Ling, M. 2010. Emergency management response to the 2009 heatwave. In: Impacts and adaptation response of infrastructure and communities to heatwaves: the southern Australian experience of 2009. *Report for the National Climate Change Adaptation Research Facility (NCCARF) synthesis and integrative research project,* Gold Coast. http://www.nccarf.edu.au/publications/impacts-and-adaptation-responses-infrastructure-and-communities-heatwaves.

King, D., Bird, D., Haynes, K., Boon, H., Cottrell, A., Millar, J., Okada, T., Box, P., Keogh, D. and Thomas, M. 2014. Voluntary relocation as an adaptation strategy to extreme weather events. *International Journal of Disaster Risk Reduction* 8, 83-90.

Okada, T., Haynes, K., Bird, D., van den Honert, R., and King, D. 2014. Recovery and resettlement following the 2011 flash flooding in the Lockyer Valley. *International Journal of Disaster Risk Reduction* 8, 20-31.

Phillips, E., Bird, D., O'Brien, J., van den Honert, R., Coates, L., Okada, T., Haynes, K., Roche, K., 2013. An integrated research assessment of the physical and social aspects of the March 2011 flash flooding in Shellharbour, Kiama and Bega Valley, NSW. Report prepared for the New South Wales State Emergency Service (NSW SES), Sydney, Risk Frontiers.

Phillips, E., Haynes, K., Bird, D. and van den Honert, R. 2012. Review of relevant literature surrounding hazard and risk communication to the public. *Report for the Risk Assessment, Measurement and Mitigation Sub-Committee (RAMMS) of the National Emergency Management Committee (NEMC)*.

Part B: Current Risk Frontiers' Projects concerning decision making around mitigation and resilience (Dr Rob van den Honert)

(Question from Page 27 of the PC Issues Document) *What mechanisms and models are governments using to evaluate and prioritise natural disaster mitigation options? What approaches could be used to prioritise mitigation options?*

Natural disaster mitigation aims to reduce the threat to people and assets from natural perils. Selecting the most appropriate mitigation options needs to trade off *benefits* offered by alternative investments (e.g. fatalities and injuries avoided, potential property and infrastructure losses prevented, reduction in anxiety and safety concerns of citizens, etc.) against the *costs* of investment. Such costs include capital and on-going operational costs, as well as intangible costs, such as the impact of the project on the visual landscape or the loss of community cohesion in the event of relocation of part of a community. Furthermore dollar costs of any potential project will need to be defined within some prescribed budget and time frame.

RAMMS (Risk Assessment, Mitigation and Measurement Sub-committee of ANZEMC) has embarked on a series of NEMP-funded projects to better evaluate mitigation decisions:

- The project *A Framework for Natural Disaster Mitigation Decision-Making: A transparent framework for mitigation resource allocation decisions* is researching and developing a transparent framework within which mitigation resource allocation decision making can proceed. This framework will include approaches and suitable metrics to compare the effectiveness (in terms of costs, benefits and other non-monetary factors, and including uncertainty about future states of nature and confidence in input information) of each element of a set of potential natural disaster mitigation options. The project will also investigate how a limited budget might be allocated amongst competing options.

- The project *A multi-criteria decision analysis framework for measuring community resilience to disasters* will develop a model based on multi-criteria decision

analysis (MCDA) models for measuring community resilience – the capacity to recover following a disaster - and will in a sense be a measure of the success of any mitigation projects undertaken.

These projects will be completed by the end of the first quarter in 2015.

(Question from Page 21 of the PC Issues Paper) *Is there evidence that natural disaster funding arrangements induce 'moral hazard' behaviour by governments, households and businesses?*

This point is framed and discussed as a mathematical "game" in Appendix 1.

Part C: Insurance, mitigation and access to information (Dr Kevin Roche and Prof John McAneney)

In much of the developed world, private sector insurance plays an important but often under-appreciated role in the societal risk management of natural disasters. Insurance works by spreading individual and independent risks over a portfolio of policy-holders. This notion works well for uncorrelated risks like theft and motor accidents, but is problematic where risks are highly correlated in space and time as is the case of severe flooding and other natural hazards. For this reason much of Australia's natural hazard risk is transferred off-shore to reinsurance markets who diversify this risk globally.

Australia, as in most other countries, has a legacy of poor land planning decisions by individuals and governments that has resulted in concentrations of exposure in hazard-prone places. Often these areas have attractive attributes such as access to water or bushlands and yet by virtue of these same attributes are exposed to one or more perils. Florida is an extreme example where enormous post-World War II population growth and rapid wealth accumulation occurred during a period of below-average hurricane activity. Insurers, with government and consumers were lulled into a false sense of security until Hurricane Andrew made landfall in 1992 and some 11 insurers went bankrupt (Musulin, Lin and Frank 2009).

The situation in Florida is very similar to the development that has occurred in many coastal and flood prone areas of Australia, such as in northern NSW and South-eastern Queensland (Figure 1). A repeat of the 1954 flooding caused by a decaying unnamed tropical cyclone has been estimated to cause some $3.8 billion dollars in insurance losses and some two to three times that in economic costs (Roche et al. 2011).
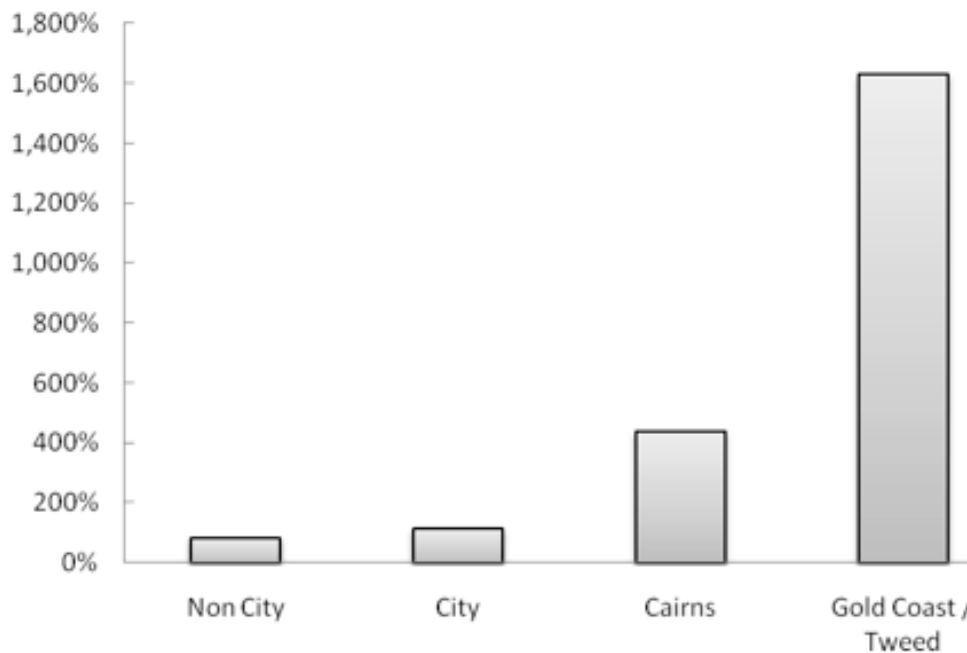
Figure 1: Australian population growth, 1961 – 2007. (Non City and City refer to rates of population growth in all Regional and Metropolitan areas in Australia as a comparison.) (Adapted from Australian Bureau of Statistics (Australian Bureau of Statistics 2009)).

In the long run, it might be expected that better knowledge of natural hazard risks would lead to a reduction of development in high risk areas and ultimately lower insurance and economic losses (Musulin 1997); however, to date there is no evidence that this is happening (e.g. Pielke *et al.*, (2008); Crompton and McAneney (2008); Crompton (2011)).

Prior to Hurricane Andrew in 1992 and the Northridge Earthquake (1994), insurance premiums were calculated using a variety of "rule of thumb" techniques developed over years of previous experience (Musulin 1997). Andrew was a wake up call and faced with the prospects of ever increasing losses, insurers then turned to technology to help it estimate its exposure to natural disasters and to calculate the appropriate level of premium. Large and now global loss modelling companies such as RMS and AIR spun out of Stanford and MIT. Risk Frontiers was the Australian expression of this movement.

(Risk Frontiers is a now world leader in this loss modelling technology and such models for all of the major Australian threats – earthquake, tropical cyclone, hail, flood and bushfire. It has also developed other tools including a database of national hazard profiles by street address that also help the insurance market underwrite Australian risks. These tools could also be adapted for government, emergency management and the public in order to estimate exposure and highlight vulnerable areas.)

Advancements in modelling and its increased use by insurers have meant that properties with greater risk are now attracting higher premium charges. Moreover uncertainty about the true risks also attracts a higher price tag -- the more accurate the information that insurers have, the more likely it is that the consumer will get a fairer price reflecting their own individual exposure. In the absence of good data insurers have no choice but to price defensively. This is a point that many local councils still fail to grasp, to the disadvantage of their ratepayers!

Risk-based pricing is already the case in motor insurance where drivers with a good history of claim-free motoring, who live in low crime areas or drive safer cars are rewarded with premium discounts. Analogously, people who live in low flood risk areas or well away from urban-bushland boundaries may see benefits with lower insurance premiums, whereas those in higher risk areas potentially face large increases in premiums, or in some cases, risk not being able to obtain insurance at all.

There should be economic incentives for homeowners to retro-fit homes or undertake other mitigation measures in order to achieve a reduction in insurance premiums and more importantly reduce their family's exposure to certain risks. The success of improved construction standards introduced after Cyclone Tracy in 1974 remain the best example of Australians learning from a dreadful experience. There have been few other examples.

Banks and other mortgage lenders may become reluctant to finance the purchase or construction of properties in locations perceived as too risky (e.g. Old Bar, NSW), especially if homeowners' insurance cannot be guaranteed. This being the case, the government may find itself called upon to address alleged failings of the insurance market in instances where some properties are deemed no longer insurable at affordable rates.

Previous policy lapses that encourage people to live in vulnerable areas and/or construct new developments in these same areas will only add to the cost of future natural disasters. Government policy actions should not exacerbate this problem, especially if we wish to maximise the risk-bearing capacity of the private insurance markets. Post-event handouts help undermine private insurance by reducing incentives for home-owners to take out insurance cover. Such largesse is rarely matched by a consideration of how more risk-informed land planning decisions and other mitigation measures might reduce the magnitude such events.

In recent times we have seen the benefits of mitigation, especially in Queensland. In Roma, once the new levee was built, insurance companies began to reoffer coverage and residents were then able to secure insurance policies. In Charleville, following the completion of the $16m levee, Suncorp reduced average home and contents premiums by $400. St George has also spent $6 m on a 4.7 km levee.

At Risk Frontiers we support in the proposal of Kunreuther et al. (2009) who state that:

> *Insurance premiums should be based on risk in order to provide signals to individuals as to the hazards they face, and encourage them to engage in cost-effective mitigation measures to reduce their vulnerability to catastrophes.*

and

Any special treatment given to homeowners currently residing in hazard-prone areas (i.e. low-income, uninsured or inadequately insured homeowners) should come from general public funding, not through insurance premium subsidies.

Although losses from natural disaster events in Australia are not yet causing significant imbalances to the economy and / or human activity relative to some other less fortunate countries, these losses are expected to continue to grow as wealth and populations at risk continue to increase. Abating these rising costs of insurance and economic losses arising from natural disasters will require difficult choices that, as a society, we have for the most part been reluctant to face.

Some concluding remarks and suggestions follow:

1. Hazard and risk data be made available to the public, land-use planners, government, emergency managers and developers to enhance decision making across the board. (Risk Frontiers did approach the previous government about making its databases available to the public but they seemed to have little appetite for this.)

2. Whilst natural disasters themselves cannot be avoided, there is a lot that could be done to reduce the impact and cost of these events:

   o Education: All New Zealand children are taught about earthquakes and what to do when they happen. We suspect few children in Western Sydney understand the flood risk in the Hawkesbury-Nepean catchment, for example.

   o Risk communication: In view of past failures in risk communication, new approaches are needed. Need to engage the community – citizen's juries and citizen science

   o Economic incentives for mitigation to reduce the number of properties exposed to natural disasters. Mitigation funding should be considered as a policy tool much like post disaster relief payments.

People often choose not to mitigate due to their personal financial constraints.

  o Risk-informed land planning. Governments play an uniquely important role in land use planning in deciding what activity a particular parcel of land can be used for. However, it is our understanding that even when both councils and emergency service object to new development on the basis of risk, these objections are often dismissed in the Land & Environment Court. (Risk Frontiers is currently considering exploring this issue in NSW.)

3. Building codes be revised when new information and technology comes to light. The recent floods in Brisbane have highlighted the fact that many modern buildings have been built as 'slab-on-grade' and have floor levels much lower than more traditional Queenslanders.

4. Government policy should be consistent (and coherent) across all levels: federal, state and local.

5. Governments should encourage a viable private insurance sector and in particular, support insurance premiums that reflect actual risks. Communities potentially face restrictions on the supply of private insurance if insurers are unable to charge a fair price for their policies.

6. The government consider subsidising risk-based premiums for residents already living in extreme hazard-prone areas to deal with the legacy problem; people who later decide to move into the area should be charged market premiums reflecting the real risk.

7. Make hazard information available to the public especially at the point of sale of properties. Risk Frontiers would be pleased to help in this respect in partnership with Government.

References

Australian Bureau of Statistics (2009) http://www.abs.gov.au/ (last accessed June 4 2014).

Crompton, R. P. & K. J. McAneney (2008) Normalised Australian insured losses from meteorological hazards: 1967-2006. *Environmental Science & Policy,* 11**,** 371-378.

Crompton, R. P., 2011. *Normalising the Insurance Council of Australia Natural Disaster Event List: 1967–2011.* Report prepared for the Insurance Council of Australia (ICA), Risk Frontiers.

Kunreuther, H. C., E. O. Michel-Kerjan, N. A. Doherty, M. F. Grace, R. W. Klein & M. V. Pauly. 2009. *At War with the Weather*. The MIT Press.

Musulin, R. T. (1997) Issues in the regulatory acceptance of computer modeling for property insurance ratemaking. *Journal of Insurance Regulation,* 15**,** 342-359.

Musulin, R. T., R. Lin & S. Frank. 2009. Dealing with the axis of financial destruction, demographics, development and disasters. In *Beyond PML: Frequency vs. Severity* ed. N. Britton, 77- 95. Gold Coast, Australia: Aon Benfield Australia.

Pielke Jr, R. A., J. Gratz, C. W. Landsea, D. Collins, M. A. Saunders & R. Musulin (2008) Normalized hurricane damage in the United States: 1900–2005. *Natural Hazards Review,* 9**,** 29-42.

Roche, K., McAneney, K.J. Chen, K and R. Crompton, 2011. The Great Australian Flood of 1954: cost of a recurrence. *Weather, Climate and Society,* 5: 199-209.

Appendix A

Briefing Note 272
Can Government policy on mitigation and post-event
funding lead to Moral Hazards?

Can Government policy on mitigation and post-event funding lead to Moral Hazards?

This briefing note is based largely on the Appendix of Jaffe and Russell (2013), a paper on the welfare economics of catastrophe losses and insurance. Both authors are economists from University of California, Berkeley, and have written widely on insurance-related problems. This note illustrates how insightful a simple payoff matrix can be in helping to explore complex problems and situations (games) between non-cooperative players. The original analysis and introduction of the term 'Samaritan's Dilemma' came from Buchanan (1975). There is not necessarily an optimum solution for both parties and the analysis assumes rationality. (Rob Van den Honert and John McAneney)

The desire to provide help to victims of disaster is a natural part of the human condition, but, unfortunately, such Samaritan aid inevitably interferes with the *ex ante* incentives of the victims to help themselves (Buchanan, 1975). This gives rise to a problem called *time inconsistency*. As Kunreuther and Pauly (2006) note, although this concept was developed by Kydland and Prescott (1977) to deal with the design of macroeconomic policy, time inconsistency is a ubiquitous policy problem; indeed Kydland and Prescott used the problem of the design of a programme of flood relief to motivate their treatment of monetary policy.

As originally set out by Buchanan, the Samaritan's Dilemma can be viewed as a 2 x 2 simultaneous matrix game with the payoffs shown in Table 1. It is helpful to think of these payoffs as a ranking of outcomes of preferences for each of the players, on a scale from 1 to 4, where 4 represents the best outcome.

Table 1: *Samaritan's dilemma – ranked outcomes*

	B_1 - Work	B_2 – No work
A_1 – Provide help	4,3	3,4
A_2 – Provide no help	2,2	1,1

Here player A is a potential Samaritan, while player B is in need of help. A has two strategies: A_1, "help", say, by providing a money transfer, and A_2, "do not help". B has two strategies, B_1 "work", and B_2 "don't work". A's payoffs are listed first.

The game has a dominant strategy pair, A_1B_2 (i.e. player A will provide help, player B does not work). Thinking strategically, the victim, B, knowing that help is imminent (because B knows that A is a Samaritan, and will want to help), shirks work, thus failing to help himself.

The essence of this game can be transferred to the policy design problem for *ex post* catastrophe relief. Consider the payoffs to a government which is considering A_1, a policy of providing a finite, budget-constrained amount of relief, or alternatively A_2, a policy of no relief.

The efficacy of these two policies depends on the expectations of the victims. When the victims expect that the government will *not* undertake relief, call this expectation B_1, they will themselves mitigate the potential loss. But if they expect the government to provide relief, call this expectation B_2, they have no incentive to mitigate, and will not do so. Looking at the payoffs to the government we again have a 2 x 2 matrix of payoffs. We assume that the government is concerned with the welfare of the victims, with payoffs as in Table 2.

Table 2: *Government relief and mitigation efforts – ranked outcomes*

	B_1 – Expect no relief, and therefore mitigate	B_2 – Expect relief, and therefore do not mitigate
A_1 – Provide relief	4	2
A_2 – Provide no relief	3	1

The best outcome for the government (4 on a scale from 1 to 4, where 4 is the best) is $A_1 B_1$, in which they provide budget-limited top-up relief funding for private mitigation efforts to the extent that they did not fully protect against the catastrophe. The worst outcome is $A_2 B_2$, in which the citizens make no plans for the disaster and the government provides no relief.

The ordering of the other two outcomes, $A_2 B_1$ (no government help, but private citizens mitigate) and $A_1 B_2$ (government help, but no private mitigation) depends on the effectiveness of private mitigation versus the amount of relief which a budget-constrained government can afford. An interesting case is the ranking in Table 2 in which private mitigation leads to a better outcome than a government can provide with limited relief.

This case is an example of a decision-theoretic problem called 'Newcomb's problem' (see Broome (1989)). This problem arises when a decision maker must make a decision choice such that its payoff is affected by whether or not its action was *anticipated* by another rational agent with good predictive powers. In this case, as here, no single uniquely-best rational course of action exists.

To see this, we ask what, in this case, should government policy be? If we assume that individuals correctly anticipate government action, then if the government provides relief, it will have been expected, and no mitigation will have been undertaken ($A_1 B_2$ in Table 2). From the government's perspective (and the community's), this outcome is worse than when government relief is not expected, and losses are reduced by the actions of the potential victims ($A_2 B_1$ in Table 2). This calls for a rule of "provide no help".

However, this framework permits another way of reasoning. Before the government acts, people will have already formed their expectations, and will either have mitigated or not. No matter which, the results of providing relief are better than the results of not providing relief (a ranking of 4 is better than a 3, and a ranking of a 2 is better than a 1). Therefore the government should provide relief.

The optimal rule à la Kydland and Prescott is a rule of "provide no help" – the opposite of the argument above. But having adopted such a rule, with the mitigation in place, it would seem appropriate to break the rule and provide relief. As Frydman et al. have argued, the first casualty of this *time inconsistency* problem is rational expectations itself. Since there is no obvious *single* best course of action for the government, it is not possible for the agents to have rational expectations regarding it.

References

Broome, J. (1989) An economic Newcomb problem, *Analysis* 49(4): 220–222.

Buchanan, J. M. (1975) *The Samaritan's Dilemma*, <u>in</u> E.S. Phelps (ed.) *Altruism, Morality, and Economic Theory*, New York: Russell Sage foundation, pp. 71–85.

Frydman, R., O'Driscoll, P. and A. Schotter. (1982) 'Rational expectations of government policy: An application of Newcomb's problem', *Southern Economic Journal* 49(2): 311–319.

Jaffe, D. and T. Russell, 2013. The welfare economics of catastrophe losses and insurance. *The Geneva papers* 38:469-494.

Kunreuther, H. and Pauly, M. (2004) Neglecting disaster: Why don't people insurance against large losses, *Journal of Risk and Uncertainty* 28(1): 5–21.

Kydland, F.E. and Prescott, E.C. (1977) Rules rather than discretion: The inconsistency of optimal plans, *Journal of Political Economy* 85(3): 473–491.