KPMG
cutting through complexity

Risk Apportionment in the Insurance Sector

Prepared for Suncorp Group

FINAL REPORT

27 March 2014

Disclaimer

Inherent Limitations

This report has been prepared as outlined in the Scope Section. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, Suncorp Group management and personnel consulted as part of the process.

KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

Third Party Reliance

This report has been prepared at the request of Suncorp Group in accordance with the terms of KPMG's engagement letter/contract dated 24 February 2014. Other than our responsibility to Suncorp Group, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

Forecasting Disclaimer

Any economic projections or forecasts in this report rely on economic inputs that are subject to unavoidable statistical variation. They also rely on economic parameters that are subject to unavoidable statistical variation.

While all care has been taken to account for statistical variation, care should be taken whenever considering, using, or relying on this information.

Any estimates or projections will only take into account information available to KPMG up to the date of the deliverable and so findings may be affected by new information. Events may have occurred since this report was prepared, which may impact on it and its findings.

Contents

Executive Summary

Recent periods of severe and numerous natural disasters have stressed the current system for risk apportionment. Pricing methods for insurance which take into account the likelihood of these events in the future have meant insurance is becoming unaffordable for some sections of the community. A comprehensive review of the current system and possible options for risk apportionment or minimisation is required.

The current system for risk apportionment is characterised by individuals seeking to minimise their own financial risk through the use of insurance, and has seen government outlay required where insurance cover does not exist or is insufficient. Although mitigation projects undertaken to minimise physical risk impacts are occurring these are limited and uncoordinated.

In this document we refer to pool systems to reference structures which coordinate, typically through some form of government coordination, the financing of risk outside of open market competition. There are many global examples of pool systems. Pool systems may be appropriate in particular circumstances, but evaluation is required to consider the unplanned effects when a pool system removes the price signal and lacks explicit mechanisms that aim to minimise risk. Where participants have some ability to control the risk, removing the price signal can result in increased risk overall. A pool system may be appropriate where the likelihood of an event is of equal likelihood across the whole pool or across the majority of that pool, and therefore it is reasonable for participants to share the contribution to risk equitably. In that case, arguably, the pool will not remove incentives to mitigate risk as the pool shares in the benefits of risk mitigation.

Our study identifies that a program of structured mitigation has significant upside and could be of greatest benefit where it is targeted to highest risk areas. The potential savings are demonstrable through numerous case studies.

Central to our review is the qualitative analysis of each of the three alternative risk apportionment strategies, and an empirical analysis using a comparative static, computable general equilibrium (CGE) model to test the material impacts on the economy from switching from the current structure to either a pooled insurance system or a publically mitigated system. KPMG's latest CGE model, FLAGSHIP, was developed over the past two years and is based on the most up-to-date detailed data available from the Australian Bureau of Statistics.

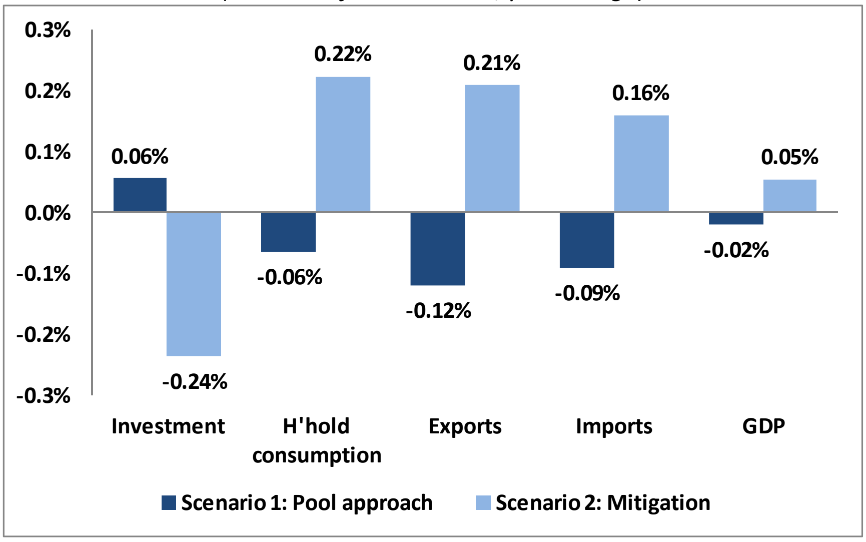
The baseline in the CGE model already reflects the current situation, which assumes continuation of current natural peril risk exposures (i.e. no increase for land use patterns and or other factors such as climate change). This means that the modelling results present the impact of an event if two alternative risk mitigation strategies were in place, in comparison to the impact of the event under the status quo.[1] Thus, under this CGE approach, the baseline scenario of continuing the current structure is effectively a no change scenario.

[1] Say, for illustrative purposes that an event leads to 5% lower GDP, the modelling results will show how this impact on GDP would vary as a result of the alternative strategies (So a result showing 1% lower GDP means that the event would have 1% more GDP loss compared to what it would have had under the baseline. That is, the overall impact of the event would be -5% + -1% = 6% lower GDP under that strategy).

The CGE economic assessment of the impact of a pool system or structured mitigation relative to the current system demonstrates the following:

- A pool system is expected to lead to higher costs from a 1-in-10 year catastrophe, which negatively impacts capital stocks, leading to a lower GDP compared to baseline. Investments (and returns) increase in response to this fall in capital stocks (largely in reconstruction activities), further drawing resources away from consumption and trade.
- Structured mitigation is expected to lead to a reduction in the costs from a 1-in-10 year catastrophe, which lessens the negative impact on capital stocks, leading to a higher GDP compared to baseline. Investments (and returns) are lower in response to the relatively higher capital stocks (as less reconstruction activity is required), while the additional productive capacity in the economy flows through to benefits in consumption and trade.

Figure 1: Key modelling results - impact in the year of the event (or every ten years) total accumulated cost of the pool/mitigation over ten years and the total cost of one event (deviation from baseline, percentage)



Source: KPMG modelling

Key findings from the qualitative research include:

- Globally, a number of insurance pools have been established in response to risk exposure from earthquakes. The insurance pool provides coverage to the affected population and is coupled with regulated improvements in building standards. Each pool is unique and there is no one common or prevalent model. The pools that appear most effective cover risks that are prevalent to all or the majority of the populace and those that are not at this time subject to strong mitigating actions and controls (for example earthquake risk) in respect of property damage
- A comparative insurance pool is established in the USA to provide flood insurance at subsidised rates to high risk areas. Mandatory mitigation activities have not been successful in lowering the exposure in high risk areas. The scheme is in substantial deficit ($24 billion USD) and does not appear to be financially viable.
- These case studies highlight the likelihood that financial risk from natural disasters is unlikely to decrease following the implementation of an insurance pool, and there is strong evidence that subsidised premiums act to mask the value of risk mitigation in the absence of compensating mechanisms. There is also concern that pools can create disincentives to risk adaptation and mitigation.

- Within Australia, natural disaster perils are not evenly spread or prevalent to all. Uncertainty and unpredictability around natural hazards has been reduced due to advancements in modelling technology and the funding of specialised research facilities, which is highlighting this position to consumers.
- Pre-disaster mitigation strategies have been demonstrated to be cost-effective when comparing the upfront cost of mitigation to the reduction in potential losses they provide. This can be quantified in the Benefit Cost Ratio for specific projects.

From the findings in the economic modelling, with support from the qualitative research, we conclude that:

- The disparate exposure to natural disaster risk in exposure does not appear to readily lend itself to national level pool solutions, particularly in respect of flood, cyclone and bushfire risks.
- The pool system performing worse than the baseline scenario supports the continuation of the current system of risk apportionment as the most effective method of financial risk transfer.
- Over the long term government investment in natural disaster management can have the greatest economic value in structured mitigation programs, rather than post disaster assistance.

1. Introduction

Financial risk from a natural disaster is shared in varying proportions between the Government, Business and Households. The upward trend in overall losses as a result of natural disasters experienced has resulted in challenges to those providing financial relief. As such, there is growing impetus to determine how best to manage and share the risks associated with catastrophic events.

A well functioning financial system relies on maintaining accessibility of financial risk management alternatives to those exposed to risk. Underlying this risk sharing are embedded certain assumptions, which are currently being tested due to increasing costs, improvements in technology and resulting unaffordability of insurance as a means of financial risk transfer. Part of the insurer role is the emphasis of risk management principals and to ensure that as a nation we retain focus on the value of risk mitigation[2].

1.1 Objectives

The structure of Australia’s insurance industry frames the way in which risks are apportioned across society and is a major component of the nation’s resilience to natural disasters.

The objective of this study is to examine how effective the current structure is comparative to alternative risk apportionment options. More specifically, the study aims to compare the relative costs and benefits from an economy wide standpoint of the current insurance market relative to the expected outcomes under a pooled insurance market and a government led mitigation alternative. This is achieved by a qualitative analysis of each of the three alternatives as well as an empirical analysis using a comparative static, computable general equilibrium (CGE) model to test the material impacts on the economy from transitioning to a pooled insurance system versus a publically mitigated system.

1.2 Scope

Technological advances have enabled a fundamental change in the understanding and hence the visible cost of weather related natural disaster risks and exposures at very granular levels. KPMG have been engaged to write a report in this context to:

- provide an analysis of the current system of risk apportionment across the Australian insurance sector;
- provide commentary on alternate approaches to risk apportionment within Australia and internationally; and
- undertake economic modelling of alternative models to estimate the net cost/benefit of alternative approaches compared to the current system.

The scope of the study has been limited to an Australian focus covering all weather related natural disaster phenomenon. The empirical analysis captures economy wide impacts and the investigation into insurance alternatives has been conducted on an industry level.

[2] Insurance Council of Australia's Property Resilience Exposure Program

1.3 Methodology

The two risk apportionment alternatives being considered in this paper are a pool insurance system (coordinated by government), and government led structured mitigation.

Insurance can be viewed as a mechanism through which risk is pooled. In this report, references to an insurance pool, pooled insurance market and pool system refer to risk financing structures operating outside open market competition. Example structures include those operated or coordinated by government and insurance markets working within government led intervention – such as compulsory underwriting rates that cross-subsidise high-risk areas.

Within our modelling we are referring to a hypothetical insurance pool established for the cover of risks arising from natural disasters.

The qualitative study on these two approaches (Section 3.2 and 3.3 respectively) involved desktop research into currently existing schemes and case studies. The output of the qualitative study was the development of assumptions which could then be used in the quantitative assessment to test the effect each alternative would have on the overall economy, relative to a base scenario representing the current system.

The economic assessment (Section 4) tests the performance of both scenarios in the event of a major natural catastrophe occurring in year 10, relative to the current system of insurance coverage and government support. The approach uses KPMG's existing in-house CGE model, which itself is based on a modelling framework established over a number of decades as a base for investigations such as this. The CGE Model used allows for the relative impact of each alternative on economic performance to be modelled on a national scale.

KPMG's latest CGE model, FLAGSHIP, was developed over the past two years and is based on the most up-to-date detailed data available from the Australian Bureau of Statistics. FLAGSHIP brings together 80 years of combined modelling experience (gained with the world's pre-eminent economic modelling institutions, and in economic policy advice and research roles with several international governments), the latest theoretical developments in the field and a database constructed from the latest available data. The model embodies an array of features that enhance its utility in policy and economic modelling, including sophisticated economic and behavioural assumptions (further discussed in Attachment A). This makes CGE modelling the most appropriate tool to use when assessing the economy-wide impacts of any policy or economic shock.

The data used to design the CGE simulations were sourced from a variety of databases including Australian Government Budget, the Insurance Council of Australia, the Australian Prudential Regulation Authority and Suncorp. We also tested the sensitivity of the results to some of the key assumptions input into the modelling as part of the analysis (discussed in Section 5).

1.4 Report structure

The remainder of this report is structured as follows.

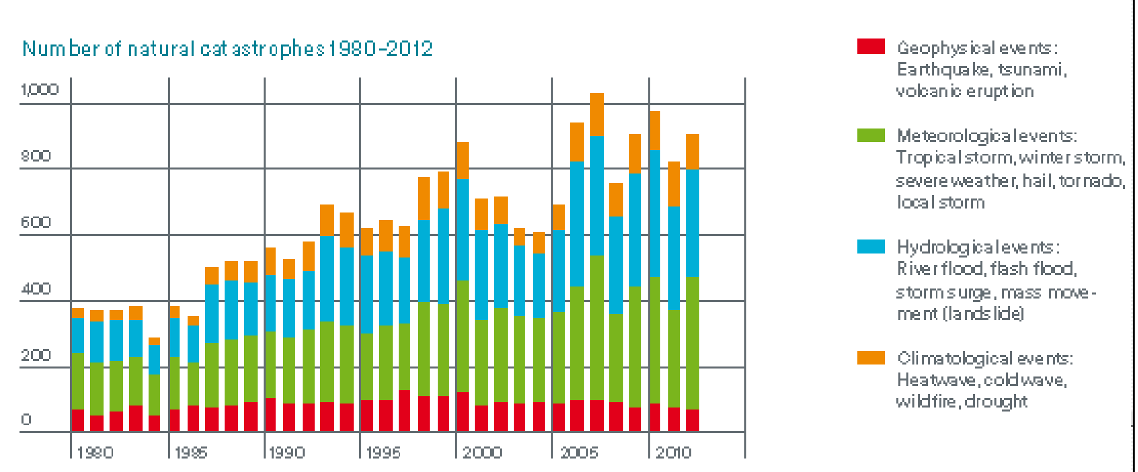
- ***Section 2 Background*** - This section establishes the context of the study and the key dynamics that have informed our research.
- ***Section 3 Risk Apportionment Alternatives*** - This section provides a detailed examination of three risk apportionment models: Current system, Insurance Pool Alternative and Structured Mitigation.
- ***Section 4 Economic Assessment*** – This sections details the assumptions and approach used in the economic assessment and the detailed results from the General Equilibrium Model.
- ***Section 5 Discussion*** - This section considers the output from the economic modelling in the context of the full report.

2. Background

2.1 Rising costs

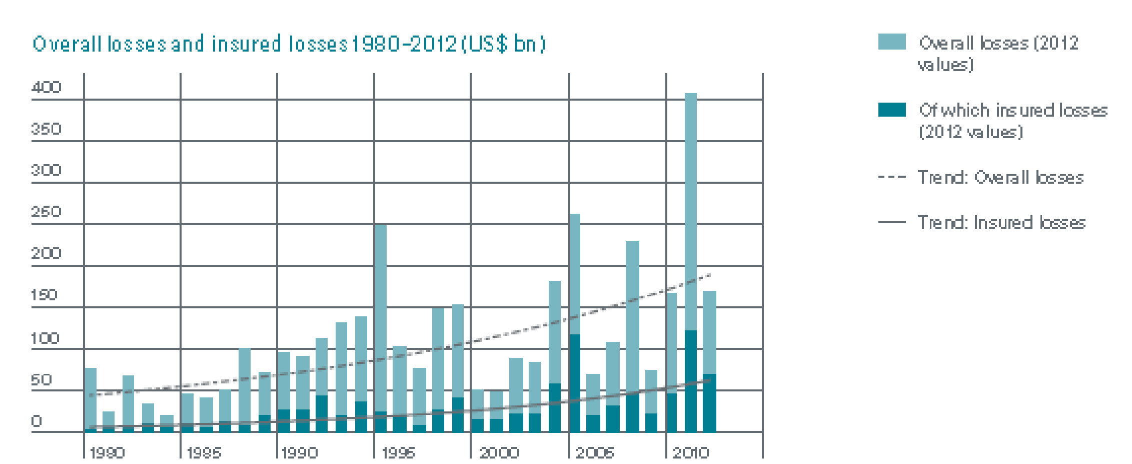
According to the Institute of Actuaries of Australia (2010), global trends in disaster incidences have shown a significant rise in the frequency of shock events (by number, see Figure 2-1) over the last 60 years. This trend is most prevalent since the 1980s and is forecast to continue into the future. In addition to this expected rise in frequency, the severity of natural disaster events in terms of damage costs has also been increasing (see Figure 2-2). This is largely driven by the effects of population growth, increases in the concentration of infrastructure density and domestic migration to more vulnerable regions (sea changes and tree changes). These observations are reflected in other studies such as the graphs below prepared by Munich Re, a large global reinsurance company.

Figure 2-1: Number of natural catastrophes 1980-2012



Source: Munich Re (2013) "Natural Catastrophes 2012: Analyses, assessments and positions" Topics Geo

Figure 2-2: Overall losses and insured losses 1980-2012



Source: Munich Re (2013) "Natural Catastrophes 2012: Analyses, assessments and positions" Topics *Geo*

According to a study conducted by Deloitte Access Economics (2013) the economy wide cost of natural disasters in Australia was over 6 billion AUD in 2012 alone. Excluding the potential effects of climate change this was estimated to double by 2030 and increase to a per annum average of 23 billion AUD by 2050. Whether this is funded by government, the insurance sector or individuals, this represents a substantial increase in the expenditure on natural disaster assistance, placing significant pressure on the economy. An assessment is needed on the best way to minimise the overall economic impact of these events.

2.2 Principles for risk management

The general principles for risk management can be described with the following hierarchy:

- ***Avoiding or reducing*** the level of risk, by adopting alternative approaches to achieving an objective.
- ***Transferring*** the risk to another party which has greater control over the risk situation, or is less susceptible to the impact of the risk.
- ***Accepting*** some or all of the risk and developing contingency plans to manage the risk that minimise the impact should the risk eventuate.[3]

Within the context of managing the financial risks arising from natural disasters in Australia, these general principles apply. Certain actions can be taken to avoid or reduce financial loss from natural disasters, insurance is available to transfer a portion of the financial risk; and any remaining risk exposure is accepted and plans are put in place to manage this impact.

2.3 Key parties

The different parties who share exposure to financial risk from natural disasters creates layers of complexity in any decision making process around reducing, transferring and accepting of risk. Financial risk from a natural disaster is shared in varying proportions between the Government, Business and Households. The Business sector includes Insurers, Banks and Business owners.

While this report has focused on the role of insurers, it is worth acknowledging that the financial risk exposure of banks through their mortgage portfolio at present also relies on the availability of insurance to the home-owner and the system is based upon a strong presumption that such cover will remain available.

The apportionment of risk for natural disasters in Australia sits largely with the Insurance Industry; supplemented by State and Federal Governments[4]. Insured losses from natural disasters in Australia average over $1.2 billion each year, supplemented by an additional per annum average $560 million from the Australian Government[5]. The Business Roundtable for Disaster Resilience and Safer Communities 2013 whitepaper indicates that by 2050, natural disasters may cost the Australian economy as much as $23 billion AUD per annum. A key question for insurers and governments that are responsible for rebuilding communities in the aftermath of natural disasters

---

[3] *Review of the insurance arrangements of State and Territory Governments under the Natural Disaster Relief and Recovery Arrangements Determination 2011*. Commonwealth of Australia, Department of Finance and Deregulation. August 2012.
[4] *Natural disasters in Australia: An issue of funding and insurance*. Chris Latham, Peter McCourt and Chris Larkin. Prepared for the Institute of Actuaries of Australia's (Institute) 17th General Insurance Seminar (November 2010)
[5] *Building our nation's resilience to natural disasters.* Prepared for the Australian Business Roundtable for Disaster Resilience and Safer Communities by Deloitte Access Economics (June 2013). http://australianbusinessroundtable.com.au/white-paper

therefore is, *'is the current approach sustainable in the face of increased frequency, intensity and costs of natural disasters?'*

2.4 Extent of structured mitigation

While investment in mitigation has been occurring in Australia for decades, implementation has occurred on a project to project basis. As such, a nation-wide mitigation strategy targeted at reducing exposure in the most vulnerable areas has not had the funding nor the granularity in natural disaster modelling to deliver a coordinated and targeted approach.

Due to the inherently uncertain and unpredictable nature of natural hazards, mitigation strategies tend to focus on reducing the vulnerability of communities (i.e. reducing the sensitivity and increasing the adaptive capacity of local communities, public assets and the services they use). In recent years this uncertainty and unpredictability around natural hazards has been reduced due to advancements in modelling technology (e.g. aerial surveys and LiDAR) and the funding of specialised research facilities such as the CSIRO Climate Adaptation Flagship, the James Cook University Cyclone Testing Station in Townsville and the Bushfire Cooperative Research Centre in Melbourne. These advances in technology and research enables more refined and localised data, which provides a clearer understanding of the extent of hazard-prone areas, the probability of events occurring, and the effectiveness of various mitigation techniques.

2.5 Loss of life

Whilst mitigation can be successful in reducing the costs of a natural disaster mitigants also play a critical role in preserving human life and reducing the occurrence of injury. In a 2007 review into the cost-benefits of FEMA Hazard Mitigation Grants in the United States, grants to mitigate the effects of floods, hurricanes, tornados, and earthquakes between 1993 and 2003 are expected to save more than 220 lives and prevent almost 4,700 injuries.[6]

Some of the worst Australian natural disasters have occurred in recent years including the 2009 Black Saturday bushfires in Victoria, the Queensland floods in 2010/11 and Cyclone Yasi in 2011. In the three years 2009 – 2011, over 200 lives were lost and hundreds of thousands of people were affected.[7] The desire to protect life and property is paramount for all Australians, driving the need for a cost-effective and long term approach to managing the risk associated with natural disasters.

The economic modelling within this paper has not taken into consideration any economic consequences associated with loss of life arising from natural disasters and we have not modelled the additional benefit that might arise from a reduction in such impacts through structured mitigation.

2.6 Pricing and risk granularity

Pricing of insurance premiums requires identification of risks associated with the asset to be covered, to allow an estimate of expected losses to be calculated. When one insurer improves its understanding of risk it can price more effectively. Those insurers that do not follow such trends will retain those higher risks that are, as a result, inadequately priced under less granular pricing

---

[6] *Benefit-cost analysis of FEMA Hazard Mitigation Grants*. Natural Hazards Review ASCE. Adam Rose; Keith Porter; Nicole Dash; Jawhar Bouabid; Charles Huyck; John Whitehead; Douglass Shaw; Ronald Eguchi; Craig Taylor; Thomas McLane1; L. Thomas Tobin1; Philip T. Ganderton; David Godschalk; Anne S. Kiremidjian; Kathleen Tierney; and Carol Taylor West, November 2007.

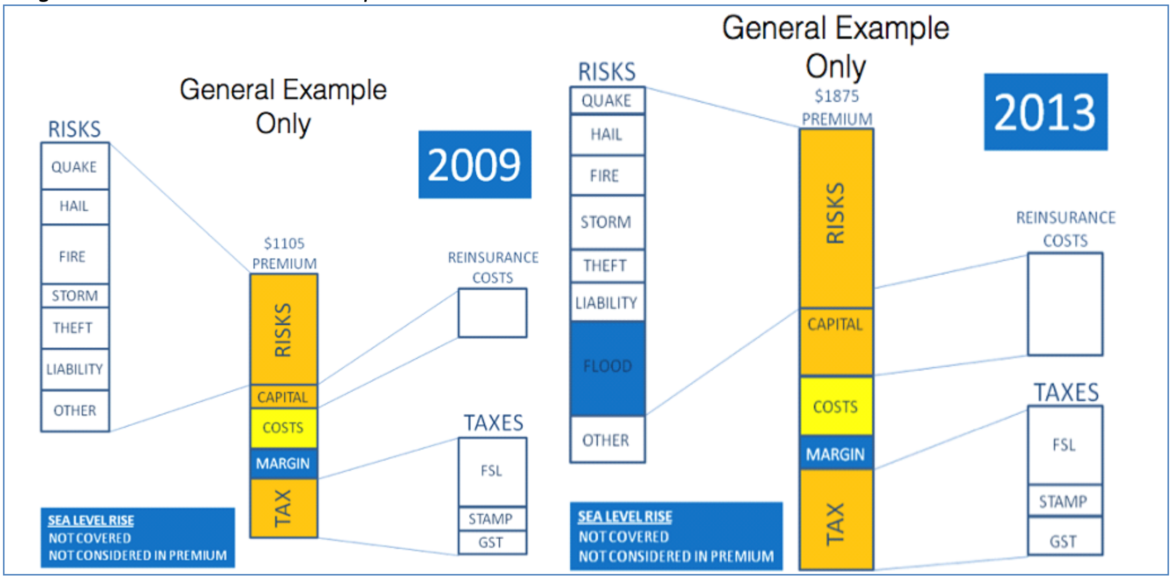
[7] *Natural disasters in Australia: An issue of funding and insurance*. Chris Latham, Peter McCourt and Chris Larkin. Prepared for the Institute of Actuaries of Australia's (Institute) 17th General Insurance Seminar (November 2010)

structures. Referred to as adverse-selection or anti-selection these features drive the insurance industry, when operating in open competitive markets to pursue an improved understanding of risk at granular levels and to price each risk accordingly.

Technological advances in modelling enable fundamental improvements in the understanding and pricing of weather related natural disaster risks and exposures. This provides increased granularity in forecasting specific risk exposure for specific houses, which leads to higher premiums for those in high-risk areas. Two neighbours may now have vastly different premiums, as the granular level of pricing now established by insurers allows for more accurate pricing of individual risks. The high risk exposure associated with flood prone localities makes the provision of private insurance challenging as in order for insurance companies to cover their risks, premiums would need to be close to the value of the expected loss payment stream.[8] In the past some insurers may have excluded flood events from their coverage, in an effort to keep premiums lower, and eliminate uncertainty associated with flood events.

The change in insurance premiums arising from the change in the assessment of risk from flooding, as well as other cost such as reinsurance is illustrated in figure below over the period 2009 to 2013.

Figure 2-3: Risk and insurance premiums



Source: Insurance Council of Australia, presentation 20 March 2014 with Edge Environment.

Premiums in some high risk flood areas are quoted at over $10,000[9]. The current alternatives to this approach, is for insurers to withdraw coverage from high-risk areas, decline to renew policies, or in exceptional circumstances, internalise costs that can no longer be backed by re-insurance at affordable prices (as reinsurers also seek to avoid anti-selection). The insurance industry faces significant challenges in balancing the need to provide affordable coverage for natural disasters (including flooding), to their customers with competitive pressures to remain profitable. Unaffordable insurance premiums exacerbate problems of non-insurance or underinsurance which result in greater sections of the population turning to government or charities to help them

[8] Sigma (2011) "State Involvement in Insurance Markets," Swiss Re
[9] Disaster insurance premiums becoming unaffordable as floods and bushfires increase. ABC Ratio national 11 February 2013. http://www.abc.net.au/radionational/programs/breakfast/more-natural-disasters-as-insurance-premiums-rise/4511192

manage the financial impact from a natural disaster. In addition, better measurement of risk allows a better measure of liability for the insurers which dictates the extent of capital required to be held. In this way, more accurate liability measurement maintains the stability of the financial stystem.

It is in everybody's interest to resolve the pricing challenges which have been brought about through the increasing accuracy in pricing of risk. If not remedied it appears that the presumption that all homeowners will have access to insurance, for example as appears to be the base assumption in the home mortgage market, will not hold going forward.

2.7 Aims

This research paper will explore the themes introduced above and investigate whether changing the apportionment of risk through the establishment of insurance pools will have a material impact on the costs to the Australian economy from natural disaster or whether investment in targeted natural disaster mitigation is a more sustainable approach to reduce overall impacts to both the economy and communities.

The investigation will draw on domestic and global case studies on risk pooling and targeted mitigation as well as economic modelling to inform out findings.

3. Risk Apportionment Alternatives

3.1 Key observations

The current system in Australia:

- Insurance is the primary mechanism by which households reduce their financial risk exposure from natural disasters. Technological advances have allowed for more accurate pricing based on individual risk exposure.
- Portions of the population remain exposed as a result of accurate pricing in high risk localities which yields unaffordable premiums.
- Underinsurance also exposes some portion of the population, resulting from numerous factors, both intentional and unintentional.
- The State and Federal governments have historically taken responsibility for providing post disaster assistance to under or non insured segments of society; however the extent of this contribution is varied.
- Mitigation has been very successful where implemented, but remains largely unstructured.

Insurance pool:

- Insurance pools have been established in a number of countries internationally to combat insurance coverage issues.
- The nature of such pools globally is varied with regard to premium pricing, exposure of underlying population and funding. No clear common themes or single model is apparent.
- Key challenges in the establishment of a pool include reduction or removal of risk sensitive price signals, reduction in risk adaptation, large financial burdens placed on governments and inequitable distribution of financial burden comparative to risk exposure.
- A flood cover insurance pool in the United States has proved financially unviable following large accumulations of public debt. This is likely to be caused by subsidised premiums failing to reduce exposure in high risk localities.

Structured mitigation:

- Targeted mitigation programs have been successful in reducing the impacts and costs of natural disasters in communities and seen significant reductions in insurance premiums.
- Recent advancements in technology are allowing risks to be more accurately identified, priced and managed.
- A sufficiently incentivized community, with access to funding can lead the coordination of mitigation programs at a regional level and effectively drive down the cost of insurance premiums. There are many examples where individuals, communities and insurers have taken such steps even in the absence of government structured mitigation.
- Communities need to be educated in the benefits of mitigation and including the return on investments that can be expected from investment in risk reduction. A key barrier against households (and governments), investing in risk mitigation is the up-front cost relative to other investments (i.e: education, transport infrastructure) and the perceived benefits of these actions.

3.2 The current system

The current system of disaster risk apportionment in Australia is characterised by the sharing of risks between insurers, the government and households. While the insurance industry captures a large segment of these risks, the ability to cover high to extreme risk households is limited by financial capacity and the competitive drivers to avoid anti-selection as risk is understood at more granular levels. As such, the government's role in providing post disaster assistance has become increasingly significant in supporting disaster prone communities. Furthermore, while some households have taken responsibility for some of the risk exposure of their properties by engaging in private mitigation, such activities remain largely unstructured. As a result the pool of risks associated with natural catastrophes is larger than if mitigation was formally recognised as a significant policy priority, placing greater financial strain on government resources.

3.2.1 Insurers

The insurance industry is critical in allowing the economy to manage financial risks and reduce the financial uncertainties associated with natural disaster events. The availability of sufficient reinsurance is critical for insurers to be able to provide cover for properties. Reinsurance is particularly important in managing exposure to natural disaster as risk of loss is generally well known and generates highly correlated claims. The diversified risk portfolio of reinsurance companies allows them to bear some of the risk of loss from natural disasters at a lower cost, ultimately allowing primary insurers to expand their coverage capacity. For the costs of reinsurance to be sustainable premiums must be in equilibrium with payouts with an additional allowance for profit, it is critical that the level of risk associated with a property is not under-reflected in the insurance premium. In addition sufficient capital must be available to respond to the accumulated risk following a natural disaster event. As insurers and reinsurers must dedicate capital to these accumulations, noting they must also pass off some of that risk, the premium charged must ultimately provide a return on the capital committed at each level. The principals of the capital that must be held to protect against insurers largest insurance risk concentration are well illustrated through the role this element plays in the APRA capital regime through both a vertical and horizontal natural perils assessment.[10]

3.2.2 Insurance challenges

Coverage

Typically, all home and contents insurance policies in Australia include compulsory cover for bushfires, earthquakes and storms. As a result the economy was able to recover rapidly from the losses associated with natural disaster events such as the 2009 bush fires in Victoria and cyclone Yasi in 2011. Until relatively recently, flood cover however was generally excluded and frequently offered on an opt-in basis (Natural Disaster Insurance Review, 2011). This generates a coverage problem. According to the Australian Insurance Contracts Regulations, a flood is defined as "*the covering of normally dry land by water that has escaped or been released from the normal confines of any of the following: a lake, a river, a creek, another natural watercourse, a reservoir, a canal or a dam.*[11]

[10] APRA Prudential Standard GPS 116, Capital Adequacy: Insurance Concentration Risk Charge
[11] *Australian Insurance Contracts Regulations* http://www.comlaw.gov.au/Details/F2012C00369, last amended June 2012

If households do not have flood cover then the financial burden of post disaster restoration falls into the hands of the individual who must bear the costs themselves or rely on governments schemes such as the Australian Government Disaster Relief Payment (AGDRP)[12] , to relieve the cost burden. This can lead to severe personal and financial distress with potential flow on effects throughout the wider community.

The polarised exposure of properties to flood risk underpins this issue – the vast majority of Australian homes have minimal exposure to flood risk while a small proportion have a known (and likely), exposure to extreme flood risk. When these high risk properties are priced by insurers the premiums matching specific risk exposure are often so high that coverage is in practice unaffordable. In contrast, a larger proportion of homes are exposed to storm and bushfire risk, however uncertainty regarding where these natural disasters may occur and the likelihood of occurrence reduces the actuarial risk associated with these properties and hence coverage for these natural disasters is at present more accessible and affordable.

In an attempt to correct the flood coverage problem, insurers have begun incorporating flood cover into policies, leading to increases in the cost of insurance premiums which has in turn forced many of the most vulnerable households out of the market. According to the National Disaster Insurance Review "those most exposed to the risk of flood are the least likely to purchase it"[13]. This generates a problematic set of circumstances; if insurance companies price their premiums correctly then existing customers in high risk localities may 'drop-off' leading to an underinsured or uninsured market and hence an increase in the cost to government to cover the uninsured 'gap' for recovery. If insurance companies keep premiums at a more competitive level however, they will themselves bear the financial risks associated with a potential disaster event and risk financial insolvency.

We note that as modelling improves the understanding of bushfire and cyclone exposures the premiums for these risks will also in time become more concentrated on specific areas and homes. Such patterns have already emerged, for example in respect of Strata dwellings (without retro-fitting to new standards) in North Queensland becoming difficult to insure due to cyclone risk. We are also aware of increased examination and modelling of the proximity of homes to bush areas as insurers further refine the understanding of that risk.

We therefore expect that the current issues in respect of flood cover and those emerging for Cyclone risk will become an even more pronounced issue for high-risk homes.

Non-insurance

Non-insurance is a situation where a person either does not have an insurance policy, or an insurance policy is held but an event occurs which is excluded from coverage.[3] The extent of non-insurance has been difficult to measure and is likely to vary across Australia due to different exposure to risks as well as socioeconomic factors. The Insurance Council of Australia estimates that currently 3.8% of Australian homes and 29% of contents are not insured. However, within the portion of the market who hold insurance cover for home and contents, close to 10% of policies do not include flood cover[14]. These estimates appear low compared to the findings of the Victorian Bushfire Royal Commission.

[12] *Australian Government Disaster Recovery Payment website.* http://www.humanservices.gov.au/customer/services/centrelink/australian-government-disaster-recovery-payment. Accessed March 2014.
[13] *Natural disaster Insurance Review – Inquiry into flood insurance and related matters.* The Australian Government the Treasury (September 2011). http://ndir.gov.au, p2.
[14] Insurance Council of Australia Flood Cover as at 31 March 2013.

The Victorian Bushfire Royal Commission found that 13% of properties destroyed by the Black Saturday bushfires may not have had insurance. This percentage is likely to be higher in the case of flooding as discussed in the previous section. Non-insurance occurs due to lack of coverage by insurers, unaffordable premiums, the underestimation of the risk that an event will have consequences that warrant insurance or 'moral peril' (where by individuals believe that in the event of a disaster, Governments will provide the financial assistance they require).[15]

Under insurance

Under insurance occurs when the extent of a household's insurance coverage falls below the cost of recovery, leaving the household financially responsible for some portion of the restoration expenses. There are a number of different causes of underinsurance and these can be both intentional and non intentional. Under insurance can occur as a result of the complexity associated with estimating the correct amount of coverage required. As this task is typically left to the policyholder, who generally has no expertise in insurance, errors in estimation often occur, even when insurers provide calculations. Furthermore while insurers use indexation to adjust policies to account for changes in economic conditions it is uncommon for households to increase their coverage over time as they make improvements to their property. The Blue Mountain bushfires that occurred west of Sydney Australia in November 2013, highlighted the knowledge gap that consumers have regarding what value to place on their homes when purchasing an insurance policy. New building requirements for fire-prone areas have been in place since 2010, however the cost of these additional requirement, was not been reflected in the insured value of homes. As a result the cost of replacing a home following the fires has increased by up to AUD $100,000 and homeowners did not understand this well prior to the event.[16]

Conversely under insurance may be a premeditated decision made by policyholders in response to rising premiums. This is particularly common across households in high risk localities that recognise the importance of attaining some sort of coverage but cannot afford or do not wish to pay the premiums associated with full coverage over their properties.

Finally under insurance may result from a rise in the cost of restoration in post disaster periods. Even if coverage is accurately selected in the purchase period, a surge in the demand for restoration services following a disaster shock or changes in the regulatory requirements for new developments may push the price of construction and restoration up beyond competitive, business as usual prices. Hence coverage would not be adequate enough to fund these amplified costs.

For the above reasons, under insurance continues to be prevalent across Australian households. A study conducted by the Australian Securities and Investments Commission (ASIC) in 2005 stated that between 27 and 89 percent of households were underinsured by 10 percent or more during the Canberra bushfires of 2003. The Institute of Actuaries of Australia published a report in 2010 that estimated that 23% of the costs incurred during the Sydney hailstorm of 1999 were under or uninsured. This equates to an estimated figure of 0.5 billion AUD.[17]

---

[15] *Review of the insurance arrangements of State and Territory Governments under the Natural Disaster Relief and Recovery Arrangements Determination 2011*. Commonwealth of Australia, Department of Finance and Deregulation. August 2012.
[16] *Under-insurance a significant issue in fire devastated Blue Mountains*. ABC News. 12 November 2013.http://www.abc.net.au/news/2013-11-12/under-insurance-a-significant-issue-in-fire-devastated-blue-mou/5085040
[17] *Natural disasters in Australia: An issue of funding and insurance*. Chris Latham, Peter McCourt and Chris Larkin. Prepared for the Institute of Actuaries of Australia's (Institute) 17th General Insurance Seminar (November 2010)

3.2.3 Government

The proportion of Australian households who are uninsured or under insured is likely to grow as affordability of insurance declines in line with predicted increase in the frequency and intensity of natural disasters. Under the current system the insurance industry does not have the capacity to support the whole market, with price signals deterring high risk households from attaining coverage. Consequently, the government is assumed to have a responsibility for supporting the uninsured and under insured population to ensure they are not left to carry the full financial burden of post disaster recovery. Ultimately the government's role is two-pronged involving both pre disaster regulatory action and post disaster restoration assistance. A key question is whether the Government can sustain its role in supplementing insurance as the cost of natural disasters grows.

Building pre disaster resilience

The current system of natural disaster risk management is characterised by a fragmented framework spread across a number of different government agendas and bodies. While the Council of Australian Governments (COAG) has recognised that a "national, coordinated and cooperative effort" is critical in building Australia's resilience to emergencies and disasters[18], the current framework of pre disaster risk management is still inherently incoherent and segmented across bodies including the Australia New Zealand Emergency Management Committee, Trusted Information Sharing Network, and the National Insurance Affordability Council[19].

COAG's National Strategy for Disaster Resilience (NSDR) describes the role of the government in pre disaster risk management as comprising of three main elements (COAG Natural Disaster Resilience Statement, 2009):

(1) Education – the government is responsible for informing communities about how to reduce their vulnerability to natural disasters and how to respond to a hazard as it approaches.
(2) Support – the government is responsible for supporting communities in both preparation before a natural disaster event and in recovery following a natural disaster event. Further, the government has a role in supporting emergencies services in order to ensure they can respond effectively to any hazard.
(3) Land management – the government is responsible for implementing land management and planning arrangements that account for disaster risks and engaging in other mitigation activities, the specifics of which are not detailed.

According to the NSDR, governments of all levels are responsible for the provision of these components of pre disaster risk management with a specific focus on allocating resources to initiatives designed to respond to local conditions. The National Partnership Agreement on Natural Disaster Resilience provides approximately $27 million of funding to states and territories per annum to finance local and state initiatives.[20] Despite this focus on local action, according to local government consultations conducted by Deloitte Access Economics there is still some confusion around applying for funding which has the potential to limit the scale of local mitigation activities. Building pre disaster resilience at a local level therefore could be improved by incorporating local governments into the planning stages and educating them about how to effectively source and

---

[18] *COAG Natural Disaster Resilience Statement*, http://www.coag.gov.au/sites/default/files/national_strategy_disaster_resilience.pdf, 2009
[19] *Building our nation's resilience to natural disasters.* Prepared for the Australian Business Roundtable for Disaster Resilience and Safer Communities by Deloitte Access Economics (June 2013). http://australianbusinessroundtable.com.au/white-paper
[20] *The National Partnership Agreement on Natural Disaster Resilience* http://www.em.gov.au/npa, 2009

utilise data to better inform planning decisions. In addition to issues regarding pre disaster risk management, the coordination of local government responses to natural disaster events has also received criticism. According to a study conducted by NCCARF (2010) residents in Mackay, Queensland rated their Local Council poorly in terms of its response to the flood event of 2008, with only 26 percent rating it very responsive. Furthermore, 93 percent of residents received no warning about the onset of the flood and only 5 percent of residents would consider themselves to have been significantly prepared.[21]

Post disaster assistance

In line with the increasing severity of natural disaster events in Australia the trends of government expenditure have been increasing exponentially across all levels of government. This is estimated to continue and worsen as a result of both population growth and increasing urban densities[22].

Figure 3-1: Historical government support for natural disasters

Year Ending 30 June	Historical NDRRA Support ($ m)								
	ACT	NSW	VIC	QLD	WA	SA	TAS	NT	Total
2002	0.0	81.7	0.0	29.0	0.0	0.0	0.0	4.4	115.2
2003	16.0	53.2	30.9	3.5	0.0	0.0	0.0	0.0	103.7
2004	0.0	0.1	1.0	4.8	0.0	0.0	0.0	0.3	6.1
2005	0.0	0.0	0.1	22.8	0.3	2.3	0.0	0.2	25.8
2006	0.0	0.6	0.2	47.4	0.5	0.3	0.6	3.1	52.7
2007	0.0	0.5	50.6	157.8	0.0	0.6	0.0	7.2	216.7
2008	0.0	12.6	4.5	90.1	0.2	1.3	0.0	8.1	116.7
2009	0.0	3.8	226.4	170.3	0.0	0.0	0.0	4.2	404.7
2010	0.0	58.3	102.0	354.2	0.2	0.1	0.0	2.4	517.3
2011	0.0	71.9	126.1	1,288.8	0.8	0.1	8.9	7.7	1,504.2
2002 - 2011	16.0	282.8	541.7	2,168.7	2.0	4.7	9.5	37.7	3,063.1

Source: Department of Finance and Deregulation; *Review of insurance arrangements of states and territories under the Natural Disaster Relief and Recover Arrangements*. Historical Payouts

The current scheme of post disaster assistance is characterised by a cost sharing relationship between the federal government and the states and territories and comprises of a range of on the ground projects as well as financial aid. Resources are distributed from the federal government to the states via the National Disaster Relief and Recovery Arrangement (NDRRA). This framework establishes the conditions for funding to be granted and includes assistance to both individuals through the provision of Personal Hardship and Distress payments (PHD) and to communities which comes in the form of reimbursements to state and territory governments for 50 to 75 percent of all disaster recovery related expenses. Under the NDRRA the federal government also provides a one off financial aid payment to Australian residents who have been affected by a natural disaster both domestically and international. This financial assistance also extends to the private sector via the Disaster Income Recovery Subsidy which provides aid to farmers, small businesses and employees whose operations have been affected by a natural disaster event.

As populations grow and the cost of natural disasters increases, State and Federal Governments will increasingly face the challenge of finding sufficient funds to provide these services – a task which is most often achieved through cuts to other budgeted programs and initiatives. Following

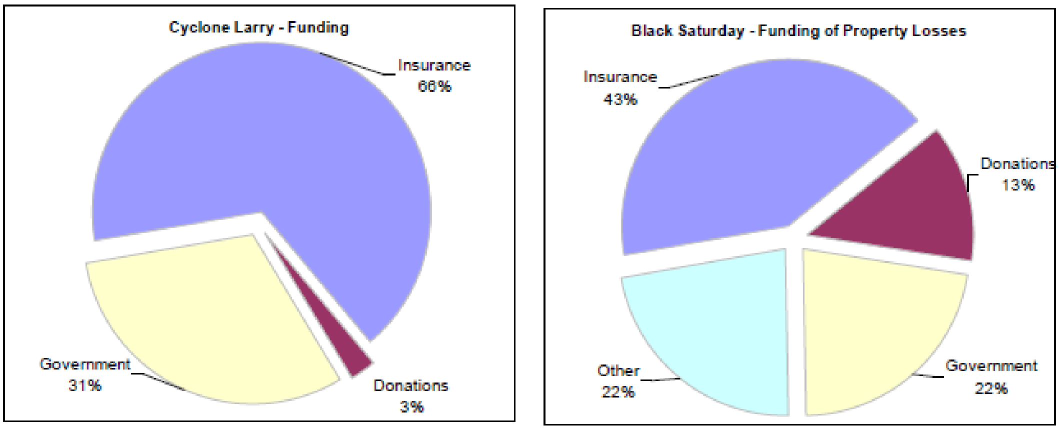
---

[21] *The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity.* National Climate Change Adaptation Research Facility (2010) NCCARF Synthesis and Integrative Research Program
[22] *Natural disasters in Australia: An issue of funding and insurance*. Chris Latham, Peter McCourt and Chris Larkin. Prepared for the Institute of Actuaries of Australia's (Institute) 17th General Insurance Seminar (November 2010)

the 2011 Queensland floods, the estimated cost to the Australian Government to rebuild Queensland was in the order of $5.6 billion AUD. To assist in reducing the cost burden, the Government introduced a temporary flood and cyclone reconstruction levy which applied during the 2011-12 financial year. Treasury estimated that the levy would raise around $1.8 billion AUD, this required a further $2.8 billion AUD to be re-prioritised and cut from established program budgets and infrastructure projects[23].

While the relative proportion of risks covered by the government versus the insurance industry varies from one disaster event to another, the government's contribution is generally substantial. With marginal assistance from charities the government acts as an insurer of last resort, funding the excess recovery that is not covered by insurance. The following charts generated by the Institute of Actuaries of Australia illustrate the mix of funding in the aftermath of Cyclone Larry in 2006 and the Black Saturday Bushfires of 2009. From both these case studies it can be observed that at least one third of the funding is not provided by the insurance industry demonstrating an inherent insurance coverage gap.

Figure 3-2: Natural disasters in Australia: An issue of funding and insurance.



Source: Chris Latham, Peter McCourt and Chris Larkin. Prepared for the Institute of Actuaries of Australia's, 17th General Insurance Seminar (November 2010)[1]
Note: Other is largely an estimate of timber losses (including plantation forests) which was included in the damage estimates made by the Royal Commission.

3.2.4 Government challenges

These two areas of government involvement prior to and following a natural disaster have been associated with several challenges, the most critical being effectiveness and budget capacity. Firstly, the regulatory framework laid out in the NDRS has received criticism for being fragmented across too many government bodies, preventing an efficient, cohesive response to catastrophes.[24] Secondly, while both the NSDR and the Select Committee for Climate Change specify businesses as playing a fundamental role in building pre disaster resilience, this potential has not been adequately realised as while cooperation between the government and private enterprise is written into the policy dialogue, it has in many cases not been fostered through regulatory action or education. The establishment of the Australian Buildings Code Board represents one example where regulatory action has attempted to ensure that the activities of businesses are in line with

[23] *Building our nation's resilience to natural disasters.* Prepared for the Australian Business Roundtable for Disaster Resilience and Safer Communities by Deloitte Access Economics (June 2013). http://australianbusinessroundtable.com.au/white-paper
[24] *See reference 23 above*

the government's pre disaster resilience objectives. This however has failed to be effective in informing construction decisions in regions vulnerable to flooding. This was evident in the Charleville, Queensland flood of 2008. The settlement plan of Bradley's Gully, Charleville has been noted as being a significant contributor to the vulnerability of the area and has remained unchanged despite the region's history of flood.[25]

There are significant challenges associated with supplementing the cost of disaster recovery. For households, the provision of post disaster government assistance has been inconsistent across historic natural disaster events generating uncertainty and, if you are assuming some degree of government support, that in turn makes pre disaster decision making difficult. This is demonstrated starkly by estimates of the Institute of Actuaries of Australia (2010). These show that government assistance contributed considerably to recovery and restoration activities following disaster events such as Cyclone Larry, 2006 and the Black Saturday fires of 2009, funding 31 percent and 22 percent of all property losses respectively. This kind of support however can't always be expected. Following the Sydney hailstorms of 1999 which generated the largest insurance cost of any single event in Australian history, the government didn't contribute any funding or aid to assist in recovery and restoration. This kind of inconsistency in government support across different disaster events is problematic for high risk households who need to make informed decisions about how to prepare for a potential disaster event and how to apportion the risks associated with their property.[26]

In addition, the use of a levy mechanism to raise finances for post disaster recovery has significant social and economic implications. It generated widespread public debate surrounding issues of inequality as households who had chosen to live in low risk localities were charged with the same cost as those households that had actively chosen to live in flood prone areas. The uniform nature of the levy did not account for differences in risk exposure and this was not received well by communities who were not exposed to any flood risks. Furthermore a uniform charge has the affect of disrupting regular incentive structures creating the potential for moral hazard to emerge. If households in high risk localities know that in the event of a natural disaster they will be charged the same as households in low risk localities then they will have no motivation to relocate or reduce the risk exposure of their property via private mitigation.

3.2.5 Modelling assumptions

The base scenario in the economic modelling assumes that the current system of risk apportionment remains in place. This includes the significant contributions of both the insurance sector and the government in the event of a major natural catastrophe. In normal years the existing equilibrium is maintained to reflect current levels of spending around premiums, claims, reinsurance and Government contributions.

In addition an assumption has been made regarding the extent of unstructured mitigation which is likely to occur as a result of the current condition of pricing risk premiums. Following the recent natural disasters, customers in high and extreme risk areas are now experiencing unaffordable insurance premiums – which can only be made more affordable through individual or Government led mitigation measures. Individual mitigation for a home in a high flood risk area, such as raising the height of the house, could reduce the insurance premium for the individual, as the risk rating is reduced. Recent media coverage has noted the substantial change in the premiums in townships

---

[25] *The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity.* National Climate Change Adaptation Research Facility (2010) NCCARF Synthesis and Integrative Research Program

[26] *Natural disasters in Australia: An issue of funding and insurance*. Chris Latham, Peter McCourt and Chris Larkin. Prepared for the Institute of Actuaries of Australia's (Institute) 17th General Insurance Seminar (November 2010)

where levees have been built as mitigation of flood risk. In this way, insurance premiums charged (or quoted) to customers act as a price signal which may result in mitigation by individuals. The potential spend on mitigation and the potential reduction in losses as a result of individual mitigation has therefore been included within the current system model.

3.3 Insurance pool: an alternative risk sharing model

3.3.1 Purpose and benefits

The issues of availability and affordability which characterise the current natural disaster insurance market have provided impetus for reform in the way in which natural disaster risks are apportioned and managed. The establishment of natural disaster insurance pools are being tested globally as an alternate risk apportionment model.

An insurance pool is a collective pool of assets from multiple insurance companies or governments designed to spread the risk exposure of each contributor. The mutually beneficial implications of such risk sharing behaviour are most starkly realised in the case of catastrophic events, when independently insurance companies would not have the capacity to respond to all damage claims or where open market competition would not naturally lead to that result.

Cummins, Doherty and Lo (2002) conducted a study of the financial capacity of the United States insurance and reinsurance industry to pay catastrophic losses. It was estimated that for a $100 billion USD catastrophe, the industry could pay up to 93% of insured losses, 84% for a $200 billion USD catastrophe and 78% for a $300 billion USD catastrophe, leaving $7 billion USD, $32 billion USD and $66 billion USD respectively in unpaid damage claims. As a result, independent insurers would face the risk of insolvency in the case of such catastrophes, a risk that could be offset via risk pooling[27].

Risk sharing schemes can act to minimise risk exposure to all participating entities via diversification which will in turn increase the financial capacity of the insurance industry at an aggregate level. In this way, pools can act to expand coverage, allowing high risk or low income consumers who were previously priced out of the market to re-enter. An effective way to allow for coverage expansion is a pooled system with mandatory participation of all the population with pricing based on the ability to pay. This ultimately acts to redistribute funds from low risk, high income segments of society to households that under competitive market conditions could not afford coverage.

3.3.2 Challenges

In theory insurance pools offer a potential solution to the issues of availability and affordability of natural disaster cover by reducing risk exposure via enforced diversification, expanding financial capacity, and broadening coverage of the market. However, whether these benefits translate in practice remains a contentious topic of debate.

Several pools that are currently in operation such as the USA's National Flood Insurance Program (NFIP) have become characterised by severe levels of public debt and a breakdown of efficient

[27] Cummins, J.D., N. Doherty and A. Lo. 2002. Can insurers pay for the "Big One"? Measuring the capacity of the insurance market to respond to catastrophic losses. *Journal of Banking and Finance* 26, 557-583.

incentive structures. This ultimately results from the inherently non-rivalrous and non-excludable nature of public goods.[28]

Risk minimisation is an outcome consistent with competitive markets that is difficult to achieve via the public provision of goods and services such as insurance. The market framework enforces effective risk reduction by applying heterogeneous charges to customers based on risk level, allowing discrimination in order to minimise adverse selection and constraining benefits to minimise moral hazard. Due to these factors, a competitive market structure allows insurers to be rewarded privately for their ability to reduce aggregate risks. Conversely governments are fundamentally unable to provide these foundations necessary for risk reduction. The inherently non-discriminatory nature of public goods prevents the control of adverse selection. The prevention of moral hazard is hindered by the Government's motivations to respond to voter interests through benefits. And the inclusiveness and scale of Government insurance prevents efficient risk aggregation.[29]

This conclusion is supported by studies conducted by the United States Government Accountability Office (GAO) into the structural inefficiencies of the current NFIP. After accruing 24 billion USD in debt the program was reviewed and integration into the private sector has since been encouraged. Along with the privatisation of the NFIP, the GAO suggests eliminating subsidized premium rates to reinstate competitive pricing that reflects real risks such that individual property owners pay for the risks associated with flood damage rather than taxpayers. Currently, high risk properties in this program have been granted premium subsidisation of up to 60 percent.[30] This subsidisation of premium rates prevents property owners from responding to real price signals and consequently dampens incentives to engage in private mitigation which may ultimately amplify damage costs comparative to those that would prevail under competitive market conditions. The GAO believes that if flood cover is distributed privately these inefficiencies and the associated moral hazards will be reduced. In order to regulate against these moral hazards the NFIP previously required communities to engage in mandatory mitigation activities as a prerequisite to be eligible for flood cover. Such mitigation was required to be cost effective and government approved, however as these mitigation efforts were driven by regulatory forces rather than incentives structures they were inefficient, never exceeded minimum requirements and were difficult and costly to monitor, cementing the NFIP's indebtedness.

3.3.3 Implementation challenges

The perceived benefits of pooled insurance in the context of natural disaster events, has driven the establishment of several insurance pool schemes internationally, often as a result of the realisation of severe financial distress following a natural catastrophe. We note as an example that effectively the combination of the NDRRA and tax levied in 2011/12 established that outcome in Australia after the events of late 2010 and early 2011.

[28] United States Government Accountability Office, Strategies for Increasing Private Sector Involvement, 2014, http://www.gao.gov/assets/670/660309.pdf

[29] *The Government, the Market, and the Problem of Catastrophic Loss.* Priest. G .L (1996). Journal of Risk and Uncertainty, 12:219-237, 1996 Kluwer Academic Publishers

[30] *Extreme events require a disaster scheme.* Anthony Bergin (2011). Australian Strategic Policy Institute

The structure, scope and operations of such schemes vary considerably from case to case with no standardised framework being regarded as most effective. A summary of a number of existing pools is included in Appendix C. The key implementation challenges identified with risk pooling can be summarised as:

1. Disruption of the price signals that are inherent in competitive markets generating moral hazard which may reduce private mitigation or migration to low risk localities.
2. Inequitable distribution of financial burden occurs when pooling is used in situations where risk exposure is not evenly distributed.
3. At a macro level reduced level and pace of risk adaptation.
4. Large financial burdens placed on governments in order to expand coverage to high risk households. There is therefore a need to establish platforms through which funds or contributions are gathered from the public and the need to examine the extent to which additional capital is retained by government to back the risks assumed (akin to the regulatory capital required of insurers).
5. It is difficult to conclude on the individual effectiveness of a pool insurance scheme, as they are often established to meet a social need, and so a financial assessment may not be appropriate. The current schemes and the scheme proposed by the National Disaster Insurance Review are summarised in the table below including an assessment against these challenges identified (1-4).

Figure 3-3: Example insurance pool schemes currently in operation

Scheme	Country	Govt involvement	Funding	Compulsory participation	Implementation Challenges			
					Priced premiums (1)	Proportion of population exposed to potential event (2)	Ability for individuals to minimize risk (3)	Financial viability (4)
EarthQuake Cover	New Zealand	Yes	Disaster Insurance Premium (levy).	No	Yes (cross-subsidised)	Majority	Minimal beyond meeting building standards.	Current deficit $1.4bn. Higher levy implemented to help recover funds following very material (in excess of 20% of GDP) claims.
Flood Re	United Kingdom	Yes	Levy imposed on insurance companies which is reflected in higher premiums.	No	Yes	Many	Yes - household flood mitigation is possible but not encouraged by the eminent introduction of Flood Re. Since 2010 21% of new houses built in London are in high flood risk areas.	The scheme is yet to be implemented. While it will be established as being dependant on government funds, it is envisaged that the scheme will ultimately become self sufficient.
National Flood Insurance Program	United States	Yes	United States Government	No	Yes, however subsidized premiums are available for high risk households.	Minority	Yes	The program has accrued 24 billion USD in debt.

Scheme	Country	Govt involvement	Funding	Compulsory participation	Implementation Challenges			
					Priced premiums (1)	Proportion of population exposed to potential event (2)	Ability for individuals to minimize risk (3)	Financial viability (4)
Turkish Catastrophic Insurance Pool (primarily for earthquake risk)	Turkey	Yes	World Bank and Turkish Government	Mandatory according to a decree law however this has little weight as no sanctions can be imposed to enforce participation.	Yes, however subsidized premiums are available for high risk households.	Majority	Minimal beyond meeting building standards.	The scheme has a 4 billion USD claims paying capacity and is backed by the World Bank.
California Earthquake Authority	United States	No	CEA premiums	No	Yes	Majority	Minimal beyond meeting building standards.	As the scheme is not backed by the United States government, financial pressures have translated into escalating premiums – now more than 15 times higher than the NZ EQC.
Australian reinsurance pool corporation (terrorism risks)	Australia	Yes	Premiums	No	Yes	Majority	No	Despite being established in 2003 there have been no claims to date. The capacity of the scheme is 13.4 billion AUD.

3.3.4 Model assumptions

To model the effectiveness of an insurance pool scheme in managing natural disaster risks, several assumptions had to be made regarding the design of a hypothetical scheme which could then be empirically examined. The structure of the hypothetical pool is as follows:

- A Government run pool, funded by a levy on all Australians.
- Participation is mandatory.
- The resulting insurance pool will cover:
  - natural disaster cover for all uninsured Australian homes;
  - a 50% subsidy for natural disaster coverage of homes in high risk areas; and
  - administrative costs.
- The natural disaster insurance will cover all natural hazards, including floods.
- The levy will be uniform, e.g. via a general tax, and not linked to individuals' risk exposure.
- Insurers' approach to identify exposure and calculate premiums for homes will not change.

3.4 Mitigation options

Concerns regarding the ability of the current system to manage impacts of natural disasters in the long term, without significant impact to the Australian economy, has triggered an exploration of the feasibility of alternate approaches. Alternatives such as risk pooling allow risks to be spread and diluted. However, as the total costs of natural disasters grows it appears based on the background research discussed above, that it is questionable whether simply redistributing costs and risk is sustainable for Australia in the long term. It also appears that mitigation options will hold greater long-term value and we explore mitigation further below.

3.4.1 What are mitigation strategies?

In this context, mitigation strategies include actions taken to help cope with hazards associated with natural disasters, leading to a reduction in harm or risk of harm, or realisation of economic benefits through a reduction in the damage to property and lower costs or quicker restoration of economic activity.

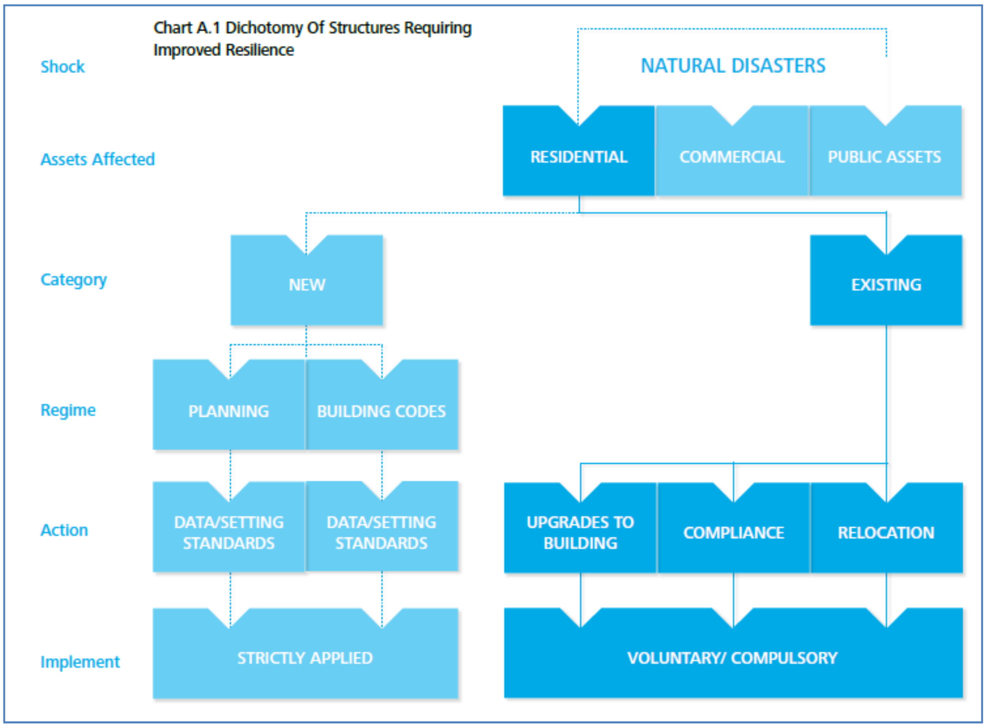
Due to the inherently uncertain and unpredictable nature of natural hazards, mitigation strategies tend to focus on reducing the vulnerability of communities (i.e. reducing the sensitivity and increasing the adaptive capacity of local communities, public assets and the services they use). In recent years this uncertainty and unpredictability around natural hazards has been reduced due to advancements in modelling technology (e.g. aerial surveys and LiDAR) and the funding of specialised research facilities such as the CSIRO Climate Adaptation Flagship, the Cyclone Testing Station in Townsville and the Bushfire Cooperative Research Centre in Melbourne. These advances in technology and research enables more refined and localised data, which provides a clearer understanding of the extent of hazard-prone areas and the probability of events occurring.

In hazard-prone areas (whether floods, cyclones or bushfires), the need to design new buildings to withstand impacts through building regulation, zoning restrictions and improved design standards have been proven to reduce the overall vulnerability of a development. Coupled with this, there is an underlying issue of an aging housing stock built prior to the introduction of zoning restrictions and many design standards. Evidence is that these homes will continue to remain highly vulnerable if not retrofitted to current standards.

3.4.2 Types of mitigation strategies

There a variety of mitigation strategies that may be considered. Many of these strategies are implemented to protect either private property or public assets. The appropriate mitigation strategy can also be different for new and existing assets. The following figure introduces a range of mitigation strategies that assists in illustrating the varying approaches to mitigation based on the type and category of the asset affected.

Figure 3-4: Dichotomy of structures requiring improved resilience



Source: Australian Business Roundtable for Disaster Resilience and Safer Communities 2013.

At the action level (refer to figure above), pre-disaster mitigation strategies may include the following:

- **Flood mitigation** – transfer of development rights, asset relocation, construction of easements, barriers and levees, elevated development, rezoning of flood prone areas, resizing of drainage and the raising of dam walls.
- **Bushfire mitigation** – rezoning of bushfire prone areas, vegetation management, placing power utilities underground and introducing design standards to reduce ember attack on homes.
- **Cyclone mitigation** – rezoning of cyclone regions, design standards for increases in wind speed, roofing deck attachments, secondary water barriers, strengthening of roof coverings, bracing and glazing protection.

3.4.3 Cost and benefits of mitigation & model assumptions

Although a greater upfront expenditure is required to invest in mitigation strategies, these methods have been shown to be cost-effective, when comparing the ultimate cost of mitigation, to the reduction in potential losses they provide[31].

By understanding the costs and benefits of different mitigation strategies, more economically informed decision-making will be achieved. This in turn leads to safer, more responsible, economically sound communities. In the long term, entire communities benefit by investing in mitigation strategies. Post natural disaster, power and water utilities will be restored more quickly, businesses will re-open sooner and communities will be functioning again with minimal disruption[32].

Up-front investments in mitigation strategies have demonstrated that they contribute to a successful future. By accounting for the full costs of risks including the improvement of outcomes in respect of injury, loss of life and disease post event, all levels of government can make strategic decisions about where, when, and how to make investments in mitigation strategies to maximise benefits and minimise risk. The full costs of mitigation may include the varying costs associated with specific mitigation strategies, non-economic factors such as community profile and engagement, as well as the lifespan and effectiveness of any mitigation measure which is dependent upon maintenance costs and the severity of future event[33].

The figure overleaf provides a summary of the net benefits of various mitigation strategies reviewed. In some of the case studies presented a Benefit Cost Ratio (BCR) has been used as an indicator of the programs cost effectiveness. This measure captures the return on investment yielding from mitigation by quantifying the ratio of benefits to costs both expressed in a present value, monetary metric. A ratio of greater than one indicates that benefits exceed costs generating a positive return on investment while a ratio of less than one indicates the reverse. The key findings outlined in the figure overleaf were used to inform the assumptions for the economic modelling of the three alternative options being considered.

Testament to the effectiveness of mitigation strategies in reducing the cost of impacts, is the recent move for Insurance companies to fund mitigation strategies directly. Following a hailstorm that swept through Calgary Canada in 2010 resulting in insured losses of over $400 million, a consortium of insurance companies jointly financed Weather Modification Incorporated (WMI). Since 1996 WMI has identified severe storms and sent aircraft to disperse chemical agents to reduce the storms severity. Early evidence suggests that the insurance industry has saved as much as $50 million each year as a result.[34]

[31] RMS 2009 *Analysing the Effects of the My Safe Florida Home Program on Florida Insurance Risk*, Florida Department of Financial Services

[32] *An economic framework for coastal community infrastructure* Prepared for National Oceanic and atmospheric Administration by Easton Research Group (June 2013)

[33] *See reference 32 above*

[34] *Sharing risk – Financing Australia's disaster resilience*. Australian Strategic Policy Institute (February 2011).

Figure 3-5: Summary of the net benefits of mitigation strategies

Study	Scope of mitigation measures	Key findings
RMS 2009 *Analysing the Effects of the My Safe Florida Home Program on Florida Insurance Risk*, Florida Department of Financial Services	Mitigation program assisting the general public with mitigating the risk of property damage due to high winds following a hurricane. This is achieved through the promotion of retrofitting and education through an inspection program and public outreach campaign.	• Reductions in 100 year loss of between US$1.50 and $2.75 per $1.00 spend in hurricane mitigation can be achieved, i.e. a benefit to cost ratio (BCR) of up to 2.75 can be achieved. • Reductions in 100 year loss of up to 77% can be achieved for claims liability.
Mason & Haynes 2010 *Adaptation lessons from Cyclone Tracey*, NCCARF	Changes to Australian design standards in cyclone prone regions – considering low-frequency, high-impact events.	• Cyclone mitigation measures post 1974 can achieve up to 85% reduction in damage.
Mortimer, Bergin & Carter 2011 *Sharing risk: Financing Australia's disaster resilience*, ASPI	Storm mitigation program in Alberta, Canada initiated by the insurance industry that cloud seeds severe storms to minimise the extent of insured losses.	• Insurance industry saves up to AU$51M each year.
Deloitte 2013 *Building of nation's resilience to natural disasters*, Australian Business Roundtable for Disaster Resilience and Safer Communities	Program focusing on building more resilient new houses in cyclone risk areas of South East Queensland that reduces the risk of cyclone-related damage.	• A BCR of up to 3 can be achieved for cyclone mitigation measures.
	Flood mitigation program that involved the raising of the dam wall at Warragamba Dam, NSW that reduces annualised average flood costs.	• BCR between 2.2 and 8.5 can be achieved for flood mitigation measures.
	Program of building more resilient housing in high risk bushfire areas in Victoria through improved vegetation management and the placing of electricity wires underground.	• BCR of between 1.3 and 3.1 can be achieved for bushfire mitigation measures.
Australian Government 2004 *Natural Disasters in Australia: Reforming mitigation, relief and recovery arrangements*, COAG	National flood mitigation program that funded 149 structural and non-structural projects over a three year period.	• Flood mitigation can achieve savings and reduction in damage of up to AU $0.6 to $29M.
Case Study - Charleville and Roma, Suncorp	Flood mitigation program that included a flood levee in Charleville and Roma, as well as house raising in Charleville.	• Flood mitigation is expected to reduce premiums between 30% and 80%.
Woodruff (2008) Samoa Technical Report – Economic Analysis of Flood Risk Reduction Measures for the Lower Vaisigano Catchment Area	A study conducted on household flood mitigation activities in Samoa found that the highest return on investment was generated from constructing homes with raised floors[35]. More specifically, the benefit cost ratio was determined to range from 4 to 44 for wooden homes, and from 2 to 28 for cement block homes.	

[35] Woodruff, A. 2008 (February). Samoa Technical Report – Economic Analysis of Flood Risk Reduction Measures for the Lower Vaisigano Catchment Area. EU EDF – SOPAC Project Report 69g Reducing Vulnerability of Pacific ACP States. SOPAC (Pacific Islands Applied Geosciences Commission), Suva, Fiji.

4. Economic Assessment

4.1 Economic modelling – key findings

This part of the report considers the possible impact of two alternative risk apportionment strategies on the Australian economy, including the impacts on activity across the whole economy and at the industry level.

To estimate the different direct costs/benefits associated with the two alternative approaches (insurance pool and system with natural catastrophe mitigation), each approach will be examined under a 'significant natural catastrophe' scenario which creates a "shock" to the economy.

The size of this shock is based on the impacts observed during 2010 and 2011 natural catastrophe events. That is, we have assumed that the 'significant natural catastrophe' under the current system leads to losses of the same magnitude as those actually incurred as a result of these 2010/11 natural catastrophes. For modelling purposes, we will also assume that these catastrophes are 1-in-10 year events.

Figure 4-1: Key impacts under alternative risk mitigation strategies

	Scenario 1: Pool approach	Scenario 2: Mitigation
Total change over ten year period ($million, 2009/10 terms)		
Investment	198	-845
H'hold consumption	-462	1,621
Exports	-354	618
Imports	-227	401
GDP	-276	741
Selected Industries - gross value added:		
Residential construction	875	-1,994
Finance and insurance	228	39
Services from housing stock	483	-967
Other construction	-1,064	2,340
Average annual change in employment over ten year period (jobs)		
Residential construction	1,008	-2,293
Finance and insurance	146	-83
Other construction	-757	1,680
Total employment	0	0

Source: KPMG estimates. Note: the results above show the estimated cumulative or total impacts every ten years, assuming one event occurs in this time period.

The results above indicate that:

- A pool system is expected to lead to higher costs from a 1-in-10 year catastrophe, which impacts capital stocks, leading to a lower GDP compared to baseline. Investments (and returns) respond to this fall in capital stocks at the expense of consumption and other expenditures.
- Structured mitigation is expected to lead to a reduction in the costs from a 1-in-10 year catastrophe, which lessens the impact on capital stocks, leading to a higher GDP compared to baseline. Investments (and returns) are impacted by higher capital stocks, while the additional productive capacity in the economy benefits consumption and other expenditures.

4.2 Proposed risk apportionment strategies

Based on the research undertaken in the previous sections of this report, the following baseline and two alternate scenarios were examined.

Figure 4-2: Estimated cost of event under alternative risk mitigation strategies

	BAU: current approach	Scenario 1: Pool approach	Scenario 2: Mitigation
Insurance Sector spend	$7,375 million	$7,375 million	$7,375 million
Government spend	$7,279 million	$7,279 million	$7,279 million
Impact from unstructured mitigation	-$2,317 million		-$2,317 million
Impact from structured mitigation			-$7,548 million
Cost of event (1-in-10 year)	$12,337 million	$14,654 million	$4,789 million

Source: KPMG estimates

Current System

The Computable General Equilibrium (CGE) model takes into account all economic flows which are in a stable state. For this reason, no specific inputs are required for the continued growth in insurance premiums, claims or uncovered economic losses, as they are already reflected in the stable state of the economy. Variation from the normal state will occur from the following assumptions:

- A series of major natural disaster events will affect Australia every 10 years. The magnitude of these events will be based on the scale of the 2010 and 2011 series of natural disasters which occurred in Australia. Costs associated with these events include both Insurance sector costs paid out and Government contributions (as shown in the first two rows in the Figure above).
- One further adjustment has been made to these actual costs under the current scenario. That is, following the recent natural disasters, customers in high and extreme risk areas are now experiencing unaffordable insurance premiums - which we assume can only be made more affordable through individual or government led mitigation measures. Individual mitigation for a home in a high flood risk area, such as raising the height of the house, could reduce the insurance premium for the individual, as the risk rating is reduced. In this way, insurance premiums charged (or quoted) to customers act as a price signal which may result in mitigation by individuals. The potential spend on mitigation and the potential reduction in losses as a result of individual mitigation has therefore been included within the current system model (shown in row 3 of the figure above).

Insurance Pool Model

The Insurance pool will function as described in section 3.2.4, providing natural disaster coverage to the uninsured and subsidising the natural disaster cover for those in high risk areas. The key assumptions included in modelling the pool scenario include:

- Premiums and claims paid out on a normal year remain unchanged from the Current System. An assumption is made that any decrease in premiums from the government subsidy will be offset by an increase in uptake of insurance policies (triggered by the subsidy).
- Any price signal in the pricing of premiums to encourage mitigation is removed, and so no reduction in the cost of natural disasters relative to the shock scenario is assumed. The

government contribution under the current system will now be funded by the insurance pool, but there is no difference in the assumed overall funding required.

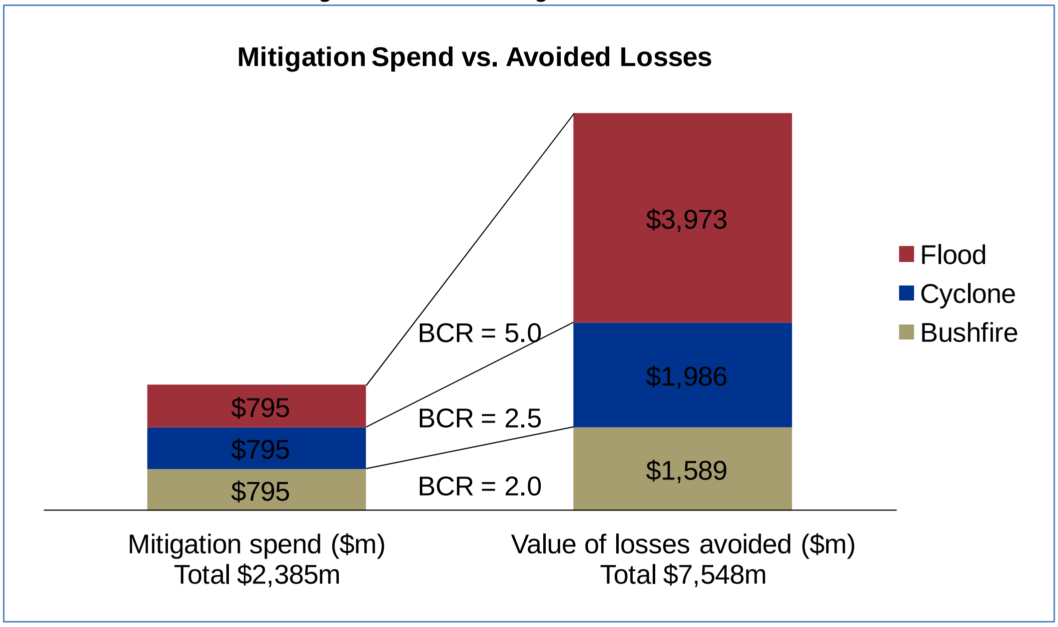
- The size of the pool has been calculated on the expected premiums that would be required to fund the risk exposure, plus an allowance for the cost of administration of the fund. These premiums are then spent on rebuilding after the event.

Mitigation

The mitigation approach assumes that government led mitigation will occur with a budget equal to the amount of funds which would be required under the insurance pool. The key assumptions are:

- Premiums and claims paid out on a normal year remain unchanged from the Current System. An assumption is made that any decrease in cost of premiums as a result of mitigation measures will be offset by an increase in uptake of insurance policies.
- 10 years of mitigation expenditure has occurred by the time the major natural catastrophe occurs.
- Mitigation will be undertaken strategically at the areas with highest risk. It is assumed that mitigation funding will be equally split between the spending on Bushfires, Floods and Cyclones The reduction in losses experienced in the event of the major natural catastrophes scenario is based on an average Benefit Cost Ratio for the three types of natural disasters. The figure below illustrates how this expenditure is then translated into a value of avoided losses.

Figure 4-3: Estimating avoided losses



Research into mitigation case studies was used to inform the selection of Benefit Cost Ratios (BCR) that could be applied to cyclone, bushfire and flood mitigation programs separately. Assumptions were then selected, with some degree of conservatism relative to the case studies observed, to model the monetary inputs and outputs associated with future mitigation activities.

- A BCR of 2 was determined to be appropriate for bushfire mitigation programs which was supported by a fire prevention program in Victoria that generated a BCR ranging from 1.3 to 3.1. This was considered to be a reasonable estimate given that 2 is below the median of this range.
- A BCR of 2.5 was selected for cyclone mitigation programs based on a case study of a program in South East Queensland involving the construction of cyclone resilient housing which generated a BCR of 3.
- For flood mitigation a BCR of 5 was determined to be appropriate based on extensive desktop research. There is an expansive range of BCRs associated with different flood mitigation programs between 2.2 and 44 from academic literature examined (See 3.3.4). Furthermore a case study of flood events in Roma Queensland, which has had no flood mitigation, demonstrated that since 2005 the community has incurred 500 million AUD worth of damage from reoccurring floods. Mitigation in the form of a flood levee however would only cost the community 2 to 15 million AUD generating a BCR ranging from 33.3 to 250.

4.3 Economic Scenarios

The risk apportionment strategies outlined above will have different impacts in terms of the costs associated with the risk (or event occurring), the cost of insurance/mitigation, and those that ultimately bear these costs. The key cost implications are shown in the table below.

Figure 4-4: Key modelling data

	BAU: current approach	Scenario 1: Pool approach	Scenario 2: Mitigation
Cost of event (1-in-10 year)	$12,337 million	$14,654 million	$4,789 million
Annual Costs			
Pool Administration		$60 million	
Pool Premiums		$178 million	
Mitigation			$238 million

Source: KPMG estimates

These costs have been converted into model inputs as outlined in the table below. These inputs were then applied to KPMG's in-house CGE modelling framework (more details provided in Appendix A) to identify the impacts across the economy, including the impact on GDP, industry output, and employment.

The table below shows how the two alternate risk apportionment strategies change activity in the economy, compared to the current approach. These changes are in four main areas:

- returns to the housing industry during the period of reconstruction;
- activity in the insurance industry with the additional administration of the Pool;
- activity in the construction industry resulting from any change in rebuilding required after the event and the construction activity associated with any mitigation; and
- government spending as a result of funding the pool/mitigation, plus any changes in the cost of the event *net* of any costs covered by the pool.

Figure 4-5: Model Scenarios (annualised costs, assuming one event every 10 years)

	Scenario 1: Pool approach	Scenario 2: Mitigation
Change in returns to dwelling sector (annualised)	**-0.013%**	**0.044%**
Change in insurance activity - pool administration	**$60 million**	
Dwelling construction		
- change in re-building costs	$232 million	-$755 million
- mitigation costs		$238 million
Net change in construction activity	**$232 million**	**-$516 million**
Change in Government funding		
- change in cost of event annualised	$232 million	-$755 million
- less annual payments from pool	$178 million	
net change in government payments for event	$54 million	
plus pool/mitigation funding	$238 million	$238 million
Net change in gov't outlay (annualised)	**$292 million**	**-$516 million**

Source: KPMG estimates

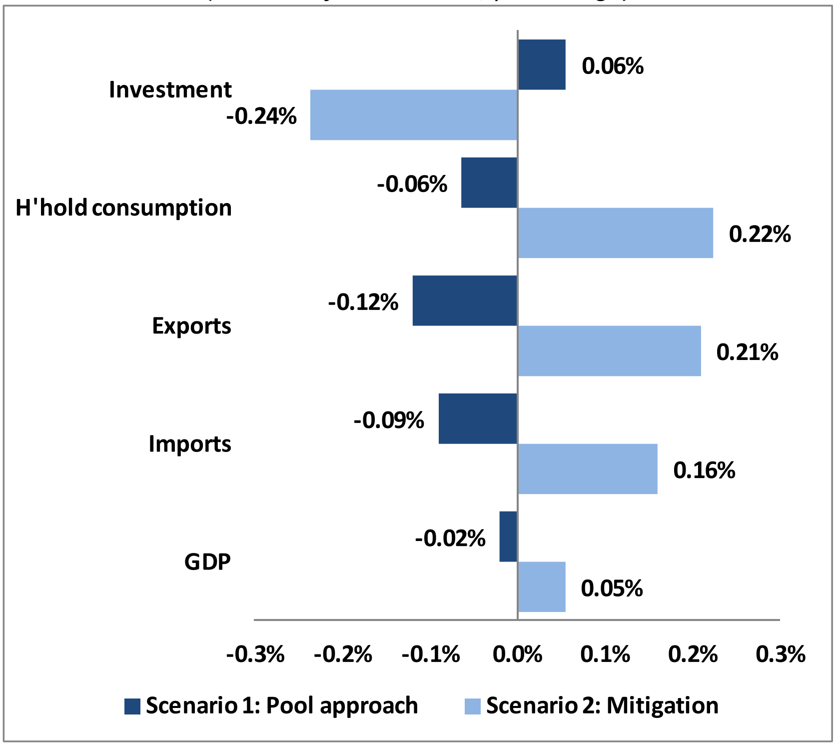
4.4 Economic Impacts

The results of the alternative risk apportionment strategy scenarios are now provided in a series of sub-sections. These results are provided in terms of deviations (or changes) in activity compared to the business as usual (current) baseline (discussed in section 3.1). This section starts by discussing the national or macro results and then drills down into how these impacts vary across industries.

4.4.1 Macro Impacts

The expected higher costs of a 1-in-10 year event across the economy under the pool scenario (when compared with the expected costs under the baseline) lead to lower real GDP. In contrast, the expected lower costs of a 1-in-10 year event across the economy under the mitigation scenario (when compared with the expected costs under the baseline) lead to comparatively higher real GDP. The figure below shows the total estimated change over each ten year period going forward, expressed as a percentage of current annual macro levels.

Figure 4-6: Impact on the Macro economy - impact in the year of the event (or every ten years) total accumulated cost of the pool/mitigation over ten years and the total cost of one event (deviation from baseline, percentage)



Source: KPMG CGE modelling

Lower GDP in the pool scenario is largely driven by the event having a larger negative impact on capital stocks. Under the pool scenario, in each ten year period, total GDP is estimated to be almost $280 million lower (in 2009/10 terms) than it would have been in the baseline. Access to less (or less productive) capital means lower production across the economy, and the diversion of output to reconstruction activities in larger volumes than in the mitigation scenario.

Investment responds to restore the level of the capital stocks, particularly in housing. Resources move into investment and away from final demand categories like consumption and exports. As a result, both household consumption and exports are lower than they would have been under the baseline. Lower activity in the economy also leads to lower imports (compared to the baseline) *but* also a negative impact on the trade balance – less output and domestic income leads to lower saving, and capital goods must be imported to supply investment.

Higher GDP in the mitigation scenario compared to the baseline is results from the event having a smaller negative impact on housing stocks as a result of implementing mitigation strategies. In this case, in each ten year period, total GDP is estimated to be $750 million higher (in 2009/10 terms) than it would have been under the baseline.

This means that capital stocks (and returns to the economy) are comparatively higher under the mitigation scenario compared to the baseline.

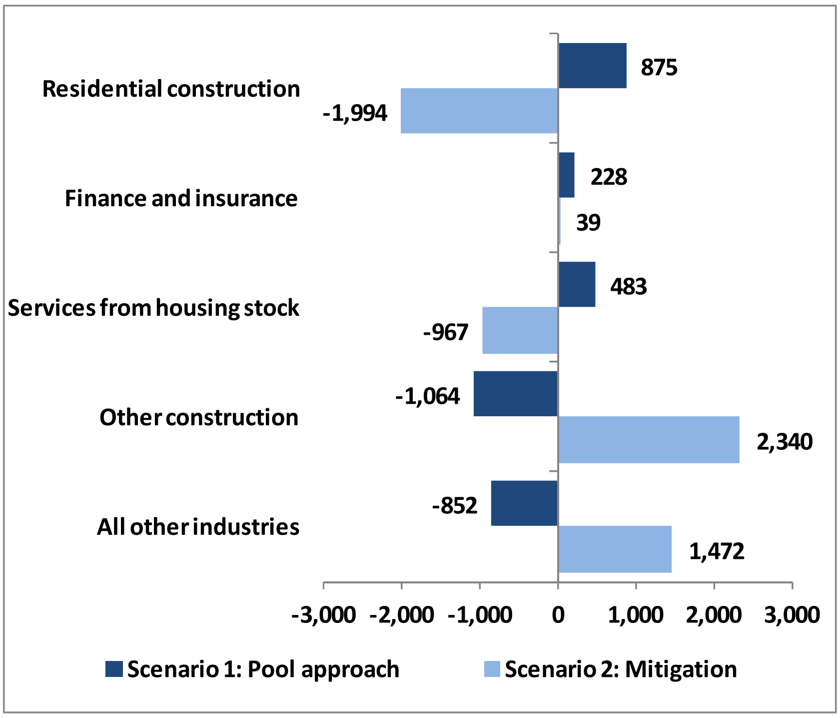
Less investment is needed to restore the level of capital stock than in the baseline, and this leaves more resources available for the other demand categories – consumption and exports. As a result, both household consumption and exports are higher than they would have been under the baseline. Household consumption is also boosted by the lower government costs (due to the mitigation of the event) being returned to consumers through a reduction in income tax rates (as assumed in the simulation design).

Higher activity in the economy also leads to higher imports compared to under the baseline, but in this case with an improvement in the trade balance – higher domestic income and saving coupled with lower investment leads to an improvement in the trade balance.

4.4.2 Industry impacts

The figure below shows the impact of a pool strategy and a mitigation strategy on industries, both in comparison to the activity expected under the business as usual, or current, baseline. The figure below shows the total estimated change over each ten year period going forward, expressed in 2009-10 dollars.

Figure 4-7: Impact on Industry Value-added - cumulative impacts every ten years including the total cost of the pool/mitigation over ten years and the total cost of one event (deviation from baseline, $m 2009-10 terms)



Source: KPMG CGE modelling.

There is expected to be additional rebuilding required under the **pool scenario** compared to the baseline. This occurs because it is assumed the introduction of the pool removes some of the price signals that discourage risk taking behaviour, or, alternatively that encourage risk mitigation activities. The chart above shows higher residential construction activity as a result of this re-building.

Activity in the insurance industry is higher under the pool scheme. This slightly higher level of insurance activity is because this industry is tasked with administration of the scheme.

There are two opposing forces impacting on dwellings sector – a sector that captures the flows of services ("imputed rents") from the housing stock - activity under the pool scenario, as follows:

- The event leads to a higher loss of housing capital productivity under the pool (as more housing stock is off-line whilst rebuilding occurs). This reduction in capacity leads to a reduction in services provided by this housing capital stock ("imputed rents").
- After the rebuilding is completed, the services that can now be provided by the housing stock are at a slightly higher value than under the baseline. This is because the scenario targets a specific rebuilding value that is replacing the damaged existing homes with new homes. The new homes are likely to be now subject to different building standards/methods etc. This will result in higher construction costs and therefore, by this view of valuation, a higher value for the housing stock. In this scenario, the economy ends up with a higher new-house share in the total housing stock compared to the baseline.
- Housing construction costs for new houses are higher, and on this cost basis the value of the housing stock increases. The modelling assumes that these new houses have higher market values than those they replace. If the market value of the housing stock did not change when housing is rebuilt, this would reduce the positive impact of this scenario on services flowing from housing. This means that the modelling results under this scenario potentially underestimate the negative impacts of the pool scheme.

The additional residential construction activity will also increase demand for inputs, driving up costs to industries that use similar inputs. The other construction sector illustrates this, with a slightly lower level of output under this scenario compared to baseline.

Under the **mitigation scenario**, there is expected to be less rebuilding required compared to the baseline, as less housing capital is affected. The chart above shows a reduction in residential construction activity compared to the baseline as a result. This lower rebuilding activity will be slightly offset by the construction activity associated with the mitigation measures.

In a similar manner to the pool strategy impacts, but working in the opposite direction, there are two opposing forces impacting on dwellings sector activity under this mitigation scenario, as follows.

- The comparatively lower impact of the event leads to a higher level of housing capital productivity under the mitigation strategy compared to the baseline (as less housing stock is off-line whilst rebuilding occurs). This comparatively high capacity leads to comparatively higher services flowing from this housing capital stock.
- Fewer houses need to be replaced under the mitigation scenario (compared to the baseline), leading to a slightly lower flow of services provided by the housing stock than under the baseline. In a similar way to the response in the pool scenario, the rebuilding under the baseline is likely to be subject to different building standards/methods etc – and this will mean a slightly higher value of new housing compared to old. Compared to baseline, there is

therefore a slightly lower value of housing stock under the mitigation scenario because less new dwellings will be rebuilt (i.e. the housing capital stock will contain less new houses).

- The assumptions regarding market values outlined above work here in the opposite direction, leading potentially to an underestimate of the positive impact of mitigation strategies. Further, it should be noted that under a mitigation scheme, the mitigation activities themselves would also potentially improve the value of housing stock. This would further offset some of the negative impacts on the services from housing stock. This adds to the potential for the modelling results under this scenario to underestimate of the positive impacts of mitigation.

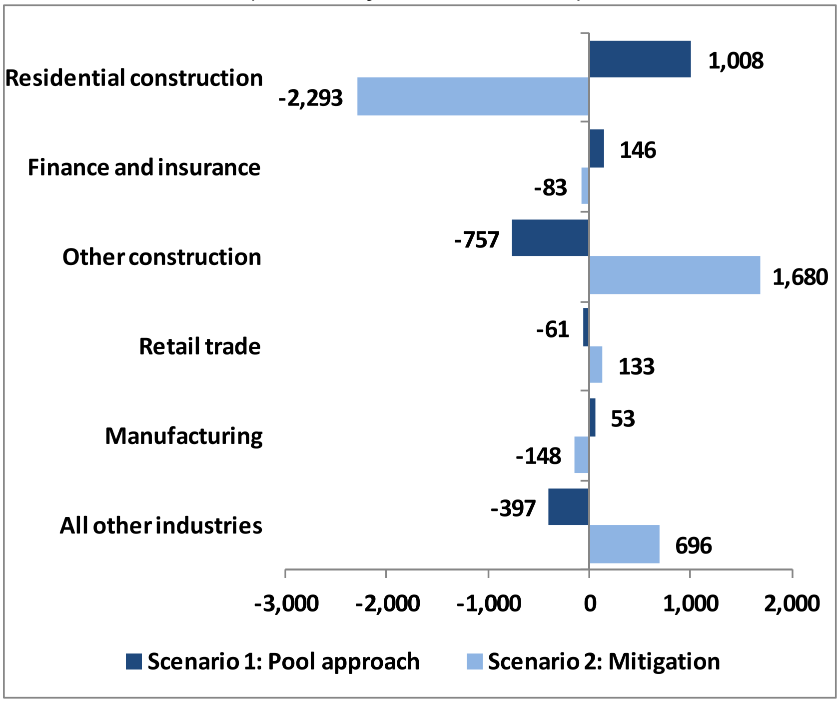
The lower residential construction activity will also lower demand for some inputs, reducing costs to industries that use similar inputs. The other construction sector illustrates this, with a slightly higher level of output under this scenario compared to baseline.

4.4.3 Employment Impacts

Employment shows a similar pattern to value-added across the industries.

The modelling makes the standard long-run assumption that the labour supply is not affected by these policies – or, alternatively, that these scenarios do not impact the long-run level of employment. This labour market assumption reflects the fact that, in the long-run, the level of employment is primarily determined by population growth and demographics, rather than by the level of output of the dwelling, construction or insurance sectors. Changes in economic activity in the long-run are reflected in real wages. Thus, there is no overall impact on employment in the simulations, but there will be a movement of jobs between industries.

Figure 4-8: Impact on Employment – average annual impacts (deviation from baseline, FTE)



Source: KPMG CGE modelling.

Similarly to the value-added impacts, the pool is expected to lead to higher employment in the residential construction sector and the insurance sector, and reduce employment across other sectors compared to the baseline scenario. In comparison, the mitigation is expected to reduce employment in residential construction and move it towards other activities, including other construction. These are essentially driven by output levels in these sectors.

Note that the impacts above have been converted into average annual impacts because jobs are not accumulated (there may be the same single job over the ten years or ten different annual jobs over the ten years).

It is likely that, given the nature of these scenarios – including a 1-in-10 year event – that the impacts will be quite lumpy, with much of the residential construction impacts being felt in the year of the event. This would lead to a much higher impact on residential construction employment in that year than is observed in the average annual impacts shown above. On the other hand, if this big employment impact was removed from the average calculation, then the ongoing impacts would be smaller than those observed on average.

5. Discussion

5.1 Key findings

The scenarios tested aimed to quantify the benefits to the economy if the proportion of government investment was shifted toward Pool Insurance, as a way to allow individuals to *transfer* some of their risk, or to Mitigation, as a way to *avoid or reduce* the level of the risk.

As discussed in Chapter 4, with consideration to impacts on the Australian economy, investment in the development of a pooled insurance scheme results in lower GDP equivalent to 0.03 percent of annual GDP every ten years. This is the result of the investment in an insurance pool not leading to any actual decrease in the overall risk/cost of the disaster, but rather transference of the risk/cost. Additionally, the cost to the economy in this scenario is exacerbated by the removal of price signals (i.e: cheaper insurance premiums), that would otherwise incentivise individuals to reduce their own risk exposure. Under the current system, there is an expectation that individuals will act to an extent possible to implement some amounts of risk reduction, as they have a financial incentive to do so. Their remaining exposure can be transferred through the purchase of insurance, and there is an expectation that some of the risk is accepted by the government.

Under the mitigation scenario, investment of the same amount of money into natural disaster mitigation activities, results in a *higher* GDP equivalent to 0.01 percent of annual GDP every ten years. This is the result of a reduction in the overall impact of the natural disaster, provided by mitigation, reducing the costs of recovery to the Australian economy. The modelling (based on the benefit cost ratios assumed) shows that the Australian economy will be stronger investing in mitigation, rather than pooled insurance, by (a total every ten years) equivalent to 0.04 percent of annual GDP.

5.2 Sensitivity testing

Two of the key assumptions included in the economic modelling were tested for sensitivity to assess the extent to which changes in the assumptions would alter the overall output from the CGE.

The **time period** over which a major natural catastrophe occurs was increased from 10 years to 20 years.

- While the average annual cost of the event was halved: we assumed that the annual cost of administering the pool remained at the same level (which makes the relative cost of the pool slightly higher); and we assumed that the total cost of mitigating remained the same.
- There was no significant change in the cumulative impact on GDP (or the impact in the year of the event). However, this means that the average annual impact on GDP would be half of the size if the event happened every 20 years instead of every 10 years.

The assumption around the **level of individual mitigation** which would occur as a result of current price signals was tested - by halving the uptake and also taking into account some mitigation by a proportion of the uninsured population. This resulted in:

- A lower change in the costs of the event under the pool scenario – dropping to just under two-thirds of the originally assumed value.
- This flowed through to reduce the impact on GDP from 0.02 per cent to 0.014 percent.

5.3 Other considerations

The focus of the research and economic modelling in this paper has been conducted on the comparison between two different responses to managing the potential losses from natural catastrophes namely between an insurance pool approach when compared to a mitigation approach. However, it is important to note that the scale of any event can be such that physical adaptation measures can be overwhelmed. In such situations it is not unknown for authorities to take deliberate actions that result in for example flooding of one area in order to save larger losses in another. In this scenario the analysis of the two scenarios become more complex and hybrid – “mitigation plus” options would need to be examined.

5.4 Case studies

Implementation of a coordinated and effective mitigation scheme will be critical in reducing the risks and costs of natural disasters. While an analysis of a transition to a mitigation scheme is beyond the scope of this study, through the research undertaken, case studies and insights have emerged that confirm the benefits of mitigation and identify elements to aid success. These case studies and key learning’s are described below:

Charleville, South west Queensland, Australia

The Charleville case study is an example of where investment in mitigation has successfully resulted in risk reduction, and reduced insurance premiums. It also highlights the need for mitigation design to be based on projected climatic conditions rather than historic data, to optimize risk reduction and ultimately return on investment.

Prior to the 2008, only 32 percent of households in Charleville were covered by insurance. In a study conducted by NCCARF, residents described flood insurance in Charleville as being very expensive and difficult to obtain. As a result the uninsured financial costs to households in Charleville resulting directly from the flood were recorded as reaching $100,130 AUD and $375,000 AUD for the 57 percent of businesses who were not covered by flood insurance. This is a significant cost for a community of less than 3,500 residents.[36]

In 2008 stage 1 of the Charleville flood levee was completed at a cost of approximately $6 million AUD, unfortunately this did not sufficiently address the flood risk (i.e: it was constructed to provide protection up to the 1997 flood levels), resulting in substantial losses. In 2011, stage 2 of the flood levee was announced along with a house raising program. As a result of the planned protection measures, average home insurance premiums have reduced from over $3,000 AUD to an approximate average of $990 AUD.

National Flood Insurance Program – Community Rating System, United States

The Community Rating System case study is an example of how a measurement system has been established to directly link mitigation activities with guaranteed reduction in premiums. Such a system allows additional certainty in the level of premiums included in any cost benefit assessment of planned mitigation activities.

The National Flood Insurance Program’s (NFIP) Community Rating System (CRP), is a voluntary program that rewards investment in flood mitigation activities (that exceed the minimum NFIP requirement), with discounted flood insurance premium rates. For participating communities,

---

[36] *The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity.* National Climate Change Adaptation Research Facility (2010) NCCARF Synthesis and Integrative Research Program

flood insurance premium rates are discounted in increments of 5 percent (up to 45 percent discount), placing participants into a specified 'class' that reflects the extent of mitigation activities undertaken. A class 1 community would receive the highest 45 percent discount, while a class 10 community would receive no discount.[37]

Four communities currently occupy the highest levels of the CRS. Each has developed a floodplain management program tailored to its own particular hazards, character, and goals. Roseville, California was the first to reach this rating (Class 1). Through strengthening and broadened its floodplain management program, average premium discount for policies in the Special Flood Hazard Area (SFHA) is $79,238 USD.

Currently, nearly 3.8 million policyholders across 1,211 communities participate in CRS by implementing local mitigation, floodplain management and outreach activities. Although these communities represent only 5 percent of over 21,000 communities participating in the NFIP, more than 67 percent of all flood insurance policies are written in CRS communities.[39]

Weather Modification Incorporated, Calgary, Canada

The Weather Modification Incorporated case study provides an example of where Insurers have invested in mitigation strategies and this has led to a reduction in the cost of claims.

Following a hailstorm that swept through Calgary Canada in 2010 resulting in insured losses of over $400 million, a consortium of insurance companies jointly financed Weather Modification Incorporated (WMI). Since 1996 WMI has identified severe storms and sent aircraft to disperse chemical agents to reduce the storms severity. Early evidence suggests that the insurance industry has saved as much as $50 million each year as a result.[40]

5.5 Key learnings

The following observations are informed by the research conducted for this study and may provide insights for decision makers into lessons learns from others who have transitioned to a mitigation focused risk management approach to disaster management:

- Targeted mitigation programs have been successful in reducing the impacts and costs of natural disasters in communities and seen significant reductions in insurance premiums.
- A sufficiently incentivized community, with access to funding can lead the coordination of mitigation programs at a regional level and effectively drive down the cost of insurance premiums.
- Communities need to be educated in the benefits of mitigation and including the return on investments that can be expected from investment in risk reduction. A key barrier against households (and governments), investing in risk mitigation is the up-front cost relative to other investments (i.e: education, transport infrastructure) and the perceived benefits of these actions.
- Appropriate regulation coupled with financial oversight and monitoring at a national level can be effective in encouraging investment in risk reduction.

[37] *National Flood Insurance Program Community Rating System* website. Federal Emergency Management Agency. Accessed March 2014. http://www.fema.gov/national-flood-insurance-program-community-rating-system

[39] *Community Rating System Fact Sheet*. Federal Insurance and Mitigation Administration. 2013 http://www.fema.gov/media-library-data/20130726-1605-20490-8915/nfip_crs_fact__sheet_sept_2012.txt

[40] *Sharing risk – Financing Australia's disaster resilience*. Australian Strategic Policy Institute (February 2011).

- Accurate risk pricing by insurers is critical in communicating actual risks to customers and incentivizing risk reducing decision making.
- Direct investment by insurers in risk mitigation has been effective in reducing the impact of events.
- To be effective in the long term, mitigation measures (such as flood levees), must be built to withstand natural disasters aligned with projected climatic conditions rather than historic events to be effective in the long term.
- Making mitigation a prerequisite for coverage (by either insurers or government based relief), has shown to be effective in reducing risk.[41]

[41] *Adaptation to Climate Change: Linking disaster risk reduction and insurance*. Paper submitted to the UNFCCC for the 6th session of the Ad Hoc Working Group on long term cooperative action under the Convention (AWG-LCA 6). Munich Climate Insurance Initiative. (June 2009)._These key learning's have been adapted from a paper produced by a working group who participated in UNFCCC workshop at the 14th COP in Poznan Poland. The workshop was held to consider the role of insurance in natural disaster risk reduction. The group sought to answer the key question of 'whether and how, insurance related mechanisms could lead to a reduction in risk and losses, particularly for developing countries and vulnerable groups?'Their investigations concluded that collaboration between the insurance industry and governments could promote risk reduction through some of the actions described here.

Appendix A: Economic Modelling

This attachment discusses and presents the economic modelling approach used to estimate the economic impact of alternative risk apportionment strategies on the Australian economy.

To estimate these impacts, this study will employ a comparative static, computable general equilibrium (CGE) model, described below. KPMG's latest CGE model, FLAGSHIP, was developed over the past two years and is based on the most up-to-date detailed data available from the Australian Bureau of Statistics. FLAGSHIP brings together 80 years of combined modelling experience (gained with the world's pre-eminent economic modelling institutions, and in economic policy advice and research roles with several international governments), the latest theoretical developments in the field and a database constructed from the latest available data.

FLAGSHIP is a development of the world-leading ORANI and MONASH model lineage created at the Centre of Policy Studies, and is based in the powerful GEMPACK modelling software. FLAGSHIP brings the best of this world-renowned modelling tradition together with several new theoretical advancements – developed by Dr Ashley Winston as part of economic modelling and policy work with the US government – to create a cutting-edge CGE framework.

The model embodies an array of features that enhance its utility in policy and economic modelling, including sophisticated economic and behavioural assumptions (further discussed in Attachment A). This makes CGE modelling the most appropriate tool to use when assessing the economy-wide impacts of any policy or economic shock.

To model the economic impacts beyond those that directly relate to the insurance and property sectors, it is necessary to employ a modelling technique that makes use of information about the linkages of the sector within the broader economic context. Input-output (IO) tables published by the ABS provide detailed information on the upstream and downstream linkages of each industry in the economy.

- **Upstream linkages** refer to the sources of inputs to the insurance or property sector. These linkages may be in the form of the use of intermediate inputs produced by other domestic industries, imported intermediate inputs, labour and other factors of production. For example, these sectors would use inputs such as labour, and other industry services such as construction, telecommunications etc. This can thought of as information regarding the cost-side of the insurance or property sectors.
- **Downstream linkages** refer to those of economic agents that purchase the insurance or property sectors' output. For example, the finance sector might purchase property services as part of its operations and households pay rent to the property services industry. Consequently, downstream linkages include sales to other industries that use the output of the insurance or property sector as an intermediate input to their own production process or final users of the product like households, the government or foreigners. This can thought of as information regarding the sales-side of the insurance and property sectors.

An IO table is a useful tool as a snapshot of the economic flows within the economy at the time the data was collected. An input-output table can be used to provide simplified estimates of the sensitivity of the economy (measured by employment, value added or turnover) to small changes (termed 'shocks') within industries. An example of such a shock might be a ten per cent increase in the price of fuel. This would lead to an increase in the costs for all industries that use fuel, particularly impacting on demand for those industries that use a relatively large proportion of fuel. This sort of analysis can be used at the industry-wide level to estimate IO multipliers – that is, the total economy-wide impact on employment or output resulting from a change in one industry, taking into account the change in demand for the outputs of other industries.

An IO table in itself is not an economic model, and IO multipliers are raw and ad hoc in nature. A major limitation of the use of IO multipliers when used to conduct impact analysis is that the relationship between industry inputs and outputs (the coefficients) are fixed, implying that industry structure remains unchanged by the shock to the industry (for example, a change in demand or prices). Furthermore, IO analysis imposes no resource constraints and so industries (and indeed the entire economy) can access unlimited supplies of inputs at fixed costs.

In reality, scarcity of inputs (e.g. skilled labour, land etc) mean that these inputs are affected by and respond to changes in prices (e.g. wages) driven by supply and demand adjustments. For example, higher prices/wages driven by the increase in demand for labour to service higher construction activity will, at the margin, increase costs in other sectors and reduce demand for labour by some other parts of the economy.

In IO analysis, where all adjustments relate only to quantities produced, this type of feedback response does not to occur, and sectors can access infinite amounts of inputs at fixed costs. Consequently, an IO model can result in an overstatement of the impacts on the economy. For these reasons, while the ABS did for some time publish IO multipliers, it has ceased publishing these estimates in recent years over concerns about their validity.

A computable general equilibrium (CGE) model makes use of an IO table in the construction of its database, but is extended to make more sophisticated economic and behavioural assumptions including:

- recognising resource constraints and responses of businesses, workers through adjusting prices/wages.
- capturing employment/capital (and other factors inputs) substitution for example, by responding to higher wages by increasing the use of capital.
- capturing a much wider set of economic impacts such as behavioural responses to price changes of consumers, investors, foreigners etc.
- can include the effects of such things as technological change and shifts in consumer preferences – which is likely to be a key factor in this study.

By introducing these additional economic variables and constraints, CGE models are able to model beyond the first round impact of an event or policy, account for scarcity and understand behavioural response to economic variables. This added sophistication means that a CGE model allows for feedback responses by producers, consumers, investors and foreigners and so the results are less likely to be overstated particularly over the medium to long run.

Appendix B: Detailed Assumptions

1. Cost of Event

The estimated cost of the event is calculated as shown, based on assumptions below.

Column1	BAU: Current approac	Scenario 1: Pool approac	Scenario 2: Mitigatio
Insurance sector spend (1.1)	7,374,891,000	7,374,891,000	7,374,891,000
Government spend (1.1)	7,279,145,000	7,279,145,000	7,279,145,000
Decrease in impact due to unstructured mitigation (1.2)	(2,317,224,872)		(2,317,224,872)
Decrease in impact due to structured mitigation (1.3)			(7,548,090,451)
Total cost of event	12,336,811,128	14,654,036,000	4,788,720,677

1.1 Insurance sector and government spend

The following natural events which occurred during 2010 and 2011 were summed together to give the insurance industries cost from the natural disasters (Source: Insurance Council of Australia Historic disaster statistics).

Total insurance payout on natural catastrophes 2010-11	7,374,891,000
VIC Christmas Day Storms (Dec 2011)	728,640,000
WA Margaret River Bushfires (Nov 2011)	53,450,000
Perth Bushfires (Feb 2011)	35,128,000
VIC Severe Storms (Feb 2011)	487,615,000
QLD Cyclone Yasi (Feb 2011)	1,412,239,000
VIC Flooding (Jan 2011)	126,495,000
QLD Flooding (Dec 2010 - Jan 2011)	2,387,624,000
Perth Storm (March 2010)	1,053,000,000
Melbourne Storm (March 2010)	1,044,000,000
West QLD flooding (March 2010)	46,700,000

The portion of the government expenditure associated with the disasters was determined looking at the spend on natural disasters disclosed by financial year. Only those states with significant contributions related to natural disasters in the period were included.

Total significant govt payout on natural catastrophes 2010-11	7,279,145,000	
VIC (Jan Floods and Feb Severe Storm)	271,266,000	2011
QLD (Dec Floods and Cyclone Yasi)	5,442,857,000	2011
WA (Perth Bushfires)	148,638,000	2011
VIC (Christmas Storms and Feb 2012 Floods)	45,633,000	2012
QLD	1,370,751,000	2012

1.2 Decrease from unstructured mitigation - Price Signal influencing mitigation

An estimation has been made of the extent of individual mitigation likely to occur under current risk pricing to reduce insurance premiums from high or extreme risk to low or nil as the premium pricing relates to natural disasters. The potential spend on mitigation has then had an average benefit cost ratios applied for both Cyclone and Flood risks (50 percent mitigation apportioned across both event types) to give an assumption for the reduced extent of losses which would occur given the current system for risk pricing, which would not exist if this was removed through price subsidisation in an insurance pool.

Total potential spend on mitigation			617,926,632
(4) Potential avoided losses			
Split between Cyclone and flood			
	Cyclone BCR	2.5	772,408,291
	Flood BCR	5	1,544,816,581
Potential reduction in losses			2,317,224,872

Other considerations

The assumptions above are for the purpose of demonstrating some effect from the price signal. The calculation only takes into account the current market, and does not account for the 10 percent who do not have flood cover, and are likely to be in high risk zones, where premiums being quoted are greater than $7,000. The relative modest individual budgets for mitigation would allow for smaller scale actions such as roofing fasteners and securing rolling doors for cyclones, and changing flooring and relocating electrical outlets for flooding.

1.3 Decrease from structured mitigation

The value raised to cover the insurance pool scenario, has been assumed to be the amount available to spend on structured mitigation. This annual spend has been accumulated to determine an amount spent over 10 years (in today's dollars), which has been assumed to be evenly spread across bushfire, flood and cyclone mitigation. The value of losses is calculated using an average Benefit Cost Ratio for each respective type of natural disaster, to give an amount of avoided losses.

Column1	Total	Bushfire	Cyclone	Flood
Annual spend on mitigation	238,360,751			
Proportion of spend		33%	33%	33%
Benefit Cost Ratio (BCR)		2.00	2.50	5.00
10 year cumulative	2,383,607,511			
Split between 3 mitigation scenarios		794,535,837	794,535,837	794,535,837
Value of losses avoided	7,548,090,451	1,589,071,674	1,986,339,592	3,972,679,185

2. Size of Insurance Pool

The Insurance pool has two components: Uninsured and High Risk premium and Administration cost. These were calculated using data from Suncorp's insurance book which were then extrapolated out to cover the whole market, and estimate the extent of exposure of uninsured households. The premium and administration cost was determined using data from Suncorp's premium pricing policy.

Pool	Uninsured	High risk	Total
Assets	298,154,399,612	92,931,551,736	391,085,951,348
Number of policies	1,254,816	190,871	1,445,688
Premiums	60,798,486	117,207,697	178,006,183
Administration cost	52,386,066.18	7,968,502.25	60,354,568
Sum of premium and administration costs			$ 238,360,751.09

Appendix C: Insurance Pools

1. Currently operating schemes

New Zealand

In New Zealand earthquake cover is provided based on an annually adjusted property valuation by the government run pool EQC. The EQC was effectively established in 1945. In order to attain EQCover the policyholder is required to purchase an insurance policy from the open market that includes a disaster premium. That element is passed onto the EQC and pooled in the Natural Disaster Fund. This premium can be up to 207NZD depending on the individual policy. After purchasing EQCover the policyholder is entitled to up to 100,00NZD for specific property damage and up to 200,00NZD for contents losses, with any claim values beyond these levels being paid out by the policyholder's primary insurer. Access to the pool is therefore dependent on purchasing additional protection from the insurance industry. While the disaster insurance premium acts as a levy in covering a substantial portion of the pool's risk exposure, the EQC further minimises risk via use of reinsurance from the global reinsurance market. If payouts required by the EQC exceed the capacity of the Natural Disaster Fund and the revenue derived from reinsurance then the Crown guarantee requires the Government to provide financial support[42].

United Kingdom

In the United Kingdom, Flood Re has been proposed as a government run reinsurance pool that is due to be implemented in 2015. It has been designed to cover the cost of flood claims from flood prone properties. While the pool will be funded by a levy imposed upon member insurance companies, these costs will ultimately trickle down to households through an increase in their insurance premiums proportional to the size of the primary premium and the underlying risk exposure. Essentially the flood insurance agreement aims to ensure that homeowners and residents living in high flood risk areas of Britain can continue to find affordable flood insurance by placing a limit on the total cost. The associated rise in insurance premiums caused by Flood Re will see households across the UK pay into a aggregate fund which will be used to offset the costs of flood damage and fund the flood insurance cap. The flood insurance element of home insurance policies will be limited to a yearly maximum. The maximum cost of flood insurance will be based on council tax bands with limited flood insurance premiums starting at £210 per annum for homes in Bands A and B rising to £540 pa for homes in Band G[43].

United States

In the United States, the National Flood Insurance Program (NFIP) was established in 1968 through the National Flood Insurance Act. The program enables the purchase of insurance protection by households in participating communities from the government to cover losses associated with flood events. The program provides a pre disaster insurance alternative to post disaster government provided support in order to meet the rising property damage costs associated with flood events. Local communities can opt into the program by making agreements with the federal government to implement a floodplain management ordinate in order to reduce the flood risks associated with new developments in flood prone localities. In exchange for agreeing to these

[42] EQC Earthquake Commission, http://www.eqc.govt.nz/what-we-do/eqc-insurance

[43] United Kingdom Department for Environment, Food and Rural Affairs, 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265445/water-bill-flood-insurance-finance-accountablity.pdf

management practices the federal government provides flood cover to the community as a financial protection against flood losses[44].

An Australian scheme

Australian reinsurance pool corporation (ARPC)

While no natural disaster insurance pool is currently in operation in Australia, the Australia Reinsurance Pool Corporation (ARPC) was established in 2003 as a by-product of the Terrorism Insurance Act and is currently valued at 13.4 billion AUD. The ARPC scheme allows insurance companies to voluntarily minimise their risk exposure from claims for eligible terrorism losses by paying premiums to ARPC. This provides coverage to holders of eligible insurance contracts in the event of a declared terrorist incident. Claims against the scheme are only fulfilled once the policyholder's primary insurance company has reached the capacity its risk retention. Claims will then be paid out from the ARPC's pool until an agreed upon reinsurance deductible is reached. Beyond this value, claims are paid out by the reinsurance scheme, of which ARPC is a participant. Ultimately if the capacity of the reinsurance facility is exhausted the government guarantees financial backing to cover any unpaid claims.[45]

Currently no claims have been made against the scheme however it represents an already established insurance pool framework in Australia. Suggestions have been made to expand the scope of the pool to incorporate natural disaster cover using the already operating infrastructure however this remains merely as a future possibility.

Pool proposed in National Disaster Insurance Review (NDIR)

In the aftermath of several severe storm, cyclone and flood events in 2010-11, the National Disaster Insurance Review was conducted to examine the issues surrounding flood coverage in Australia. The review identified several key recommendations designed to improve the current system and reduce the financial distress felt by high risk households following these catastrophes. One such recommendation involved the establishment of a pooled insurance scheme to allow for discounted insurance premiums in medium to high risk areas.

The proposed scheme was designed to allow the current insurance industry to remain operating competitively, i.e. pricing premiums based on risk. This would ensure that their relationships with policyholders for writing policies and paying out claims was untouched. This primary market would be supplemented by a government funded reinsurance pool that would subsidise some portion of claims payed out. More specifically, discounts would be delivered via a mechanism in which the primary market is responsible for retaining, underwriting and pricing some portion of the flood risk, and the government's reinsurance facility cover the risks not retained by insurers. As such, discounts would be delivered to policyholders by the reinsurance facility offering insurers a discounted premium in return for taking on some portion of their risk exposure. The review also recommends a limit be placed on the discounts available to high value homes. It proposes that this be achieved by limiting the size of the risk exposure that the reinsurance facility would offer insurers a discounted premium on to the difference between the size of the risk retained by the insurer and $500,00 AUD[46].

---

[44] United States Federal Emergency Management Agency, https://www.floodsmart.gov/toolkits/flood/downloads/NFIP-SummaryCoverage.pdf
[45] Australian Reinsurance Pool Corporation, 2013, http://arpc.gov.au/news-and-publications/general/brochure
[46] National Disaster Insurance Review, 2011

2. Drivers for the selection of the assumptions

Due to the diversity of designs among currently operating pools these assumptions were largely based on the framework proposed by the Natural Disaster Insurance Review (NDIR, 2011). According to the NDIR, an ideal public insurance scheme would allow for high risk households to be granted a discounted premium allowing them to enter an otherwise unaffordable market. This is supported by Sigma (2011) which states that government operated insurance programs allow for an expansion in coverage by redistributing funds such that low risk policyholders cover some proportion of the risk exposure attached to high risk customers. This kind of flattening of premium differentials between different risk categories is consistent across the literature and actively in operation in schemes such as the NFIP that allows for subsidised premiums in high risk localities. As a result it will be assumed in our hypothetical scheme that premiums are not priced based on the sum of individual risk pricing but rather than the pool is funded by a uniform levy paid by all Australian taxpayers based on aggregate risk.

As described above, mandatory participation is required for pools to effectively expand coverage of the market as otherwise low risk policyholders would opt out of the scheme. As a result mandatory participation is assumed in this model. A government run insurance pool has the potential to enforce such mandatory participation and in turn eliminate, or in practice reduce, the issues of adverse selection that may otherwise prevail in insurance markets. Furthermore according to Calabresi (1970), the government being the largest social entity in operation has the capacity to capture the highest degree of diversification available in the insurance market and hence spread risks more broadly than private entities.[47]

As a result, the hypothetical scheme used in this study was assumed to be government run. This assumption is supported by Table 1 which demonstrates that despite the diversity among scheme design, the one component of a pooled scheme that appears to be consistent internationally is government involvement which underpins every case study excluding the TCIP.

[47] Calabresi, Guido, (1970). “The Costs of Accidents.”

Appendix D: References

- Australian Broadcasting Corporation. (2013). "Under-insurance a significant issue in fire devastated Blue Mountains." http://www.abc.net.au/news/2013-11-12/under-insurance-a-significant-issue-in-fire-devastated-blue-mou/5085040 accessed in March 2014.
- Australian Broadcasting Corporation. (2013) "Disaster insurance premiums becoming unaffordable as floods and bushfires increase". ABC Ratio National 11 February 2013. http://www.abc.net.au/radionational/programs/breakfast/more-natural-disasters-as-insurance-premiums-rise/4511192 accessed in March 2014.
- Australian Business Roundtable for Disaster Resilience and Safer Communities (June 2013), report prepared by Deloitte Access Economics. "Building our nation's resilience to natural disasters" http://australianbusinessroundtable.com.au/white-paper
- Australian Government Attorney General's Department (2009) "The National Partnership Agreement on Natural Disaster Resilience" *http://www.em.gov.au/npa* accessed in March 2014.
- Australian Government Department of Human Services (2013) "Australian Government Disaster Recovery Payment website". http://www.humanservices.gov.au/customer/services/centrelink/australian-government-disaster-recovery-payment accessed March 2014.
- Australian Government the Treasury (September 2011). Natural disaster Insurance Review – Inquiry into flood insurance and related matters http://ndir.gov.au accessed in March 2014.
- Australian Reinsurance Pool Corporation, (2013), http://arpc.gov.au/news-and-publications/general/brochure accessed March 2014.
- Australian Strategic Policy Institute (2011). "Sharing risk – Financing Australia's disaster resilience."
- Bergin, A. (2011). "Extreme events require a disaster scheme." Australian Strategic Policy Institute
- Calabresi, Guido, (1970). "The Costs of Accidents."
- Commonwealth of Australia, Department of Finance and Deregulation (2012). "Review of the insurance arrangements of State and Territory Governments under the Natural Disaster Relief and Recovery Arrangements Determination 2011"
- Council of Australian Governments (2009). "COAG Natural Disaster Resilience Statement." http://www.coag.gov.au/sites/default/files/national_strategy_disaster_resilience.pdf accessed in March 2014.
- Cummins, J.D., N. Doherty and A. Lo. (2002). Can insurers pay for the "Big One"? Measuring the capacity of the insurance market to respond to catastrophic losses. Journal of Banking and Finance 26, 557-583
- ESRI Australia (2013) "Technology to predict natural disaster impact, years in advance" https://esriaustralia.com.au/p/news/technology-to-predict-natural-disaster-impact-years-in-advance-nar-163. accessed in March 2014.

- Federal Emergency Management Agency. National Flood Insurance Program Community Rating System website. http://www.fema.gov/national-flood-insurance-program-community-rating-system accessed March 2014.
- Federal Insurance and Mitigation Administration. (2013) "Community Rating System Fact Sheet." http://www.fema.gov/media-library-data/20130726-1605-20490-8915/nfip_crs_fact__sheet_sept_2012.txt accessed March 2014.
- Froot.K (1999) "The market for catastrophic risk: a clinical examination," National Bureau of Economic Research, NBER Working Paper no w7286
- Latham, C. Peter McCourt and Chris Larkin (2010) "Natural disasters in Australia: An issue of funding and insurance." Prepared for the Institute of Actuaries of Australia's (Institute) 17th General Insurance Seminar
- Lewis. C. M and Murdock, K. C (1996) "The Role of Government Contracts in Discretionary Reinsurance Markets for Natural Disasters" Journal of Risk and Insurance, 63:4 p567 - 597
- Mahul. O (2003) "Efficient Risk Sharing within a Catastrophe Insurance Pool" INRA Department of Economics, *Paper presented at the NBER Insurance Project Workshop, Cambridge, MA*
- Munich Climate Insurance Initiative. (2009). "Adaptation to Climate Change: Linking disaster risk reduction and insurance". Paper submitted to the UNFCCC for the 6th session of the Ad Hoc Working Group on long term cooperative action under the Convention (AWG-LCA 6).
- National Climate Change Adaptation Research Facility (2010) "The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity." NCCARF Synthesis and Integrative Research Program
- National Oceanic & Atmospheric Administration (2013), prepared by Easton Research Group. "An economic framework for coastal community infrastructure".
- New Zealand Earthquake Commission (2013), "Annual Report 2012 – 2013" http://www.eqc.govt.nz/sites/public_files/documents/EQC011-Annual-Report-2013-A-WEB.pdf accessed in March 2014
- Priest. G .L (1996) "The Government, the Market, and the Problem of Catastrophic Loss" Journal of Risk and Uncertainty, 12:219-237, 1996 Kluwer Academic Publishers
- Rose. A; Keith Porter; Nicole Dash; Jawhar Bouabid; Charles Huyck; John Whitehead; Douglass Shaw; Ronald Eguchi; Craig Taylor; Thomas McLane1; L. Thomas Tobin1; Philip T. Ganderton; David Godschalk; Anne S. Kiremidjian; Kathleen Tierney; and Carol Taylor West (2007). "Benefit-cost analysis of FEMA Hazard Mitigation Grants." Natural Hazards Review ASCE.
- Sigma (2011) "State Involvement in Insurance Markets," Swiss Re
- United States Government Accountability Office (2014) "Flood Insurance – strategies for increasing private sector involvement" Report to Congressional Committees

Jefferson Gibbs
Partner
+61 2 9455 9084
jgibbs1@kpmg.com.au

Ashley Winston
Chief Economist, KPMG Australia
+61 2 6248 1163
awinston@kpmg.com.au